By RODNEY CHAMPNESS, VK3UG

The mysterious 32V DC Monarch D671/32 from Astor

It's not often that I come across an Australian-made set for which I have no information. Made by Astor, the 32V DC Monarch D671/32 falls into that category and may have been a pre-production model.

Every so often, I come across a radio for which I am unable to find any information. Perhaps it's an orphan from a particular radio manufacturer's family or for some reason, the manufacturer omitted it from the list of receivers published in the Australian Official Radio Service Manuals (AORSM) or other trade publications.

These omissions make it just that much harder to service the "unknown" set – particularly if it has been modified (or "improved") since manufacture. How often have you obtained a set that has been modified and have had to resort to the published information to restore the receiver to its original specifications?

The Monarch brand is one of several Astor clones – like Peter Pan, National and Airchief, etc. However, I looked through all the Monarch information for this particular set without success. Because it is a 32V DC operated set, I then searched for any Monarch that had a similar valve line-up that used 32V high tension (HT), still without success.

My next step was to check all Astor clones in my various books and service manuals but that didn't turn up anything either. I had hoped that I would at least find a receiver with a nearly identical circuit but I had no luck at all.

This view shows the fully restored set. Note the polarity discs fitted to the power leads.

Astor circuits

Astor sets and Astor clones that use 32V for the heaters and HT supply (late 1940s and early 1950s) usually have a multi-band radio frequency (RF) stage, a converter and two IF stages. This is then followed by a detector and first audio stage, a 25L6 audio driver feeding a push-pull inter-stage audio transformer, and a pair of 25L6 valves in push-pull feeding the loudspeaker. The RF section tunes the broadcast band and three bandspread shortwave bands.

However, it was obvious to me that this receiver's circuit was quite different. It has no RF stage and is a conventional dual-wave set tuning the broadcast band and the 6-18MHz shortwave band. The audio section is also noticeably different and uses a 6G8-G as the detector and first audio stage. This feeds one section of a 6SN7-GT as the second audio stage. This stage acts as a phase splitter and feeds two 25L6 audio output valves in push-pull.

Another obvious difference is that this set has negative feedback from the speaker voice coil winding to the grid of the first section of the 6SN7-GT. By contrast, the common Astor 32V (HT) sets don't use negative feedback.

It really is rather puzzling as to why this circuit differs so much from the one almost universally used by Astor for 32V radios. Perhaps this was an experimental, limited production run, economy model receiver? Its circuit is certainly simpler than Astor's other 32V receivers. However, it's still quite a complex receiver when compared to sets like the Diason described back in the February 2002 issue.

