Vintage Radio

by ROGER JOHNSON

One valve receivers — 1927 onwards

This month we take a more complete look at reflex receivers and also at other sets which used single multiple-use valves, to complete the story of one-valve receivers.

The idea of a single-valve reflex receiver was more often than not to enable the valve to be an RF amplifier as well as an audio amplifier, thereby enabling two tuning circuits instead of the usual one tuning circuit. This also meant dispensing with a reaction winding, which was seen by some as a blessing.

Whilst this was usually the case, it wasn't always so — as the circuit in Fig.1 shows. This circuit was taken from *Wireless Weekly* for October 21st, 1927. The text is very specific about panel layout, how to solder and many peripheral issues, but is remarkably devoid of how the beast actually works. The text claims that the valve acts as an RF amplifier, but only inasmuch that it provides an amplified RF signal for the purposes of regeneration.

The circuit contains some tricky features. The grid capacitor is given as 0.002uF (2nF), which represents an impedance of about 80 ohms at a nominal 1MHz. Assuming the secondary of a 5:1 audio transformer to have an inductance in the order of 4 - 5 Henrys, the inductive impedance at the nominal 1MHz is within the range of 30 - 32 megohms. Clearly, the incoming RF from the tuned circuit will only be slightly impeded by the capacitor. The choice of the value of this capacitor is important, for reasons to be explained later.

Not shown in the actual circuit diagram, but explained in the text, is the fact that the reaction winding is variably coupled to the main tuning circuit. The valve, therefore, is doing no more at this stage than a standard Reinartz regeneration circuit.

Detection

The crystal detector (a 'Harlie' unit was recommended) is connected midway down the tuning coil. Had the detector been connected at the top of the coil, the loading effect of the detector in series with the transformer primary would be sufficient to broaden the tuning and detract from the selectivity of the circuit. If the detector was placed lower down the coil, it would be nearer the earth end with a consequent loss in signal level available at the detector.

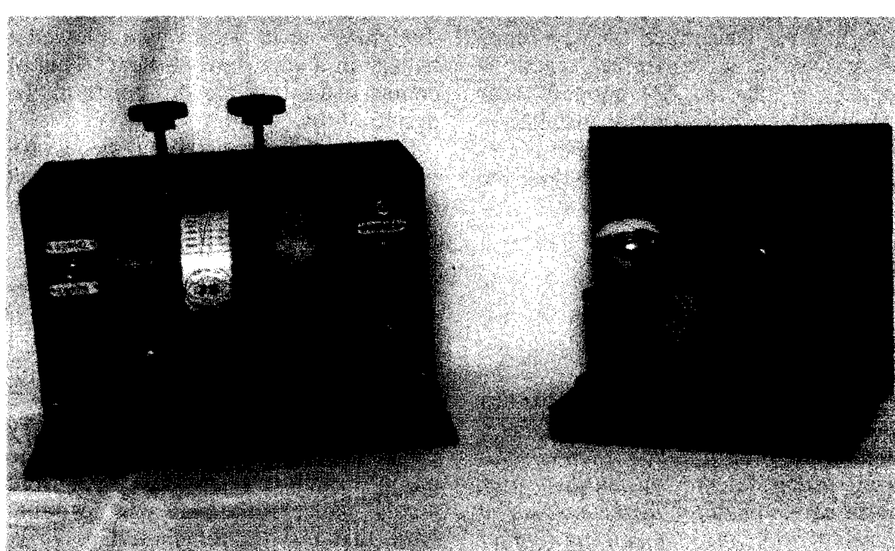
From the detector, which incidentally is shown to pass the negative half cycles, the primary of the audio transformer is excited and the voltage stepped up according to the ratio. The secondary of the transformer is connected to the grid of the valve and to earth via the secondary of the tuning coil, and shunted with the RF bypass capacitor referred to above.

