Restoring a vintage "American Midget" receiver

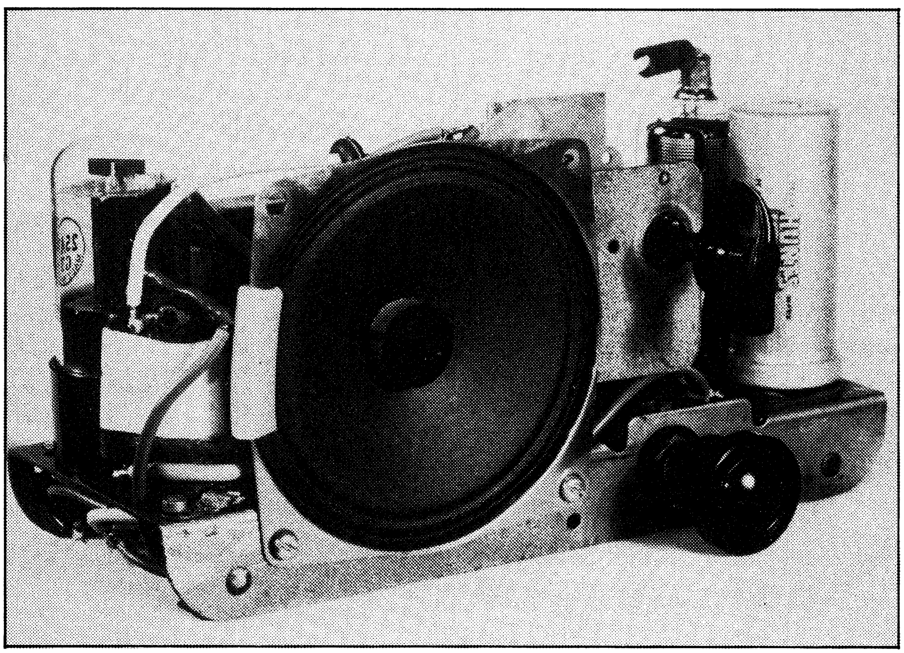
Restoring old valve radios and other equipment is a popular activity, judging by the very warm response we received last year when we published a couple of articles on the topic. Here's another very interesting restoration story, from a reader in Northern Ireland . . .

by WILLIAM JAMES

There was a special reason why this particular receiver had attracted my attention. A friend had acquired it from a village shop in County Tyrone, Northern Ireland, a few years after the end of World War II. During the War years an American soldier had left it in to be repaired but had never returned to enquire about it. My friend got the set for nothing because it had no commercial value. In fact, he saved it from the scrap heap. He kept it for a period and then offered it to me, to see if I could get it going.

At first sight the midget did not present an encouraging spectacle. It was covered with dust, while tubes, speaker and cabinet were all missing. The octal socket for one of the tubes was quite badly damaged. Tied to the chassis was a faded, tattered label which read: "Needs 12B8GT and 25A7GT." I was to find out in due course that this was not an understatement of the position! But my memory was stirred.

I recalled that a radio enthusiast in my family circle had built an American-type midget when stationed in Cheshire during the War, using the aforesaid tubes but following a design published in the British press in 1944. I have not been able to trace this design. The set, which was transformer-coupled, was working up to about 1955, but I do not know what eventually became of it. Some relevant documentation still exists. There are details of a 12B8GT tube. There is just the single note, "25A7GT", and there is a drawing showing how to wire up a Bulgin LF 33 transformer for a 1:4 step-up ratio, parallel feed. And there the record ends.



Front view of the restored chassis, taken from the speaker end. Above opposite is another view, very close to actual size.

Suffice to say that I was sufficiently interested to take possession of the American midget.