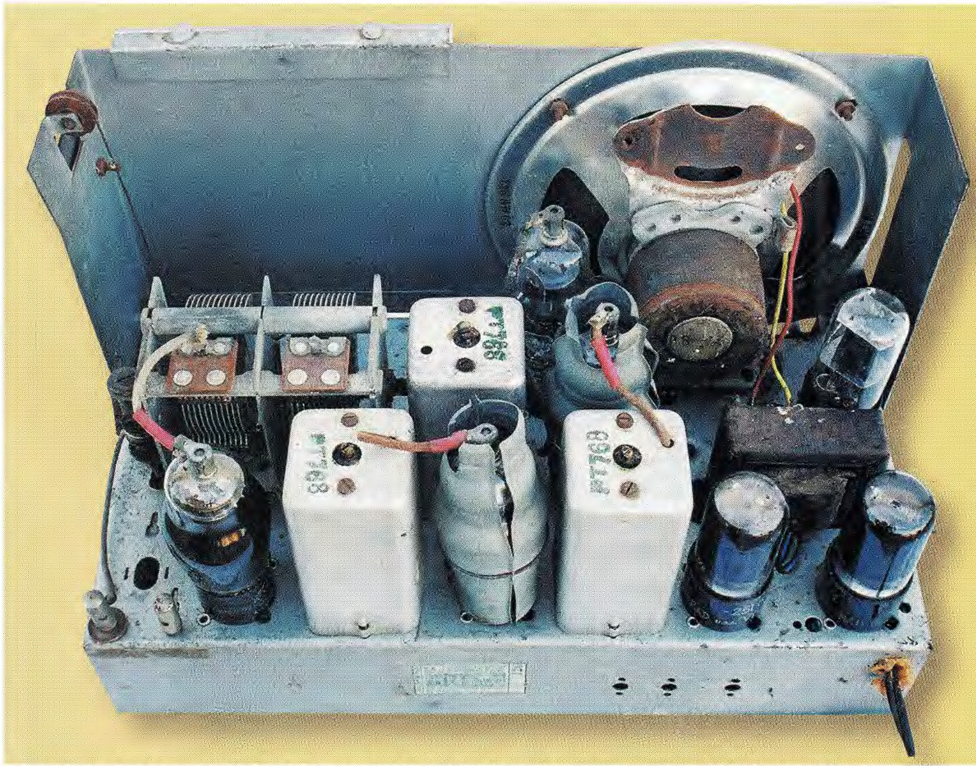
Tracing out the circuit

Before tracing out the circuit, I did what I normally do – I dusted the chassis and then cleaned it using kerosene on a kitchen scouring pad. This not only makes the set a lot more pleasant to work on but also makes the job easier. It's got to be done sooner or later, so why not when the chassis is first removed from the cabinet?

Unfortunately, it's not a particularly easy circuit to trace, as most of the wiring has been run in a single colour – in this case, rubber-coated wire that's a faded yellow colour. However, armed with a valve data book and circuits of similar 32V radios, I set to and traced out the circuit.

Lots of components had been replaced in this set during its life, so a complete circuit would quickly reveal if any "strange" circuit alterations had been done. As it turned out, it proved to be almost original, the main exception being that the previous owner had rewound the shortwave coils (and altered the padder to suit the new band), so that it tuned from 2.6-7.5MHz. He had even painted the new dial calibrations on the dial scale!

There was a reason for this – the original owner (now deceased) had been a radio amateur and had wanted to tune the 3.5MHZ and 7.0MHz amateur bands plus the two bushfire brigade frequencies he was licensed to use (2692kHz and 2836kHz).

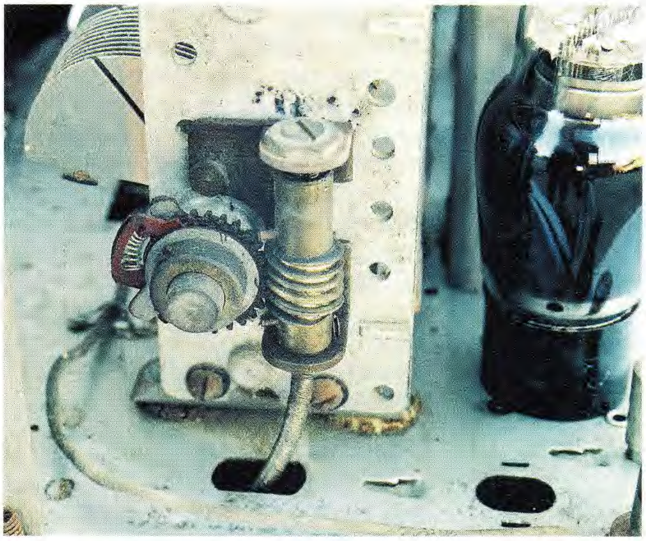


The chassis layout of the Monarch D671/32 is quite conventional (photo taken before restoration). It's a 32V set that covers both the broadcast and shortwave bands and uses seven valves.

Circuit overview

Fig.1 shows the circuit details of the Monarch D671/32. It's really quite conventional for a receiver using a 32V HT rail. However, it did surprise me that the screens of all the RF valves were fed through resistors, to reduce the screen voltages below the already low 32V on the plates. The similar Astor clones also did this but they also had an extra valve in the RF chain which meant that more care was necessary to ensure stable operation.