Choice of valve

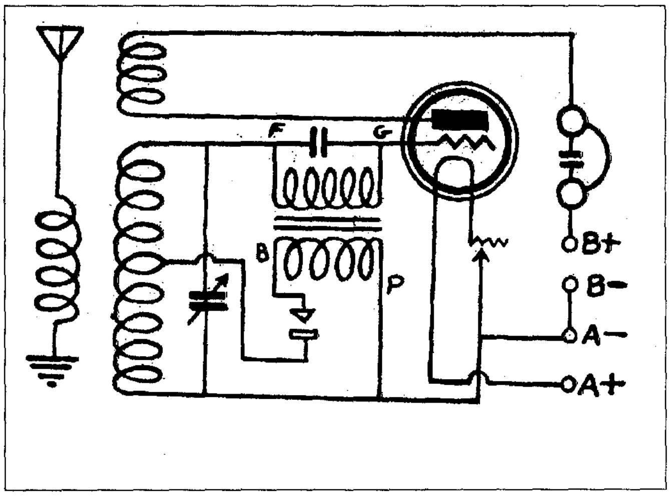
The text explains that results will depend upon the choice of valve. It states that a valve must be chosen that 'has a characteristic curve with a good straight portion', since the valve must not act as a detector (quite correct!). To achieve that end, the use of the filament rheostat is important.

The filament rheostat will alter the operating characteristics of the valve for each setting. There may well be a setting where the characteristic curve so produced has a more linear portion than at another setting. Altering the rheostat controls the emission, which in turn will alter the gain and the amount of RF signal fed back to the tuning circuit — so that operating this one-valver becomes a juggling match between rheostat, reaction and adjustment of the crystal detector! It is claimed that with 120 volts B+, this set will operate a loudspeaker (i.e., a horn speaker) on the stronger stations.

But let's turn back to that 2nF input capacitor across the audio transformer secondary. With the approximate inductance of the secondary winding



Two sets typical of the many home constructed one-valvers of the 1930s and 1940s. The little radio on the left almost certainly started life as a crystal set.



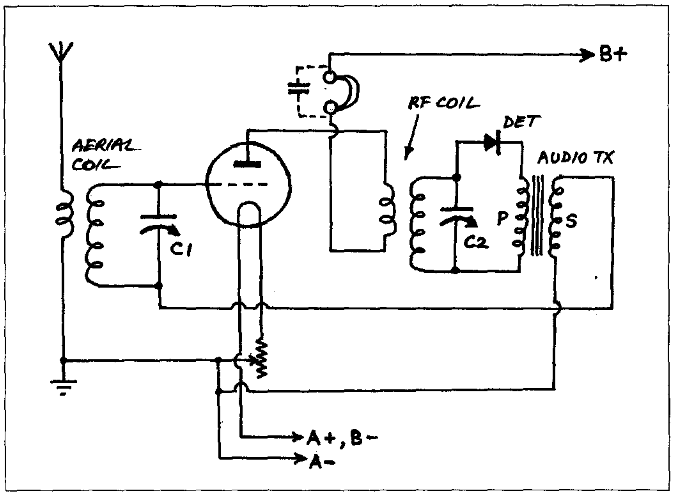


Fig.1 (left): This somewhat odd reflex/regenerative circuit appeared in 'Wireless Weekly' for October 21st, 1927. How the circuit works and how critical some of the component values were is explained in the text. Fig.2 (right): This more conventional one-valve reflex circuit is taken from a handwritten notebook of about 1927. Its performance could probably be improved by adding an RF bypass capacitor across the audio transformer secondary winding.

of (say) 4 - 5 Henries, and seeing that the inductance acts as an EMF generator, this setup may well act as a low-pass filter with the cut-off point in the range, depending upon the inductance, of about 3.0 - 3.2kHz.

If the input capacitor was lower in value, the cut-off frequency will certainly be raised, but the impedance to the RF input will also rise with a consequent loss in signal to the grid. If the capacitance is made larger, the opposite occurs, placing the low-pass cut-off well within the frequency range of the speaker and resulting in an even more unpleasant sound, if that is possible!

In the final analysis, this circuit would only have the theoretical advantage of a voltage gain afforded by the audio transformer: a whole 14dB. Given that the valve must be reduced in operating conditions, and hence gain, one wonders where the advantage of this circuit was when compared with a well designed Reinartz circuit operating under maximum conditions.