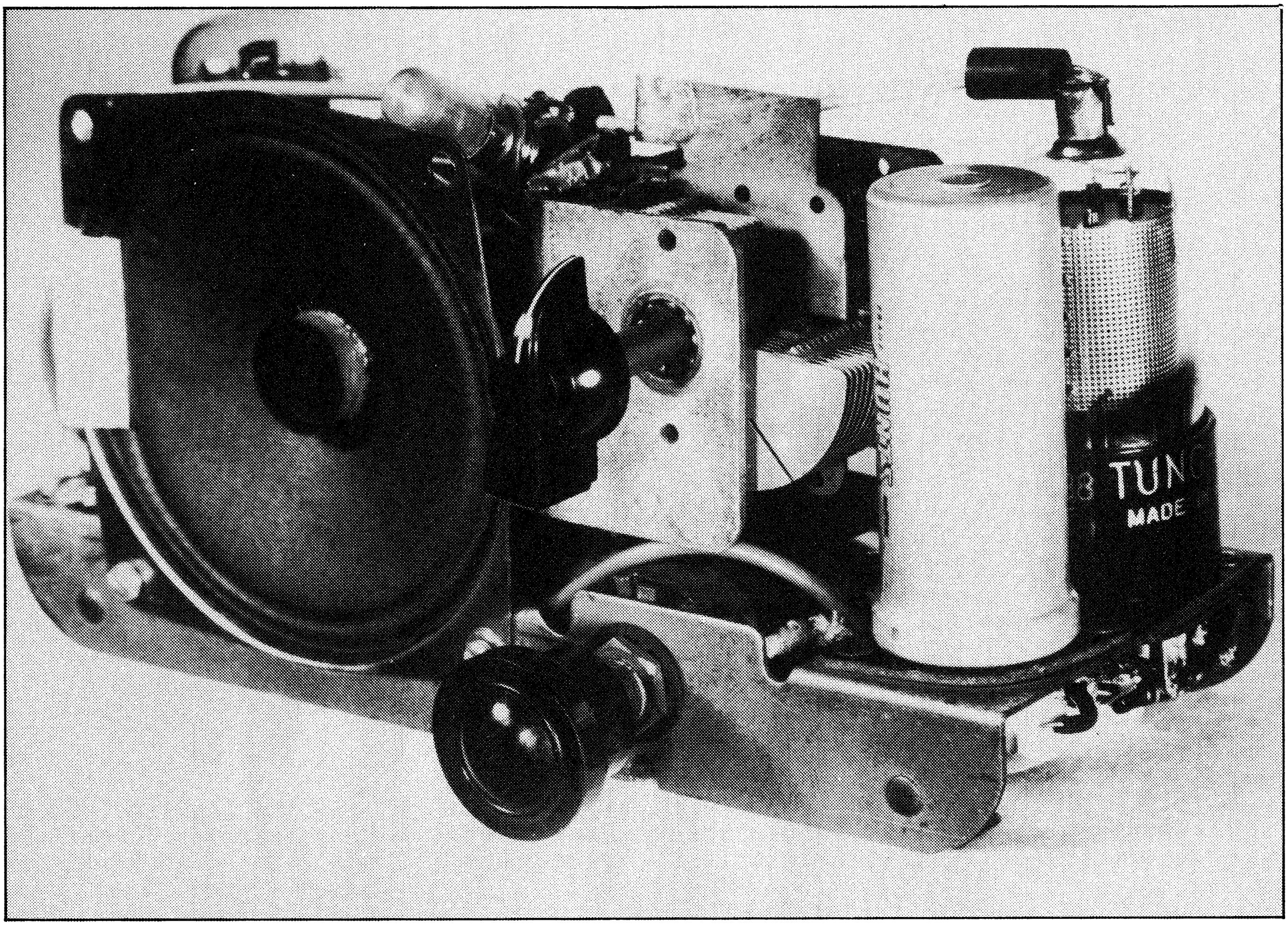
The 12B8GT is a triode/pentode, used as RF amplifier plus triode detector, while the 25A7GT is an output pentode plus half-wave rectifier.

Some years elapsed before I recently decided to commence any serious work. My first step was to clean the chassis thoroughly using a compressor and then a proprietary fluid. A blast of air at 100psi is mighty effective treatment for the dusty vanes of a tuning capacitor!

No identification could be found on the chassis, which is of stout steel with a plated surface. There had been, I was told, a plastic cabinet, white or cream, but this had been cracked and was then scrapped. The original speaker, reported to be of the reed type, had been removed for another application, but the cone had been damaged and the speaker, too, had been scrapped. Connected to the chassis was a line cord resistance cable about 2.8 metres in length, which had been tapped close to the centre to supply HT. The work on the tapping was not of factory standard, so I concluded that the line cord had either been altered or was a replacement.