As shown on Fig.1, automatic gain control (AGC) is applied only to the converter and first IF stage. AGC is not applied to the second IF valve as a strong signal would push the valve into a non-linear amplifying condition near cut-off and cause distortion. This occurs because with such a low HT voltage, the valve has a very narrow



The old Monarch D671/32 was fitted with a gear driven tuning capacitor, as shown in the photo at left. The close-up above shows an overheated 0.47µF paper capacitor that's located too close to a high-wattage resistor.

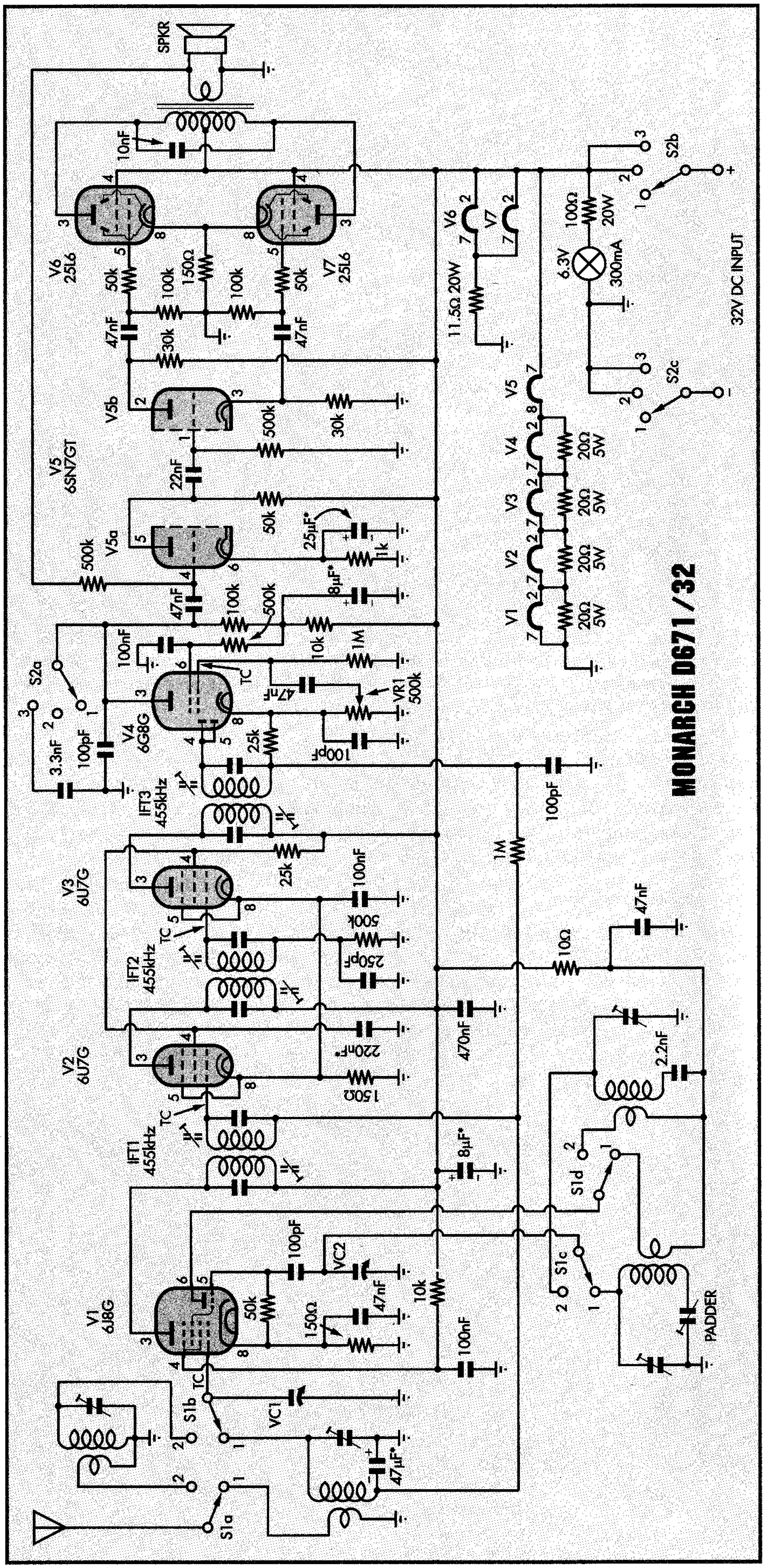


Fig.1 (left): the complete circuit for the Monarch D671/32 receiver. Note that the audio output stage employs two 25L6 valves operating in push-pull configuration.

operating range over which it amplifies linearly. If the valve had a normal HT voltage of around 200V applied to it, this would not be a critical concern.