Another reflex circuit

The circuit of Fig.2, also from 1927, is more what reflexing is all about. It contains two tuned circuits, and the regeneration winding is eliminated — which as noted earlier would be seen by some as a blessing.

In this circuit the valve really does act as both an RF amplifier and an audio amplifier. The antenna is coupled to the first tuning coil in the normal manner, but the tuning circuit is returned to earth via the secondary of the audio transformer. Typically, this has a DC resistance of the order of 5kΩ, and there will be some signal loss as a result.

Following the first tuned circuit, the RF signal is fed straight to the grid of the valve where it is amplified, and appears in the primary of the 'RF coil'. There, it is inductively coupled to the secondary of the tuned RF coil.

From the 'top' of the RF coil secondary, the signal is detected (demodulated) by the crystal detector and passed to the primary of the audio transformer. This winding is returned to the 'bottom' or 'cold' end of the RF tuned circuit, such that the detector and primary of the audio transformer shunt the RF coil secondary. This may have a loading effect on the tuned circuit, which would result in broadening the tuning.

Once the audio component has been fed back into the grid, the valve acts as an audio amplifier.

You will notice the headphone/speaker jack in the plate circuit, between the primary of the RF coil and B+. The primary of the RF coil has no effect at audio frequencies, because its inductance is very low.

The valve is effectively cathode biased, by an amount equal to the voltage drop across the filament rheostat.

Dual-purpose valves

In the period from mid 1934 to mid 1935, advances in valve technology saw the release of valves such as duo-diode triodes, pentagrid converters and dual triodes designed for push-pull class B output. These were principally the type 6A6, (later metal type 6N7) for AC operation, and type 19 and Philips B240 for all-battery operation.

The battery types were used by radio set manufacturers in class-B push-pull output, because a considerable saving in battery current was afforded at low-level listening, and also second harmonic distortion was eliminated — thereby giving a better 'tone'. The AC twin triode 6A6 did not seem to gain favour with radio set manufacturers, in this country at least.

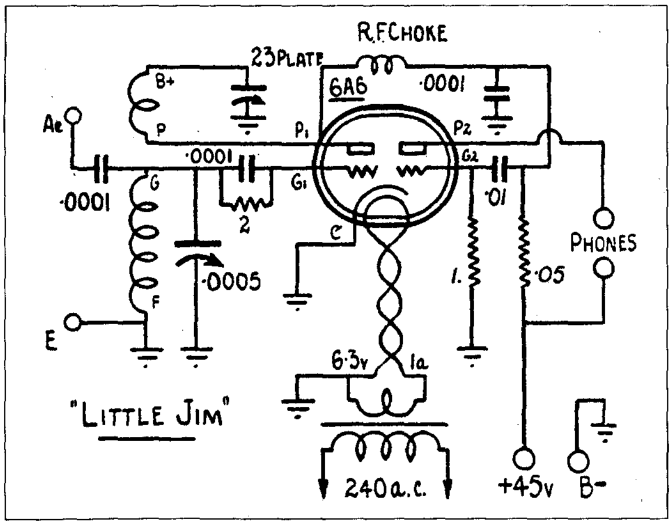
'Little Jim'

In *Wireless Weekly* for May 27th 1938, the late John Moyle described a single valve battery set for headphone operation, and called this set 'Little Jim'. It was described quite specifically in order to listen to the latest thing: the direct broadcasts of the Test Matches from England, 'whilst snug in bed'!

John Moyle was quite serious about the anticipated appeal of this set, because fully six pages of text, illustrations and photographs were devoted to its construction. The valve used was the seemingly forgotten type 6A6 twin triode, a fully imported valve and presumably there were plenty in stock because of its disfavour with radio set manufacturers.

The circuit was not a technical marvel (Fig.3). Merely a regenerative detector resistance coupled to an audio stage, the set had a self contained 45 volt B-battery and the valve heater was powered from a small 6.3 volt mains transformer. Because the total current drain was only about one milliamp, battery life was expected to be little short of shelf life.

