

Valves are dead—but

Transformers for valve equipment are now very hard to obtain. It is possible to cobble

Just recently we considered publishing a project using valves as a last dalliance with these thermionic devices of yore. After all, most major kit and parts retailers no longer bother to sell valves and those that do have a limited selection. So we thought, "Let's do this project as a nostalgia item before it becomes too late". Well, the gist of this article is that it is already too late but not because valves are unobtainable.

We did not have a really ambitious project in mind either. Nothing like a high quality stereo valve amplifier or a general coverage receiver. No, we thought we'd just do a simple TRF receiver; something which does not use a lot of parts and is not too cranky to get going.

The project we homed in on was the "Three-Band Two", a valve receiver featuring a 6X4 rectifier and a 6BL8 (or 6U8) triode-pentode. Both these valves are still available and the circuit was actually quite a respectable performer. Last published in October 1966, the project must even then have been a "bit of a chestnut" and was an update of an earlier project published way back in May 1957.

The use of the 6BL8 triode-pentode was a little unusual in that the pentode was used for the RF stage and detector and the triode used for the audio stage. As a result, the power output was low but sufficient to drive a loudspeaker on local broadcast stations. For more distant stations a pair of high impedance headphones was recommended.

Really, by any standard, the Three Band Two must have been a "gutless wonder" and relied for most of its performance on the careful use of regeneration. Nevertheless, as some of our older staff members can testify, these little regenerative sets used to turn in a surprising performance and we had many enthusiastic letters commenting to this effect.

As a matter of interest, the circuit of the Three Band Two is published here and, as can be seen, it certainly does not use many components. For many readers though its operation is probably a mystery so we'll just run through it briefly.

The incoming signal is fed from the antenna via a tuned circuit which uses a switchable or a plug-in coil to the grid of the pentode (pin 2). Though this valve is intended to function primarily as a detector, an amplified version of the input



signal is present at the plate (pin 6). Some of this signal is fed back to the grid/cathode input circuit, via the tap on the coil which connects to the cathode (pin 7). This trick is called regeneration. In this circuit the amount of regeneration is controlled by varying the voltage on the screen (pin 3) via a 250k Ω potentiometer.

Regeneration is in fact a form of positive feedback. That is to say, it increases the gain of the circuit and renders the tuning a good deal sharper (increasing the Q). If taken too far, regeneration causes the circuit to oscillate and the result is a heterodyne whistle. The heterodyne whistle is caused by the fact that the self-oscillating circuit beats with the incoming signal to produce an audible note.

In a gutless wonder such as this even

the heterodyne whistle characteristic can be put to good use when listening to Morse code transmission on the short-wave bands when the stations are using an otherwise unmodulated carrier. By having the receiver detector adjusted for a weak oscillation, the code transmission could be heard.

To be usable, the regeneration control must operate smoothly so that when it is advanced the gain increases progressively and the sound quality changes gradually, giving adequate warning that the unit is close to the point of oscillation. And even when it does go into oscillation it should be controllable, without the risk of producing an ear-piercing scream.

When listening to transmissions which are modulated with normal programs,

not forgotten

up substitutes but in many cases it is easier not to try.



the regeneration control should be advanced to the point just below oscillation. This results in maximum usable gain and best selectivity (ability to tune closely spaced stations).

To sum it up, the interesting aspect of a regenerative circuit is that it can produce a good performance, in terms of stations tuned on both the broadcast and short-wave stations with a reasonable antenna, considering that it uses few components.

Our first hurdle in re-presenting the project in 1983 was the power transformer. The original circuit used a transformer with a 6.3V winding of around one amp capacity for the valve heaters and a centre-tapped 300V winding to derive the HT or "high tension" as it used to be referred to by electronics people in those good old days of

yesteryear. These days, high tension is more usually regarded as a symptom of incipient mental breakdown.

While we did not seriously expect the major transformer manufacturers to have stocks of a suitable transformer, we did expect to be able to round up something from a "disposals" source. But no. There just did not appear to be any transformer even vaguely suitable from any source. Sure, we could have arranged for transformers to be specially wound and made available through one or more of the parts retailers but the inevitably short production run would make them expensive.

Our solution was to use two readily available low voltage transformers and connect them back-to-back. In this way, a 2155 transformer as made by Arlec Pty Ltd is connected in the normal way to

by LEO SIMPSON

provide 6.3VAC for the valve heaters from appropriate connections on the multi-tapped secondary winding, ie, from the 0V and 6.3V taps.