The audio amplifier is similar in design to many medium-power public address amplifiers of the era. What makes it different is that it uses a HT voltage of just 32V.

So why use two 25L6 valves in a push-pull configuration? With only 32V HT, the valves draw very little current, so two are necessary to get reasonable output from the speaker. Because they are in push-pull, the valves can be driven a bit harder than otherwise, to give more output before distortion becomes objectionable.

In this case, the audio output is about 300mW, hence the use of a 6-inch (150mm) loudspeaker to ensure a reasonable audio level.

Normally, 25L6 valves are designed to work effectively with a HT voltage of about 110V, whereas valves like a 6V6G are designed for HT voltages of 200-250V. This means that a 6V6G would not work well in this set, as it would draw very little plate current.

Power supply

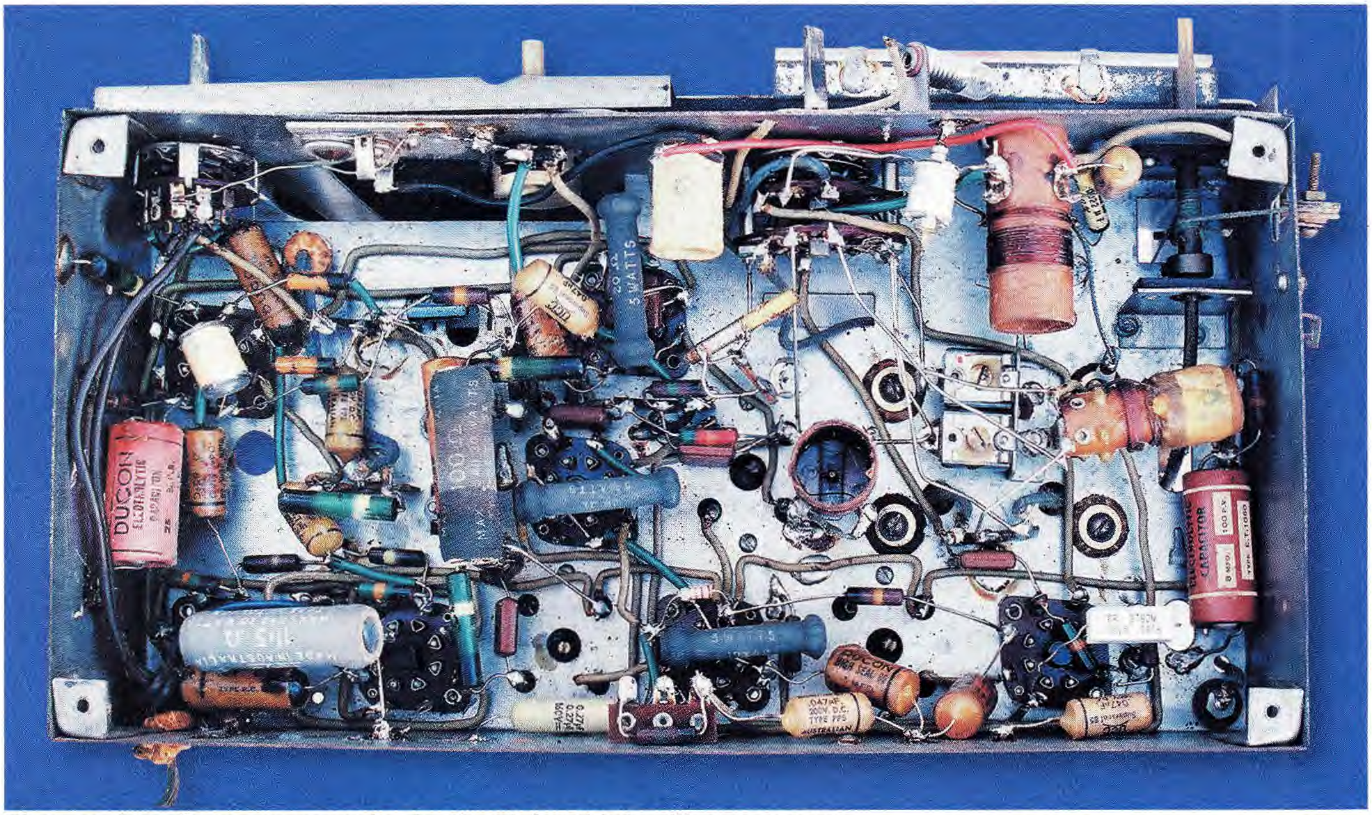
The 32V power supply is connected to the receiver via a 2-core lead and each lead is identified by a small brass label which indicates whether it is positive or negative. This is a useful feature that I haven't seen on other DC-powered radios.

