Vintage Radio

Vibrator Power Supplies - 3

Having looked at the theory of operation of the vibrator power supply, let's now turn our attention to bringing those old vibrator sets back to life and working as they were intended.

THERE WAS A huge range of sets made with vibrator power supplies, and Figs.1 and 2 show just about the ends of the spectrum. The small mantel set of Fig.1 is a Healing model 408A of 1938 vintage, using four 2.0 volt pre-octal valves, while the much larger console shown in Fig.2 is a substantial Healing dual wave model 668A, also of 1938.

As we are here to get the receiver going, a study of the filament network is a must. Refer to the circuit diagram of the Healing 408A's filament connections, shown in Fig.3. This series-parallel arrangement was fairly standard procedure for vibrator sets.

By the way, AWA had a most unusual practice of running the valve filaments from the 2V section of the accumulator, and then operating the vibrator cartridge from the 4V volt section. They surmised that the load on each portion was very nearly equal, and therefore the discharge rate would be likewise. It is assumed that this was also done to isolate the valve filaments from the ripple imposed on the battery by the vibrator action.

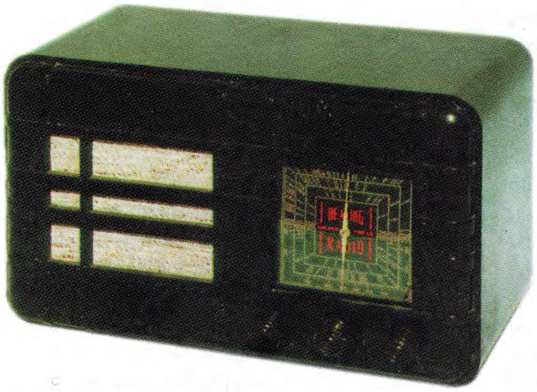


Fig.1: The Healing 408A four-valve mantel radio of 1938, which uses a vibrator power supply.

Looking at the 408A filament wiring, I don't know if the type 1D4 was designed with a series-parallel filament network in mind, but it certainly fits the bill (together with the octal equivalent, 1L5-G) very well, for reasons to follow.

The current drawn by the 1D4 is 240mA, the highest of any of the valves in the circuit, and this must be the current that passes through the entire filament network. As the types 1C4 (=1M5-G), 1C6 (=1C7-G) and 1K6 (=1K7-G) all consume 120mA, placing two of these in parallel will consume 240mA. If a parallel pair is then placed in series with the 1D4 and another pair again (or the 1C4 in parallel with an equivalent resistor, as shown), then each valve will be operating at its correct voltage and current. The equivalent resistance of any one 'leg' of this series network is therefore 8.33 ohms.

Note that in the event of the 1D4 having failed, none of the other valves will operate. However, should any one of the other valves have failed, the voltage distribution will be seriously disrupted.

The equivalent filament resistance of any of the other valves is 16.7 ohms. Should one valve fail, the total resistance of that particular 'leg' is now 16.7 ohms. Across six volts, this means that approximately 180mA flows through each leg. This means then that the voltage across the 1D4 is now 1.5V, the voltage across the leg with the two valves intact is also 1.5V, and the voltage across the remaining valve is therefore 3.0V.

It's therefore critical that before anything is done to a vibrator set, the valves should first be tested. Also, *never* remove a valve from this type of set while it's in operation.

In four-valve sets or larger sets that didn't fit into a neat series parallel scheme, ballast resistors are used to ensure that the correct current, and hence voltage, flows through each leg. So in a four-valve set like the 408A shown, typically using a 1C6, 1C4, 1K6 and 1D4 or their octal equivalents, a 16.6 ohm resistor was placed in parallel with the 1C4.