At the same time, we use low voltage from this transformer to drive the low voltage winding of another 2155 transformer. This second transformer will then develop a high voltage across what is normally its primary winding. This can then be connected to a silicon bridge rectifier and capacitor to provide the high voltage DC supply to one valve, the 6BL8.

By using the silicon bridge rectifier we were able to dispense with the valve rectifier and thus ease the heater current load for the first transformer. In fact, it is not until you go through an exercise such as this that you realise, once again, just how much power valves required. In this circuit for example, the 6BL8 requires 6.3VAC at 0.45 amps and around 180VDC at, say, 20 millamps total for an overall power consumption of about 6½ watts. Similarly, the 6X4 rectifier requires 6.3VAC at 0.6A, almost 4 watts.

This ploy succeeded. We ran the second transformer, as shown in the accompanying circuit diagram, with 8.7 volts fed to its 12.6 volt tap. Under no load conditions this should mean that about 166VAC is developed across the output "primary" winding but the loading effect of the circuit is fairly severe and the resultant DC voltage from the second filter capacitor is about right at around 170 volts. So far so good.

The next hurdle was also a transformer, that for the output stage. Again, such transformers now appear to be rare indeed. Our solution was to again employ a low voltage transformer, this time at Ferguson PF2851 or equivalent. This has an output of 12.6VAC for a mains input of 240VAC, giving a turns ratio of about 20, or 40 if referred to the 6.3V tap.

Thus if the primary winding is connected to the plate of the triode (pin 1) and the DC supply and the 6.3V winding is used to drive an 8Ω speaker, the load reflected to the triode plate will be the square of the turns ratio multiplied by the nominal impedance. This gives a figure of about 12kΩ which is higher than the original design figure of 8kΩ, as shown on the circuit, but it is not so far removed as to be unworkable.

In practice, it seemed to work quite well and was certainly comparable with an output transformer of the correct type which was "borrowed" from an old communications receiver. We also found that a pair of low impedance stereo headphones worked quite well and certainly more comfortably than the old fashioned high impedance types.

Continued on page 97

Valves are dead — but not forgotten

Continued from page 95

So much for the cobbled-up substitutions. Up to this point we had taken the attitude that, provided interested readers had access to parts such as tuning gangs and other hardware, the project could be made a working proposition. If all-new parts were to be employed then it would be an entirely different proposition and certainly not economic.

Unfortunately though, the circuit performance was not up to expectations. For a start, the hum level was much higher than we would have liked. We countered this by increasing both the filter capacitors to $47\mu\text{F}$ and by orienting the two power transformers so that the leakage fields cancelled but to no great effect. By today's standards there was too much hum although by the standards of the past it would probably have been judged as being satisfactory.

By way of example, many commercial valve mantel radios produced 20 years ago or more did have a higher hum level than is regarded as acceptable today.

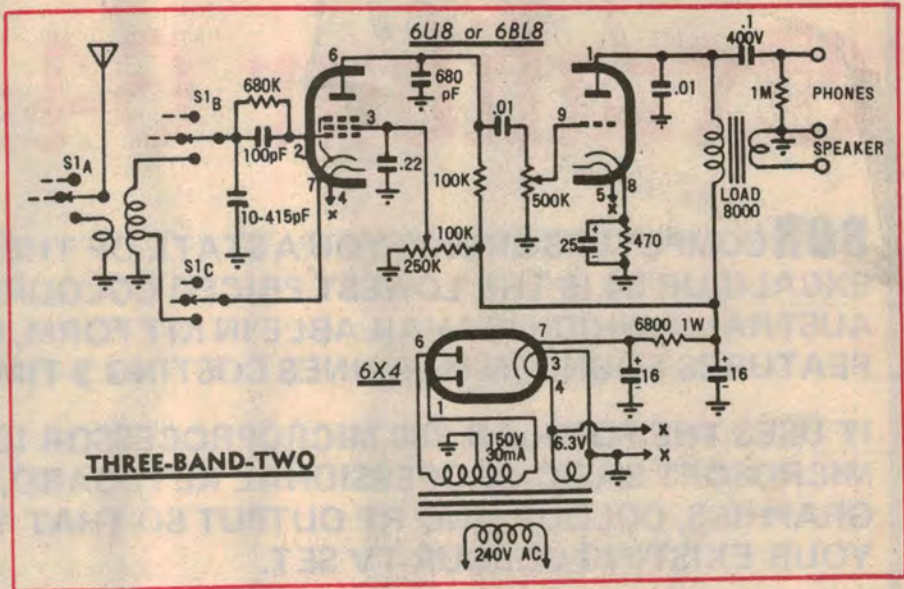
Other problems

Even so, hum was only one of the drawbacks. The main problem was lack of gain. The problem about this particular gutless wonder was that it was gutless. The problem appeared to be that the regeneration control was not working as it should. There appeared to be too much indirect feedback which made the circuit prone to oscillate too early. We tried countering this by shielding the valve, changing the wiring layout and by increasing the bypass capacitor at the screen grid (pin 3).

