Vintage Radio

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Breville 730 Dual-Wave 5-Valve Receiver

Manufactured in 1948, the Breville 730 table-top receiver was housed in an attractive timber cabinet and covered both the broadcast and shortwave bands. It featured a wide audio response and this, coupled with a large loudspeaker, gave very good performance.

THIS 1948 BREVILLE 730 receiver was obtained by a friend of mine (Marc) in almost original condition. In fact, it's quite rare to come across a set as original as this one, as most sets have had some routine servicing and parts replacement during their life.

Hopefully, any work that has been done on a set will have been carried out by a competent serviceman. An incompetent servicemen or hobbyist can leave a set with more faults than it started out with and can sometimes even destroy hard-to-get parts.

In the case of Marc's Breville 730, the only evidence of any service work was on the band-selection indicator. In fact, the condition of this 65-year-old set is so good that it has obviously been used in a lounge room for most of its life. It had eventually failed when the ECH35 converter developed a short circuit (as confirmed by a valve tester), after which it had been carefully stored away.

As a result, virtually no damage has occurred to either the cabinet or chassis, other than the normal ravages of time.

Circuit details

The Breville 730 has a conventional superheterodyne circuit that's similar to many other receivers of the era. However, it does have some features which, although not unique, are not seen in many other receivers.

Fig.1 shows the circuit details. The signal from the antenna is fed to an input tuned circuit and the position of the band-change switch determines whether shortwave (6-18MHz) or broadcast band tuning is selected.

As shown, the primary of the shortwave antenna tuned circuit (top) is in series with the primary of the broadcast-band antenna tuned circuit. Capacitor C2, a 100pF capacitor across the broadcast-band coil, performs two tasks: (1) it acts as a low impedance to earth for the bottom end of the shortwave antenna primary and (2) it tunes the primary winding of the broadcast-band coil to below the low-est frequency on this band.

This technique enhances the performance at the low-frequency end of the broadcast band.

Note that the primary of the short-wave antenna coil has little effect on the performance of the broadcast-band antenna tuned circuit and may even boost its performance slightly. This circuit works well and simplifies the band switching.

Converter stage

The selected output from the antenna tuned circuit stage is applied to the signal grid of an ECH33/35. This functions as a converter or local oscillator stage.

In operation, the local oscillator tuned circuits are also switched to suit the selected band (either broadcast or shortwave). Note, however, that there is an error in the circuit diagram regarding the oscillator switch position

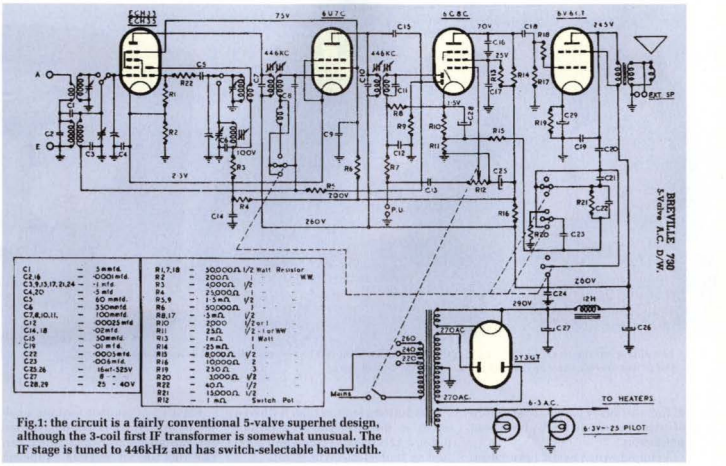


Fig.1: the circuit is a fairly conventional 5-valve superhet design, although the 3-coil first IF transformer is somewhat unusual. The IF stage is tuned to 446kHz and has switch-selectable bandwidth.

– the antenna switch is shown in the broadcast position, while the oscillator switch (immediately following C5) is shown in the shortwave position.

Capacitor C6 acts as both a padder and a phase change network when the broadcast band is selected, to provide positive feedback for the oscillator. It also provides an earth return for the shortwave oscillator primary feedback winding.

By contrast, the shortwave oscillator tuned circuit does not have a padder capacitor attached to its tuned winding. Because of the relatively small difference between the oscillator and the signal frequencies on shortwave, some manufacturers left this component out. Note also that double-spotting or image reception is quite common on shortwave receivers having no RF stage and a 455kHz IF (intermediate frequency).

Once the ECH35 has converted the tuned RF signal to a 446kHz IF (not 455kHz as we normally expect), it is applied to the first IF transformer. This transformer is different to most as it has three windings. The primary is tuned to 446kHz and so is the secondary when the tone control (immediately below it on the circuit) is in its centre (normal) and bass positions.