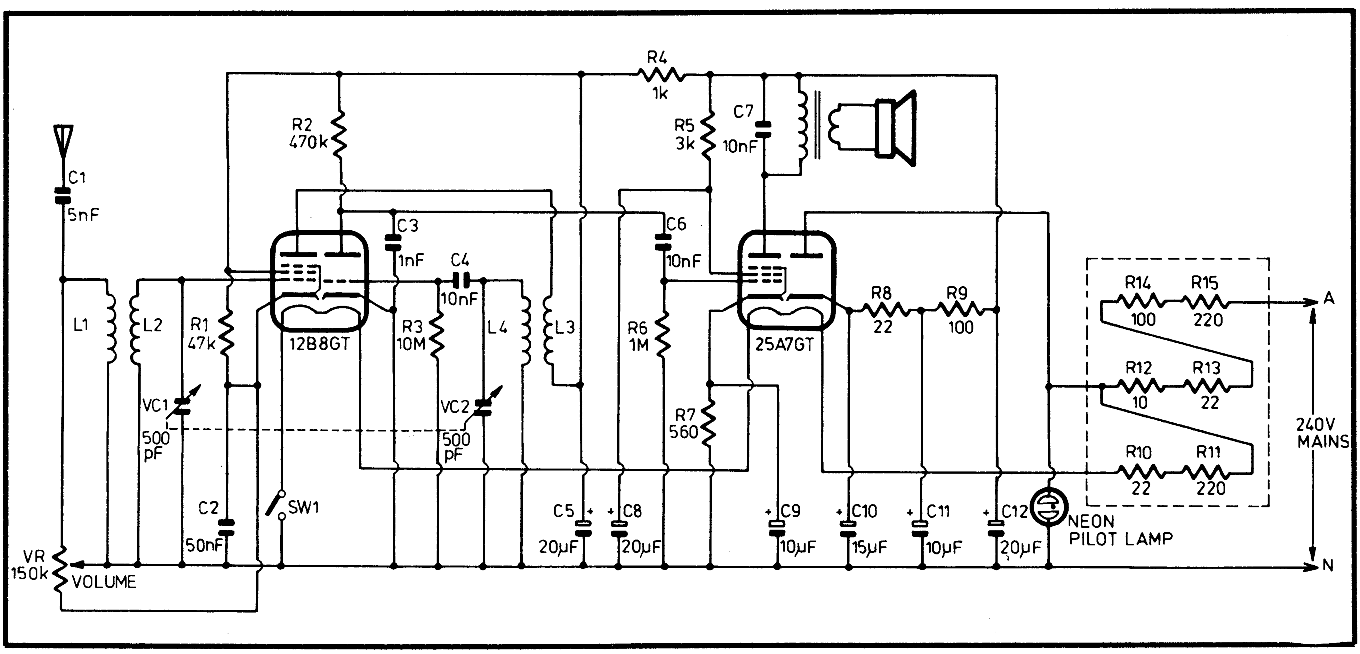
This particular set would always have required a line cord resistance of a certain value, even when used in the USA, in order to drop the mains voltage of 117V in that country to the figure represented by the sum total of the heater voltages of the two valves plus the voltage of any conventional pilot lamp. In the UK or Australia an additional 100 to 120 volts would have to be dissipated). I expected the line cord to be burnt out, but it did in fact show continuity on the vital resistance section.

Examination of the circuit showed it to be relatively simple in appearance,



but with one or two strange-looking features. Unlike the British design, the triode and the output pentode are resistance capacity coupled. The first thing to do was to try to obtain the tubes. I really did not have much hope, but after diligent searching I was able to get both of them, brand new, the 25A7GT proving to be the harder. (A 25A7, which has the same characteristics, is more readily obtainable, but is a rather larger tube). Complete data on both tubes was also found.

The socket for the 25A7GT had to be replaced, the damage looking as though someone had been trying with a screwdriver to prise out a seized up tube. This task was accomplished with no



The circuit for the receiver, as restored. It may bring back memories for some older readers . . .

great difficulty, except that the hole in the chassis had to be enlarged.