Typically, this set would have been run from a 32V lighting plant and this may have either been fully floating above earth or the negative side may have been earthed. Both the positive and negative power leads are switched, so that the receiver is completely isolated from the power supply when it's turned off.

This prevents current from flowing through the set's earth to the batteries when the set is off, which could cause electrolysis effects in the whole 32V system.

Wasteful circuits

The way in which the heaters and dial lamps are wired to work off 32V is



There are lots of components under the chassis but this is still an easy set to service. There are lots of factors which indicate that this was probably an experimental model which never went into full production – see text.

quite wasteful, both in parts and power consumption. First, the 6SN7GT valve draws 0.6A of heater current but its heater is wired in series with the other 6V valve heaters which draw just 0.3A. As a result, 20Ω 5W equalising resistors are wired in parallel with these latter valve heaters, to draw the extra 0.3A required – ie, to bring the total current drain up to 0.6A.

Similarly, the heater wiring to the two 25L6 valves is hardly efficient. These valves each draw 0.3A of heater current and are wired in parallel. They are also wired in series with an 11.5Ω resistor which drops the voltage across the heaters from 32V to around 25V.

In practice, it would have made more sense to wire the 6SN7GT's heater in place of the 11.5Ω resistor, remove all the 20Ω resistors across the heaters, and install a 20Ω resistor in place of the existing 6SN7GT heater.

The dial light is a 6V 300mA unit which is fed from the 32V rail via a 100Ω 20W resistor. However, by using a 12V 150mA dial lamp (available when this set was built) and changing the series resistor to 170Ω, the current would have been halved. In addition, the amount of under-chassis heating would have been substantially reduced. The result of this heating can be seen in one of the photographs, which shows a 0.47μF capacitor with the 100Ω 20W resistor immediately above it.

Using the original heater and dial-lamp supply circuitry, the total current is 0.6A (25L6 line) + 0.6A (6SN7GT line) + 0.3A (dial lamp) = 1.5A. With my suggested heater and dial-lamp modifications, this current would be reduced to 1.05A, which is a considerable saving.

On a 32V system, a kilowatt-hour of energy would have cost at least $2 (as opposed to around 15c today), so saving power was important. The HT current in this receiver does not exceed 50mA, so this is inconsequential when calculating the receiver's total current drain.

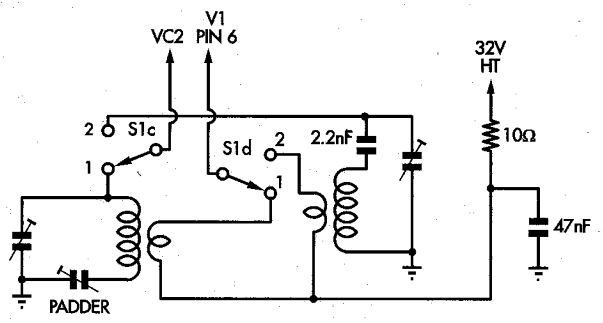
One curiosity is that the power switch has three positions: (1) "off", (2) "on" and (3) "on with top cut of audio frequencies". I believe that it would have been better if this had been changed to: (1) "off", (2) "charge" and (3) "on".