Notice how the filaments are wired, and in which order. This too is important. The voltage measured across the 1D4 is 2.0 volts, and because it's at the top of the series-parallel string the voltage at the neg-

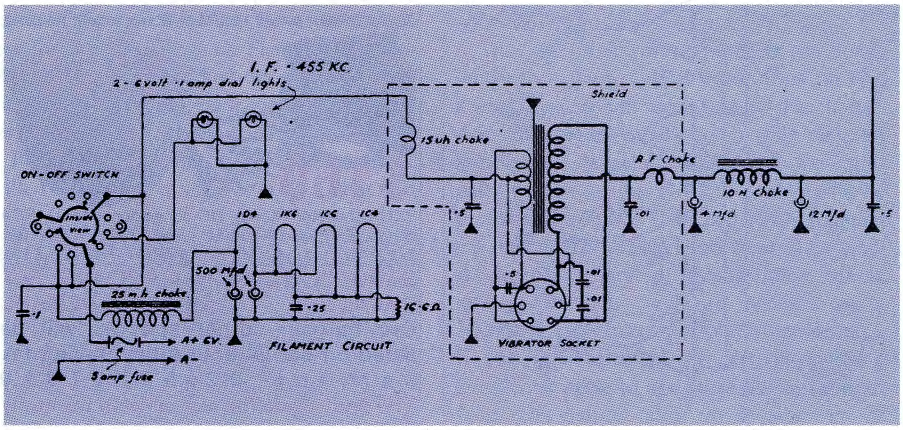


Fig.3: The power supply section of the 408A, repeated here for easier reference.

ative filament pin will be +4.0V with respect to the chassis.

This is in effect cathode bias. The cathode (filament) is 4.0 volts positive above earth, which places the grid (connected to earth via a 500k resistor) at -4.0 volts with respect to the cathode. This just so happens to be almost the correct grid bias (actually -4.5 volts) for a 1D4 operating at 135V on the anode. (It is for this reason that one wonders if the 1D4 was designed for a series-parallel filament network)

The next two valves down the chain are the 1C6 and the 1K6. Their cathode bias is 2.0 volts, compared to published figures of 3.0 volts. In this case, the figure is near enough. Further down the chain again, the 1C4 has zero bias, once again the correct figure. It is all very neat, as you can see.

Another critical point: it's essential that the signal detector diode in the 1K6 is the one surrounding the 'F-' filament pin, while the AGC diode is the one surrounding the 'F+' pin. Otherwise the AGC delay voltage will be incorrect, and signal diode will be too insensitive. So the actual polarity of filament connections can be quite important, too.

Supplying power

If the reader is seriously considering adding a reasonable array of vibrator radios to his or her collection, the purchase of a 6V accumulator is not a bad idea. They are rechargeable, and more importantly, totally authentic. Otherwise a regulated power supply of 3A capacity will be required, together with a B+ supply of between 120 and 140 volts (for testing before you get the vibrator supply going).

Now, let's say you've checked the valves and coils, replaced the electrolytic and coupling capacitors, then you hook it up to the 6V supply and nothing happens. Dead as a dodo.

First, check the fuse and the condition of the fuseholder. If there's still no result, disconnect the B+ lead from the main supply point, and remove the vibrator. Connect the battery leads to the 6V supply, and connect a lead from your external B+ supply, set to say 130V. We will assume that the set now works, so you can commence to repair the vibrator supply.

Repairs and tools

First of all, check the vibrator's coil for continuity. If it is intact, there is hope. If not, advertise, ring around or somehow scrounge another.

Assuming the coil is intact, the vibrator must be removed from its can. To do this, unsolder the little metal tag protruding from the base to the outside of the can, remove the retaining circlip, and carefully remove the cartridge.

Fig.2: The Healing 668A dual wave six valve console set, also of 1938 and vibrator powered. It's a very good performer.

Now *gently* prise the points apart and examine them. Do not disturb the parallel faces. Chances are they'll be pitted.

You will now need a 'points file', as used by motor mechanics for filing the ignition breaker points of car engines. They are available at large tool suppliers.

Carefully insert the file between a pair of points, and with the aid of a screwdriver blade, apply some even pressure on the outside contact. By carefully drawing the file to and fro, most of the muck and corrosion can be removed. This procedure must be done to each of the four points.

They must now be gapped. Using a feeler gauge and a pair of fine nose pliers, gap the primary points to about 0.015", ensuring that the tension is even and the faces of the points are parallel. Gap the secondaries to about 0.025", once again taking the same precautions as for the primaries.