I checked the RF coils. They gave faultless continuity readings. Referring to the circuit diagram, L1 is the conventional aerial winding and is isolated from the aerial by a tubular capacitor, C1, value 0.005uF. L2, on the same former, is tuned to cover the AM band. L3 and L4 are on one former underneath the chassis. L3 is an RF choke. Positioned as it is, there is a transformer effect, the arrangement giving good selectivity at some expense in terms of volume. L4 is the tuned coil for the triode detector, tuned at the same time as L2.

A reed type speaker could not be obtained, which was unfortunate because it would not have needed an output transformer. However, a moving coil speaker would give better quality. A round one, 4 ohms, and 8.5cm in diameter could just be fitted in. I bought the smallest output transformer that would suit, but it had to be mounted on one end on the top of the chassis because there was so little space to spare.

The overall dimensions of the little chassis are 185mm long, 70mm wide and 95mm high measured to the top cap of the 12B8GT.

The time came to try out the set. First, a general check was made to ensure that damage would not be caused by some erroneous connection. The set was switched on and I waited, holding my breath, to see what would happen. Slowly the tubes lit up and then sounds began to come from the speaker. Using about 5 metres of single flex as an aerial the local stations could be tuned in fairly well. Just at that moment I was not disposed to be too critical. On the contrary, I was spellbound, feeling greatly privileged to be the first person to be hearing a radio receiver that had been silent for over 40 years. I decided to leave any further work to another day.

Returning to the task, it was obvious that there was considerable room for improvement in the midget. There was a marked lack of "brake horsepower" and mains hum was very noticeable. The level of volume was not steady and there was occasional crackling from the speaker. A complete check of the circuit was indicated.

The anode voltage on the half wave rectifier was 132V RMS, far too high. The anode current of the output pentode was 35mA, when it should have been about 20. The grid bias resistor, R7, did not appear to be original and measured only 300 ohms, partly explaining the high anode current of the output pentode. All other resistors were about twice their colour coded value, e.g., a grid leak, nominally 10 meg., was actually over 21 meg.

As regards to the capacitors, with the exception of C1, none was within its prescribed tolerance and every one leaked in varying degrees. The circuit had just two electrolytic smoothing condensers in one aluminium can. Both were in better shape than I had anticipated but they still leaked to an unacceptable extent.

The current flowing through the heaters was actually only 0.25 amps, when it should have been 0.3 amps. So it was obvious that the total resistance of the line cord was too high for the mains voltage in my area.

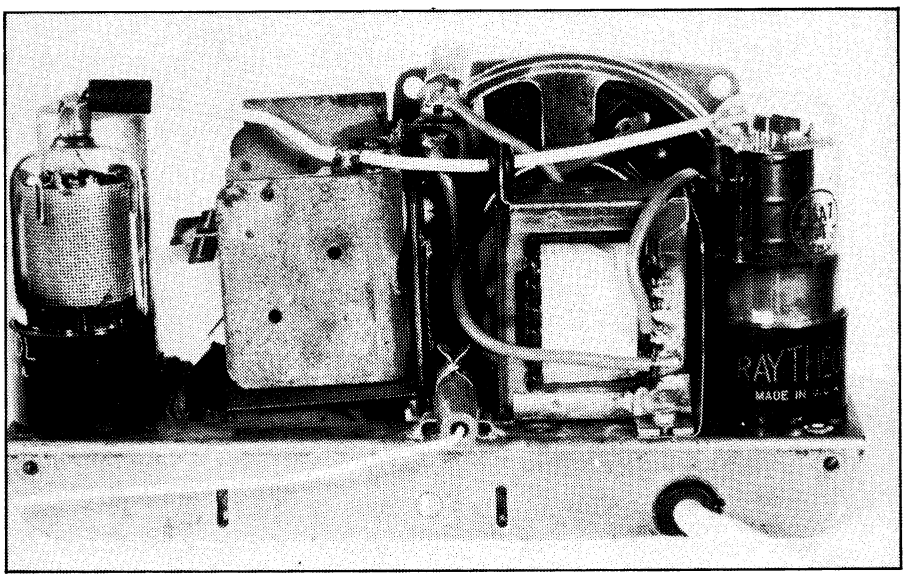
I was somewhat puzzled as to how the volume control actually worked, having no circuit diagram and finding it hard to think out the principle from an examination of the wiring. Although the set was a TRF, there was no reaction condenser, nor was there any provision for an earth connection.