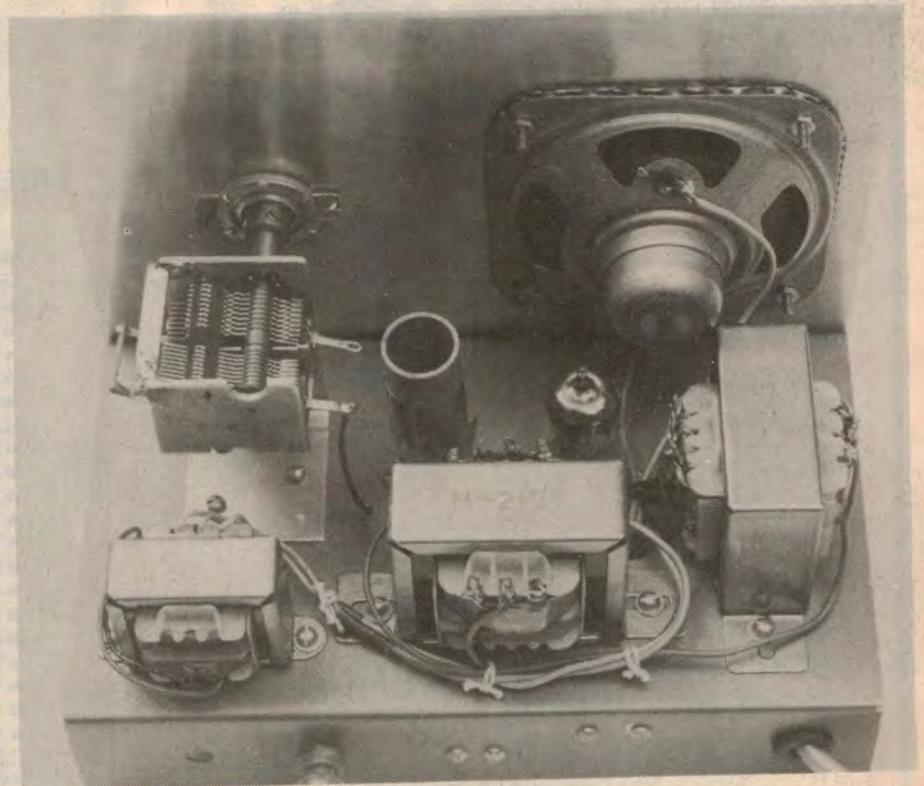
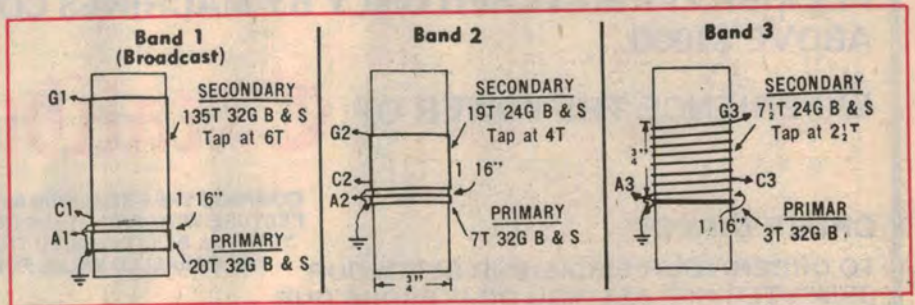
This did improve the situation but not by much. Further mods involved additional decoupling of the regeneration control and varying the taps on the antenna coil. In the end though, we "canned" the project. We are not saying that it can't be done — given time — but it was just not worthwhile. And we didn't have the time!

Our verdict must be as follows. If you have a boxful of radio parts that you are just itching to put back together in some sort of working order, you could have a go at the circuit as originally published. But on the basis of our results, don't expect too much. It is a lot easier and probably cheaper, even if you are delving into your junkbox for most of the bits, to go and buy a clock radio from your local supermarket.

So that's it. We have taken a nostalgic look at a possible valve project and have decided that they "have had their day" after all. RIP.



Above is the circuit of the original Three-Band-Two and, below the coil data, covering from 600kHz to 30MHz in three bands.



Our latest version of the set; a good try, but it didn't quite make it.