Now without replacing the cartridge in its can, insert it in the socket (after re-connecting the original B+ wiring) and connect the supply. It should work. If much sparking is evident, switch off and re-examine — re-setting the points until you are satisfied that they are as accurate as possible.

Switch on again. If there's no sound at all, chances are the RF filter choke (in the B+ output from the transformer secondary) is burnt out. This can be checked easily enough, and replaced by sacrificing one winding from an IF transformer. Simply cut the four connecting wire pillars, unsolder the capacitor and coil connections, and with a hacksaw, cut the former. Use the slug and a couple of lock nuts if need be, otherwise fit it in as best you can.

The main HT choke may also be open circuit, as they sometimes are in mains-powered radios. If you can't scrounge another, try using one of the modern audio 'line' transformers (Jaycar Cat. MM-1900, or DSE Cat. M-1100), ignoring the secondary winding. In theory, these should really have an air gap because of the DC component, but experience indicates they work quite well.

The next job is to replace all the capacitors that are in circuit. The buffer capacitors should be 3kV disc ceramics, as advertised by the major suppliers. The other capacitors can be blue or green caps of equivalent value. The high voltage electrolytics can be obtained from RS Components, and 10uF/450VW are very useful for both mains and vibrator powered sets.

The chances of the LT chokes going open circuit are extremely remote. But if such does turn out to be the case, purchase a small reel of equivalent thickness wire from the major supply houses and simply wind a neat replacement.

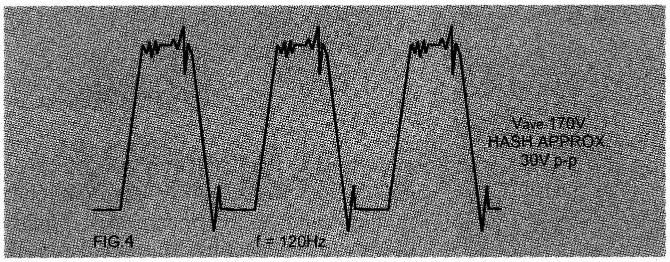


Fig.4: The waveform of this secondary voltage is satisfactory, but not perfect. The spikes in all CRO traces of vibrator waveforms are very faint, by the way; you need to examine them closely.

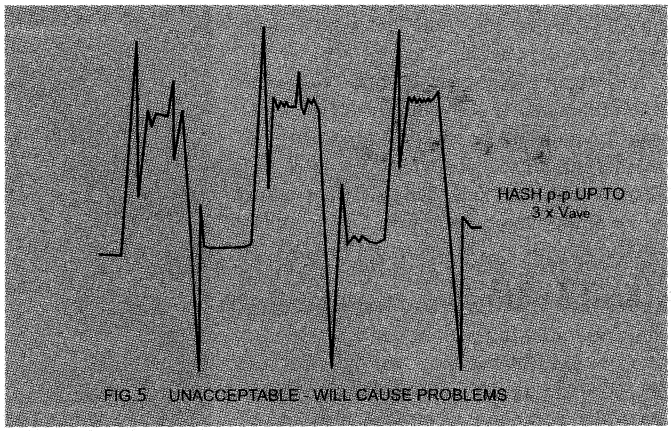


Fig.5: A representative secondary waveform showing inadequate buffering or badly adjusted points, or both.