To explain, when the batteries in a 32V home lighting plant were being charged, the voltage could reach as high as 40V if the normal 16-cell bank of batteries was used. And if an extra cell or two had been added to the bank to overcome voltage drops in the cables, the battery voltage could rise to as much as 45V during charging.

Clearly, this is not good for the valve heaters. As a result, some 32V receivers have a "charge" position to reduce the voltage to the valve heaters to somewhere near their rated voltage. This is achieved by installing a wirewound resistor in series with the supply line.

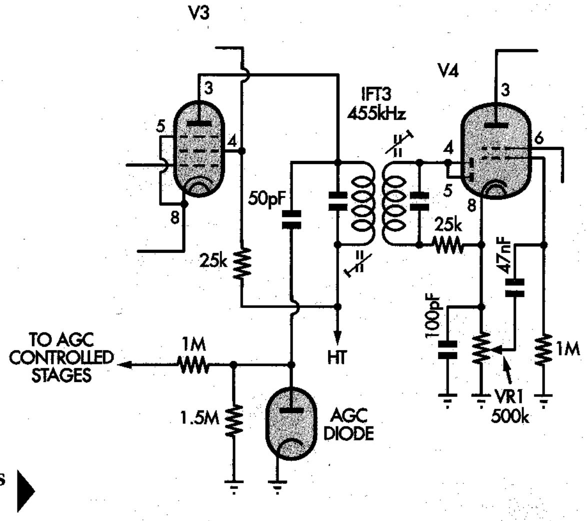
The smoke test

Armed with my hand-drawn circuit diagram, a 32V DC power supply and



AMENDED SHORTWAVE OSCILLATOR CIRCUIT

Fig.2 (above): this amended oscillator circuit gives much improved performance on shortwave.



AMENDED AGC CIRCUIT

Fig.3 (right): the amended AGC circuit. The added AGC diode is fed from the plate of the second IF amplifier (V3) and this gives higher AGC voltages than before.

my trusty digital multimeter, I decided to give the set a thorough check out. Normally, in a mains-powered receiver, I would check the capacitors before applying power. However, because the voltages are so low in these 32V sets, there's not much risk of damaging valves or other components due to faulty parts – at least, not in the short term.

The dial lamp had obviously blown so a new one was installed, after which the set was connected to a 32V power supply and switched on. The dial lamp glowed nicely but there was no sign of life in any other sections of the receiver – in fact, the valve heaters didn't appear to be lighting at all.

As a result, I checked the valve heaters for continuity and found that they all had open circuit heaters, the only exception being the 6J8G which had at some time been replaced with a 6J8GA. So what had caused this catastrophic failure in the valves? To me, it indicated that someone had probably tested the set by connecting it to 240V AC and found that it produced nothing but smoke! And in the process, six out of the seven valves were ruined.

If the set had been fitted with a fuse, little damage would have occurred, although it could have proved fatal had someone touched the chassis. In a 32V environment, the chassis is earthed and 32V is not usually considered lethal, although it can give you a nasty little surprise if you are perspiring profusely.

But why was the 6J8GA's heater still intact? The original valve used was a 6J8G which has a 0.3A heater, while the substituted 6J8GA has a 0.45A heater. This meant that it was better able to cope when the 240V was applied and the other heaters went open circuit before this one got to the point of burning out.

This has also meant that I had to replace its 20Ω heater equalising resistor with a 47Ω resistor, so that around 6V is applied to the 6J8GA's heater.

With so many valves ruined, it proved to be a relatively expensive exercise to replace them. This time, when the power was reconnected, there was a dreadful hum from the loudspeaker. The volume control had no effect on this hum and, in addition, no stations could be heard.

It didn't take long to track down the problem – the 8μF capacitor in the decoupled HT supply to the 6G8G was faulty, with very low capacitance. I replaced it a 33μF 63V unit that I had on hand and that got rid of most of the hum. However, the set's performance was very poor, the unit exhibiting poor sensitivity and a distorted audio output.