The all-battery equivalent was



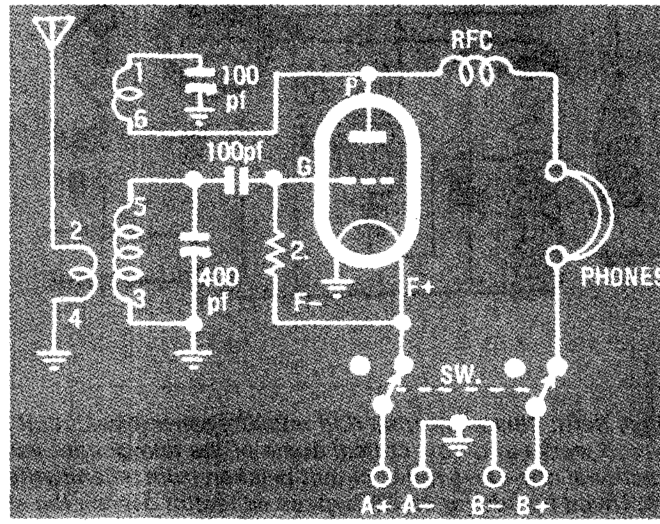


Fig.3: The circuit for John Moyle's original 'Little Jim' one valve receiver, published in 'Wireless Weekly' for May 27, 1938. It uses only regeneration, not reflexing.

Fig.4: The circuit for a one-valver intended as a training exercise for a beginner, described in 'Radio and Hobbies' for September 1954.

described in *Wireless Weekly* for June 10th, 1938, but was not nearly so complete in its description — concentrating instead on valve types and how to power them. One suggestion was to use a type 19 twin triode and power it from a 2V accumulator which was kept under the bed.

The follow-up article explained that for 'the country man' reception might be improved by resorting to a large outside aerial, rather than the wire spring of the bed base(!), and by increasing the B+ to 60 volts. The article went on to advise country constructors not to expect 'Little Jim's Mate' (was that Stan?) to do what a larger five-valve superhet could not.

'Little Jim' and his mate were revised and updated in 1939, 1941, 1946/7 and 1952/3. The 1939 rebuilds appeared in the very first two issues of *Radio and Hobbies*, viz. April and May 1939. The battery version for May 1939 used a type 19, or the octal equivalent type 1J6-G, but powering the filament from a large 1.5 volt bell battery. Obviously, experiments showed that there was enough emission even with 1.5V on the filament for the valve to satisfactorily oscillate over the entire broadcast band.

During the war years it seemed that there was demand for a cheap, economical, reliable and compact headphone set for use by servicemen whilst living in barracks, so another version appeared in 1941. This time the 'electric' version employed the mixer/converter valve type 6J8-G. The heptode/mixer portion was triode connected and served as the detector portion, and the oscillator triode section served as the audio amplifier. The 6J8-G was chosen because the types 6A6 (6N7), 6F7, 6C8-G or 6F8-G were all imported valves and were no longer available because of wartime restrictions — whereas the 6J8-G was locally made.

A training exercise

Ever since the early 1930s, when a second-hand or obsolete valve type such as an old (2)01-A could be purchased for a 'few bob' (30 or 40 cents) rather than a 'quid' (a pound note, nominally equal in value to today's $2 coin), numerous one-valve Reinartz circuits have been described particularly for novices.

For very little outlay, a valve radio could be constructed which gave result much superior to a crystal set. The other aspect of describing such sets was to introduce the initiate to the 'big time' of a valve radio. Once the one-valve Reinartz set was mastered, the sky was the limit!

One of the very last such articles was described in the September 1954 edition of *Radio and Hobbies*, and the circuit appears in Fig.4. It could be easily built today, with satisfactory results.

The 'Hikers One'

The story of one valve radios would not be complete without mention of this particular set. This unusual little one-valver completes the story of one valve radios and has been fully covered by Peter Lankshear in this column in *EA* for October 1989.

In summary, there is quite a lot of fun to be had with the humble one-valver. If anyone has on hand a working audio transformer, and has the necessary means to wind the coils, why not have an attempt at a reflex set, using a modern solid state signal diode? The results could be interesting. ❖