By contrast, when the tone control is switched to the wide range position, the third coil is switched into circuit, in series with the secondary tuned circuit.

In practice, I suspect that the secondary of this IF transformer is detuned to give a broad response through the IF strip. In addition, I suspect that the third coil is coupled to the first tuned circuit so that the combination of the primary and secondary tuned circuits also broadens the response (with a dip in the centre), so that the receiver has an audio bandwidth of up to 10kHz. This, combined with the set's large loudspeaker, would result in good quality audio although it should be noted that AM broadcast stations later restricted their audio bandwidth.

Following the first IF transformer, the signal is fed to a 6U7G IF amplifier stage and the resulting signal then applied to the second IF transformer. The IF signal is then fed to the detector diode in a 6G8G detector, AGC and audio amplifier valve.

From there, the detected audio signal is fed via R7 and C13 to volume control R12 and then to the grid of the 6G8G. This circuit technique enabled Breville to overcome the oft-experienced problem of "scratchy" volume controls, caused when DC from the detector is applied directly across them.

Note that most radios use a triode as the first audio amplifier but this set uses a 6G8G pentode for additional audio gain. The output from this stage appears at the anode and is applied to the grid of a 6V6GT audio output valve. This in turn drives a speaker transformer and an 8-inch (200mm) loudspeaker.

In addition, the audio on the plate of the 6V6GT is sampled via an RC network and fed to the 6G8G's cathode to provide tone control and negative feedback.

Record player terminals

The receiver is equipped with terminals which allow a record player (PU) to be connected. However, this really doesn't work that well because there's no way of turning off the RF section of the set when records are being played. A combination of the latest broadcast episode of "Biggles" and a recording

The chassis of the Breville 730 was in quite good order although some corrosion was evident, especially on the power transformer cover and at the top of the tuning gang.

of Tommy Dorsey playing over the top of each other would hardly have been satisfactory!

A simple switch would have solved this problem, with one pole used to switch the HT (high-tension) rail to the RF stages on or off and another pole to switch the input to the audio amplifier between radio and turntable.

AGC & power supply

The automatic gain control (AGC) signal is obtained from the plate of the 6U7G and is applied to the AGC diode in the 6G8G. This diode is normally biased off, as its anode is 1.5V negative with respect to the cathode of this valve. As a result, it will not generate any AGC voltage until the incoming signal exceeds 1.5V.

This delayed AGC signal is applied to both the converter (ECH35) and IF amplifier (6U7G) stages. Both these valves share a common cathode resistor (R2) and 2.3V of bias is obtained before the AGC voltage is applied.

The power supply is standard for the era and uses a power transformer plus a 5Y3GT rectifier. The transformer's primary is tapped at 220V, 240V and 260V, while the secondaries consist of a 6.3V winding for the heaters and dial lamps, a 5V winding for the 5Y3GT's filament and a centre-tapped 270V per side winding for the high tension (HT) supply.

The output of the rectifier is filtered using an 8µF electrolytic capacitor (C27), a 12H (Henry) choke and a following 16µF electrolytic (C26).

Cabinet restoration

As mentioned earlier, the cabinet was in quite reasonable condition. However, as antique dealers have often pointed out, timber items stored in very dry environments can develop cracks and this cabinet was no exception.

These cracks and splits were carefully repaired using an epoxy adhesive (Araldite). And because the timber was so dry, Marc applied linseed oil to the inside of the cabinet using a paintbrush. The outside of the cabinet also received attention, with linseed oil applied sparingly using a cloth.

The revitalised cabinet now looks quite good despite the minimal attention paid to it. Further restoration was not considered desirable in the interests of originality.

The original speaker cloth was in poor condition and so this was replaced with some open-weave brown cloth obtained at a haberdashery. It looks authentic even though it isn't genuine speaker cloth. In addition, new rubber buffers were fitted to the bottom of the cabinet, replacing the old ones which had either perished, become hard or had gone missing.

Finally, the cabinet features a celluloid strip which is mounted behind the various controls and which carries the control legends. Although yellowed with time, it is still original and quite legible. These strips usually deteriorate and fall to pieces over time but this one is good for many years yet.