I checked the voltages on various stages and soon found that the screen pins of the two 6U7G valves were at only 5V. This was due to two factors: (1) a leaky 270nF screen bypass capacitor; and (2) the 25kΩ screen dropping resistor intermittently going open circuit. They were both replaced and the performance was vastly improved.

The receiver was now starting to show some promise. I checked the tuning range on the broadcast band and adjusted the oscillator padder at the low-frequency end of the dial and the wire trimmer at the high-frequency end, so that stations appeared in the correct places. I then adjusted the trimmer on the antenna coil towards the high-frequency end of the band for peak performance.

Next in line was the IF amplifier stage and after making the necessary adjustments, the set really started to perform. These IF adjustments were carried out with the aid of a signal generator and an insulated alignment tool.

Unwanted whistle

Although it was now performing quite well, there was still an occasional "whistle" from the set. A few checks soon revealed that the IF amplifier stage was oscillating. The reason for this was straightforward – the close-fitting metal shield (also known as a "goat" shield) on one 6U7G was loose, so I compressed the circlip that held it together. The shield now worked properly and no further whistles occurred. However, I did notice that the set oscillated weakly at the low-frequency end of the broadcast band (more on this later).

I next checked the shortwave band and found that it tuned as the altered dial-scale indicated – ie, from 2.6-7.5MHz. In practice, it worked quite well down to 3.3MHz but below that, it ceased to operate. I suspect that the oscillator stops at about this frequency, which effectively kills the set's operation.

Some readers will be aware that I dislike having padder capacitors in the earthy end of the oscillator's tuned winding. That's because oscillators often have reliability problems when the padder is in this position.

As a result, I decided to do as I've often done before and change the position of the padder on the shortwave band. This involves moving it to the other end of the oscillator coil. The amended circuit configuration is shown in Fig.2.

When I did this, the shortwave operation improved noticeably and, what's more, it now worked right across the band. That done, the receiver was aligned using a combination of the techniques described in the December 2002 and the January and February 2003 issues.

Faulty capacitors

Paper capacitors in particular have a reputation for becoming quite leaky. However, as explained in the articles in the October and November 2004 issues, not all leaky capacitors have to be replaced.

Rather than describe every component that was replaced, I've marked them with an asterisk (*) on the circuit diagram (Fig.1). They either had too much leakage or in the case of the electrolytics, low capacitance. Several other paper capacitors were also leaky but their circuit locations meant that they didn't cause any problems, so they were left in circuit.

By contrast, all those capacitors marked with an asterisk were replaced and each gave further improvements in performance.

Subtle problems

There is only one strong broadcast station where I live and I soon found that it overloaded the receiver quite noticeably. The strength of the signal is such that it drives the second IF amplifier into non-linearity. This is largely overcome by not applying AGC to the second IF amplifier – only to the two preceding stages.

In practice, I have found that higher AGC voltages need to be applied to the controlled stages than can be achieved with the simple AGC system fitted to this set. However, higher AGC voltages can be derived by having a separate AGC diode which is fed from the plate of the second IF amplifier.

As an experiment, I altered the set's AGC circuit to this system (see Fig.3) and the improvement was dramatic, with little remaining evidence of overloading. I suspect that Astor clones with an RF stage had better AGC control by having AGC applied to three stages instead of just two, as in this receiver.

As mentioned earlier, the receiver oscillates weakly at the low-frequency end of the broadcast band. I checked the earthing of the valve shields and the IF transformer cans, looked at the bypassing around the RF/IF sections and even tried adding extra IF (455kHz) filters in the audio amplifier stage, all to no avail. However, any radio station worth listening to overcomes this problem. That's because the AGC reduces the gain and hence the amount of feedback drops below the level that causes the oscillation.

My conclusion is that it's the receiver's wiring layout that causes this problem. In this set, the detector is relatively close to the front-end circuitry. As a result, radiation of 455kHz IF energy from the detector is amplified sufficiently in the aerial circuit to cause oscillation when it's tuned towards the low-frequency end of the band.