I decided to replace all resistors and capacitors excepting the volume control, VR, and the aerial series capacitor, C1. I also decided to obtain all the information I could get on vintage American midgets. As it turned out, a surprising amount of such information was available from various sources both at home and abroad, but it did involve a considerable amount of research. Apparently, there were different versions of the classical "Midget", but all were AC/DC operated and were very compact by the standards of their time. A few models had full-wave rectification, but half-wave rectifiers were much more common.

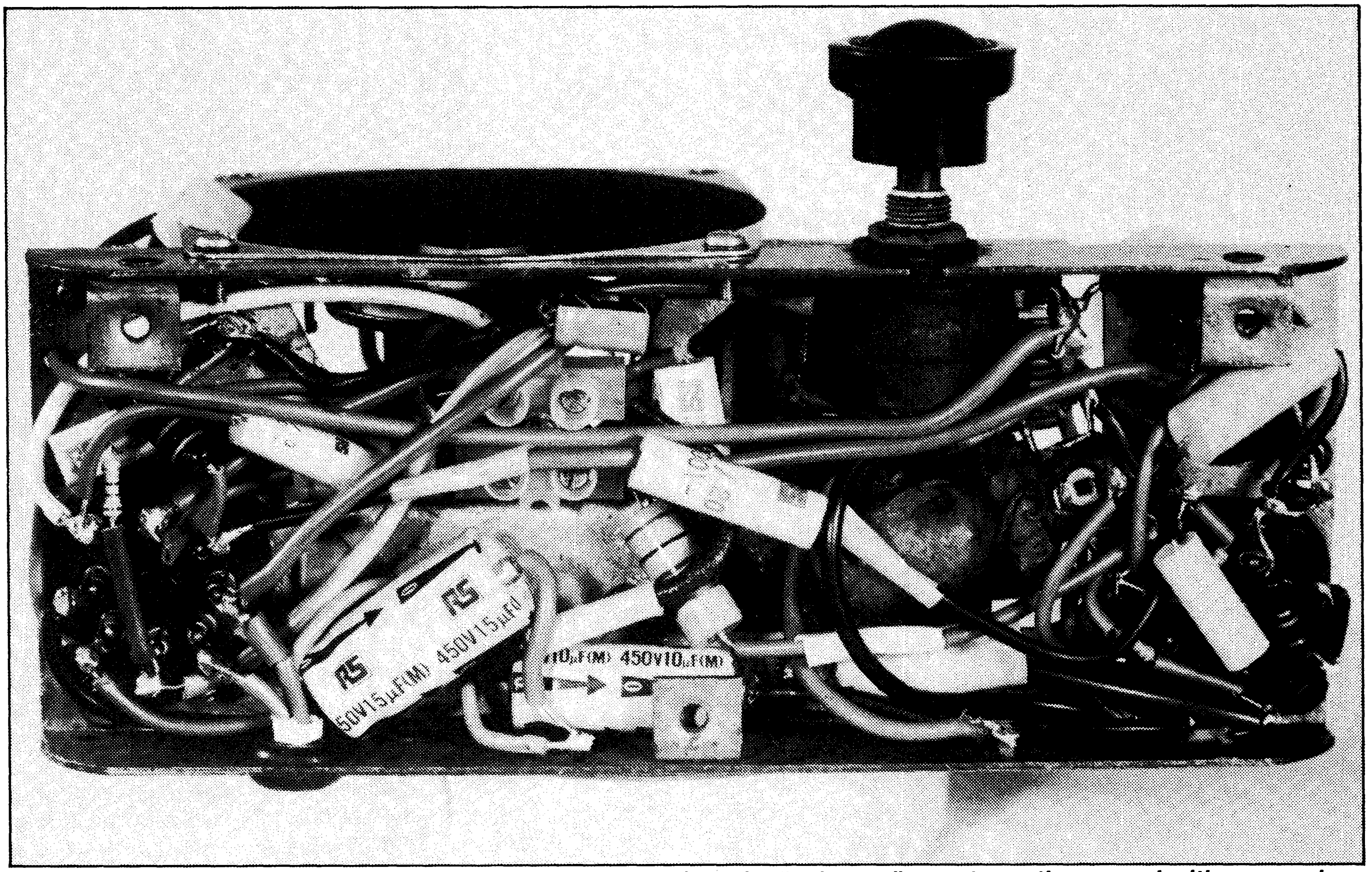
TRF designs predominated, consisting of 3 single tubes plus rectifier. Superhet versions with 5 tubes were also produced. But the type of circuit most frequently encountered in the UK was the multiple-tube set of the type described in this article. Such a set, when produced, could have been purchased in the USA for about $12.