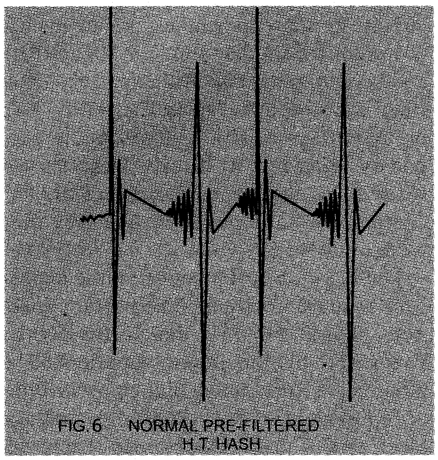
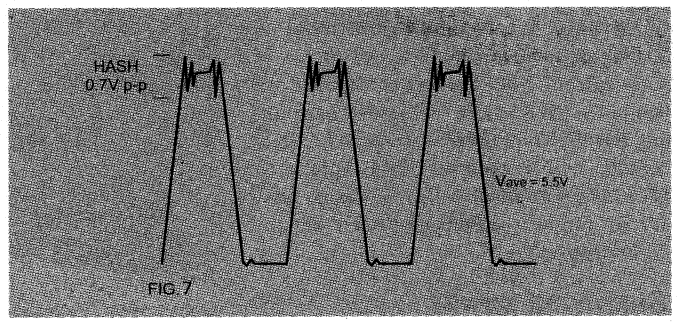


Fig.6 (left): The appearance of HT hash prior to filtering, at the transformer secondary's centre tap. This is fairly normal.

Fig.7 (right): The waveform across the primary points of the vibrator, with a minimally acceptable level of hash.



Using the CRO

Having done all this, the radio should work, but you'll ideally need a CRO to carry out the final adjustments. If sparking is still visible at the contacts, it will show on the CRO trace and will also be heard as audible hash.

If the sparking is *still* a problem, the cartridge can actually be dismantled by unscrewing the unfastening screws at the base. As the various components are removed, thread them along a straightened paper clip so that the precise order is not disrupted.

If needs be, the contacts can be ground flat on a fine oilstone block, ensuring that the pressure is as even as possible. If that doesn't stop the arcing, the points are probably too far 'gone', or else you will need to consult an expert!

Re-assemble the cartridge and re-gap the points. We will assume that the vibrator is now working satisfactorily.

As shown by your CRO, the waveform at one end of the transformer secondary with satisfactory secondary points will look like Fig.4, while inadequate buffer capacitors will produce a waveform as per Fig.5.

Fig.6 shows a waveform for the 'raw' B+ output (i.e., secondary centre-tap), prior to hash filtering. Without filtering, this hash can become quite audible. There is room for experiment with buffer capacitors across both primary and secondary, particularly if the gap has been altered from the manufacturer's specifications (which incidentally, are almost unknown).

Notice in the Healing circuit that both sides of the 1D4 filament are bypassed to chassis using 500uF capacitors. Bumping these up to 1000uF may also help reduce noise.

Voltage adjustment

The set screw and locking nut on the side of the vibrator framework, as shown in the photo two months ago, is there to alter the reed frequency. This will determine to a small extent the output voltage, but more importantly, it can have a particular bearing on the waveform shape.

You will need a 5/16" open spanner and a 1/8" screwdriver. Experiment with this adjustment by placing the CRO on the secondary.

In summary, you should aim for a satisfactory waveform that will ensure reliable life and hash free operation. This will depend on a combination of flat and parallel faces of the contacts, the correct gaps in each of the primary contacts and secondary contacts being as nearly equal as possible, plus the adjustment of the reed setscrew and the condition of the buffering capacitors, with perhaps some experiment for the best value. And finally, you'll almost certainly need new electrolytics.

Mechanical noise

In vibrators themselves, as well as their supplies, some quite elaborate steps were necessarily taken to reduce mechanical noise.

Firstly, the cartridge itself is generously mounted in soft rubber. Because this has remained relatively well sealed over the years, this rubber is quite often in nice soft condition. Secondly, the vibrator socket is usually mounted in rubber grommets as shock absorbers. Thirdly, the cartridge can is mounted inside another can (as a general rule) and some are even packed with cotton wool. All these procedures will become apparent as you examine and dismantle a given particular receiver for repair.

The acid test is to see how noticeable is the hum or noise when five to six feet away, with the volume turned to a comfortable level. If all is in order, noises of any kind will not be noticeable. Last but not least, performance of these sets is considerably improved if you use a good, moist and reliable earth.

Most people seemed to have avoided vibrator sets because of a lack of understanding. Hopefully these last three articles will help allay your fears. Think how your collection can be duly enhanced by the addition of more items of authentic radio history! ❖