It's worth noting that aerial coils don't have a particularly high "Q", so they will respond slightly to signals around 455kHz when a set is tuned to low frequencies.

Wiring & dial cord

Most of the wiring has been left in-situ, as it's not causing any problems

Six out of the seven valves in the Monarch were faulty, probably because someone plugged it into 240V AC.


Many of the paper and electrolytic capacitors had to be replaced, along with some of the wiring which had cracked insulation.

Photo Gallery: Astor Mickey Mouse Model EC

Manufactured by Radio Corporation, Melbourne, in 1939, the "Mickey Mouse" EC was a 5-valve superheterodyne receiver fitted with metal valves. Using an output valve that gave good performance at relatively low operating voltages allowed the size of the power transformer to be reduced and also reduced the heat build-up in the small Bakelite cabinet (the white cabinet shown here was not common). The valves fitted were as follows: 6A8 frequency changer; 6K7 IF amplifier; 6Q7 audio amplifier/detector/AGC rectifier; 25A6 audio output; and 5Z4 rectifier. Photo: Historical Radio Society of Australia, Inc.

and is unlikely to do so if left undisturbed. However, the insulation on some of the wiring had cracked and that meant it had to be replaced (see photo).

But I wasn't quite out of the woods yet – just as I was about to finish all the alignment and performance testing, the dial cord broke. Fortunately, its replacement wasn't all that difficult. I followed the original layout and within a few minutes, the dial drive was back in operation.

Performance

This radio was obviously designed for use in locations that were somewhat remote from radio stations, as it is unable to handle strong signals from local stations. However, its sensitivity is extremely good and signals of the order of just a few microvolts are heard quite clearly on both the broadcast and shortwave bands.

Cabinet clean-up

Although rather grubby, the cabinet was in quite good condition. First, I removed the "Monarch" badge from the front of the cabinet by undoing the nut on the inside. This badge is in two sections: a "crown" which I cleaned with a small wire brush and a main section which was cleaned with automotive cut and polish. It now looks quite presentable.

The polarity labels (mentioned earlier) were also cleaned with automotive cut and polish. This also removed the paint, so they were resprayed using black paint for the negative label and red paint for the positive label. Once the paint had dried, I used a razor blade to scrape it off the raised sections of the labels, so they now look just like they did when they were first made.

Next, the speaker cloth was removed from the cabinet, washed in soapy water and then laid out flat to dry. That turned out to be something of a disaster because it shrank too much to be refitted to the cabinet. As a result, a new piece of dark-brown speaker cloth was cut and glued into place.

That done, the cabinet and knobs were brushed clean of all loose dust and then scrubbed using a nail brush and soapy water to get rid of the surface muck. Some more automotive cut and polish and a polishing cloth brought the cabinet to life and made it look almost new. Unfortunately, however, a few scratches were too deep to remove without damaging the cabinet itself.

Summary

Because it isn't described in any of my service manuals and because the model number doesn't follow the normal Astor/clones sequence, I suspect that this receiver never went into full-scale production.

Another pointer to this is that all the knobs on the set have extended sleeves. However, this is necessary only for those knobs that have to reach the recessed control shafts beneath the protruding dial scale. By contrast, the other two shafts protrude beyond the cabinet and so the two lefthand controls sit quite proud of the cabinet.

In addition, the cabinet itself appears to have been designed for a different model. That's because the chassis mounting holes are not all in the correct positions.

These factors, together with the low-frequency instability and the inefficient valve heater circuits, all indicate that this might have been a pre-production receiver. It is similar to other 32V HT receivers from the same stable but it was obviously designed as an economy version. It doesn't handle strong signals at all well but is very sensitive and quite suitable for remote rural areas. The supply line is also poorly filtered and ripple on the line when the batteries in the power plant were being charged could have cause a "whine" in the audio output.

So the old Monarch has many design flaws, although these could have been addressed in a full production model. What a pity the manufacturer didn't do the job properly. **SC**