Tube heaters in the midgets were either 0.3 amp or, later, 0.15 amp. In the latter case heater voltages could all add up to a figure sufficiently high to enable a voltage dropping resistance to be dispensed with altogether, provided that the mains supply did not exceed 117 volts. Voltage dropping, when and where required, was by "ballast" tube or line cord resistance. The sturdy American midgets were imported or brought into the UK in thousands during World War II and in the years immediately preceding it. No doubt the midgets reached many other countries in ordinary commercial transactions or for use by Americans on service abroad.

From my research, I found out how the volume control worked. Potentiometer VR (measured by me at 150k) has one end connected to the input terminal of the aerial coil L1, while the other end is connected to the cathode of the 12B8GT, pentode section. The



A view of the rear of the set, showing the two double valves, the two-gang tuning capacitor and the replacement speaker transformer. The aerial coil L1/L2 is obscured here by the 25A7 valve at right.



Underneath the chassis things are pretty tight, and something of a "rat's nest" — not exactly unusual with compact valve equipment!

slider of the potentiometer is connected directly to the chassis, so that the aerial circuit will be damped by a reducing shunt resistance as the grid bias of the pentode is raised, reducing its gain. Conversely, tuning the volume control "up" reduces the coil shunting, and at the same time reduces the valve's grid bias to increase its gain. (Please refer to theoretical diagram. The principle is much easier to illustrate than to describe).

I also found out how to do something about the mains hum. The two electrolytics in the original design are shown as C8 and C12. Taking inspiration from, but not slavishly copying, the resistance smoothing of the Firestone "Air Chief", an American midget of the same vintage but of different design, I have added three other electrolytics plus three resistors. These capacitors are C5, C10 and C11, while the resistors are R4, R8 and R9. Surprisingly, there was no by-pass capacitor for the output valve's self-bias resistor, R7. I raised the value of R7 to 560 ohms, which seems to be about right for my particular tube, and later also added C9 to provide more gain.

I now had to face up to getting rid of the line cord, which apart from the nowadays unacceptable asbestos covering on the resistance cable, was obviously responsible for much of the trouble in the set, giving HT voltage that was too high and heater voltage that was too low.

By calculation, and also using the well established principle of trial and error, I decided that the voltage drop for the rectifier anode could be obtained with a resistance of about 350 ohms, while a heater current of 0.3 amp should be provided by a further resistance of 245 ohms, making 595 ohms altogether. There would be quite a bit of heat to be dissipated, so 50W resistors would be required.

The nearest commercial values worked out at 352 and 242 ohms, total 594 ohms. Six resistors were needed, and these were mounted in a standard diecast metal box in which ventilation holes were drilled and to which rubber feet were fitted. If the set were to be used outside the workshop the box, which gets quite hot, would need to be protected by a suitable wire cage. The actual value of the six resistors in series is 597 ohms, cold, rising to 604 ohms at full working temperature.

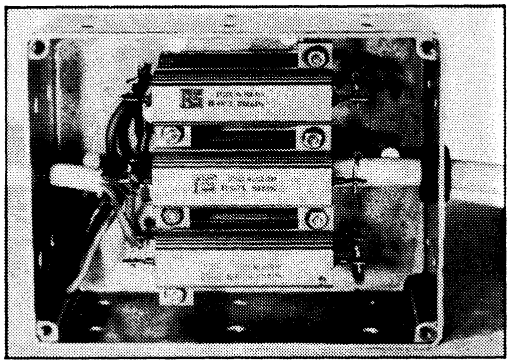
As regards the values chosen for the power pack, let me say that my mains voltage is nominally 230V, but may be varied by the supply authority up to 6% either way, so that at any particular time the voltage may be as high as 244V or as low as 216V. Usually, it is too low rather than too high.

Thus there is no absolute figure to govern these calculations and one has to settle for a compromise. Quite large voltage swings occur on a daily basis and I find them very frustrating. I am aware that some of the 50W resistors are working hard in their present application, but I am satisfied to have the set operating, and I demonstrate it for short periods only.

The power pack, which is earthed, is connected to the set by a non-reversible 3-pin plug and socket. I have another power pack, using a mains transformer with the single output of 115V, but it cannot be packaged so neatly and two voltage dropping resistors are still required.

The original set was wired in such a way that the last component in the heater chain was a 0.3 amp, 6 volt pilot lamp MES ("medium Edison screw" base). Presumably this was intended as a "set-on" indicator, there being no panel or dial to light up. I have read that the positioning of such a resistance between the last valve and the chassis is a likely cause of hum, so I have substituted a neon tube of the same MES

American Midget Radio



Inside the voltage-dropping resistance box, used to replace the original resistance-type mains cord. The diecast metal box gets quite hot!

type, connected as shown between rectifier anode and chassis.

This tube is rated at 240 volts AC and has an internal resistance. There is some loss of light at the lower voltage, but the tube gives all the warning that I require. Some slight flickering is seen. However, the oscilloscope shows that the presence of the neon tube makes no detectable difference to the performance of the set.

The speaker had already been matched to suit the output pentode's anode load of 4500 ohms, so it just remained to tune the set accurately, using a signal generator and output meter and confirming the setting with the 'scope.

The midget had now been transformed. Connected to a conventional "L"-shaped outdoor aerial, the set has more power than the small speaker can usefully handle. Selectivity is exceptionally good for a TRF. All my usual AM stations are readily available and easily separated. Even quite distant stations can be heard at reasonable strength on an indoor aerial about 1 metre long.

I had thought that the volume control potentiometer might have to go, but the crackling disappeared with the re-wiring — maybe a dry joint or a faulty resistor. The set is very tolerant of the positioning of the various components, which I would not myself regard as an ideal arrangement. The circuit is in fact completely stable.

There was still some slight hum from the speaker, so it was now that I tried a by-pass capacitor across R7. A value of 10uF proved to be sufficient, less than I had expected. The set is now virtually silent when the volume control is turned down. One has to put an ear close to the speaker to hear any hum at all and there is no modulation hum.

There may well be some readers who have never even heard a valve or "tubed" set of the TRF type in action. If so, they have missed a different quality of sound, because a TRF does not cut-off the sidebands in the same way as a superhet.

When the midget came into my possession it had a length of aerial wire as a permanent fixture, soldered direct to the aerial capacitor, C1, and just left trailing behind the chassis. What is more, it had all the appearance of being the work of the manufacturer. I have devised a modification which enables an aerial to be connected in the conventional manner. At the moment the chassis is housed in a simple, close-fitting plywood cabinet, but I have plans for something better and more stylish.

I have lately acquired a spare pair of tubes, which is a great consolation. There is no single valve which will substitute for a 12B8GT. As regards the 25A7GT, which is the one more likely to fail, a 32L7GT can be used with appropriate modifications to the power pack, the self-bias resistor R7 and the output transformer.

I was able to buy a 32L7GT and have found that it works successfully, giving even greater power output than a 25A7GT.

If it ever became necessary, the set could readily be modified to run on 0.15amp tubes, namely 25B8GT and 7OL7GT. I should perhaps make it clear that the set has had its circuit significantly changed only in the matter of additional smoothing. All the components which have been replaced have the same values as those marked on the original. (R7 was not original).

So the task has been completed. It has provided me not merely with weeks but months of intensely interesting research, experimentation and problems to be solved. Now I can start restoring my late father's 1939 4-tube battery superhet, a Bush model BA61. In this case I am fortunate in having the manufacturer's full service literature.

Sometimes when I look at the American midget, I think about the original owner and wonder what became of him. I was told that his Army unit had disappeared overnight from its local training camp not long before the Allied invasion of Normandy in June, 1944.