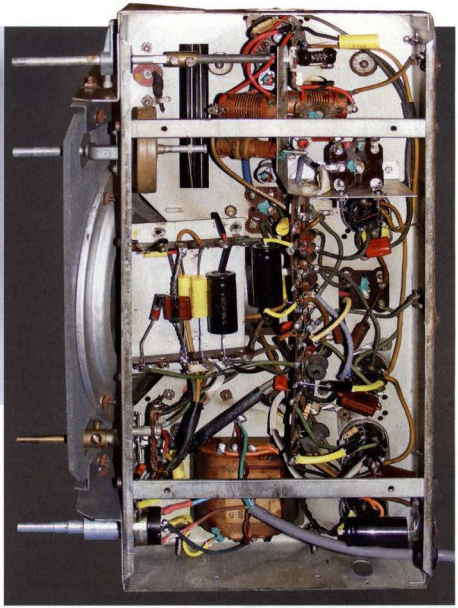
The control markings on the strip are (left to right): On-Off-Volume; Tone – Bass, Normal, Wide Range; Station Selection; and Wave Change SW/BC.

Circuit restoration

The chassis is quite easily removed from the cabinet. This involves removing the four control knobs and the dial-light assembly, followed by the four screws underneath the cabinet which secure the chassis in place. One of the dial lamps had to be replaced, after which the inside of this assembly was repainted white to ensure good reflectivity.

One problem with many sets is that the dial-scale is left behind (ie, still attached inside the cabinet) when the chassis is removed. The Breville 730 is no different in this regard but the redeeming feature of this set is that the alignment frequencies are marked on the edge of the dial scale, along with the position of the dial pointer when the tuning gang is closed.

That certainly makes it easier to get the dial pointer lined up with the



This under-chassis view shows the receiver after restoration. The original paper and electrolytic capacitors were all replaced, along with some of the wiring.

station markings correctly when the chassis is reinstalled.

Once the chassis had been removed, Marc could immediately see that some of the wiring was in need of replacement as the rubber insulation had perished. This particularly applied to the dial-lamp leads as the insulation had actually fallen off and the wires were shorting.

Closer inspection of the wiring revealed several other leads that were shorting due to perished rubber insulation. These leads were all replaced, after which the dial-light supply line was isolated and the valves removed. This was necessary to allow high-voltage tests on the power supply, to confirm that it was in a safe condition.

First, the insulation resistance between the mains and chassis and other windings of the transformer was tested using a high-voltage insulation tester. These were all found to be in good order, with over 200MΩ of resistance in each case.

That done, the old power cord was replaced with a new 3-core cable. This was securely anchored to the chassis using a cord clamp.

Marc then tested and/or replaced a number of parts that are known to cause problems. In particular, all the paper capacitors were replaced with modern polyester types, while the electrolytic capacitors were also replaced due to their age and the fact that they were visibly leaking. Several resistors were also found to be out of tolerance and were replaced.

The loudspeaker was the next on the list. It had developed a number of cracks along the speaker cone edge and these were repaired with Selleys "Quik Grip".

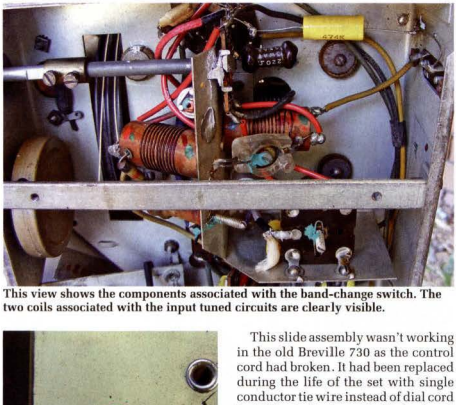
Testing the valves

Marc's next step was to use his valve tester to check all the valves in the receiver. All tested OK except the ECH35 converter, the tester indicating a short circuit inside this valve. This would have completely stopped the receiver from working and is probably what caused the original owner to retire the set.

Marc had a working ECH35 which could replace the dead ECH35 but its conductive red paint shield (which Philips call "metallisation") had been damaged. As a result, he decided to make an experimental shield to replace the damaged one.

A little investigation showed that the wire contacting the red shield and the earth pin in the valve plug was intact and accessible. A thin strand of wire was therefore soldered to this earth wire (without cracking the valve envelope) and then spiral-wound around the valve envelope. Some "Wire Glue" (available from Jaycar, Cat. NM-2831) was then applied to the envelope to secure it in place.

If access to the earth wire is not practical, a thin wire can be soldered to the earth pin of the valve and then extended up and wound around the



This view shows the components associated with the band-change switch. The two coils associated with the input tuned circuits are clearly visible.

This slide assembly is controlled by the band-switch and indicates which band has been selected.

envelope. Another possible earthing shield can be seen at **www.anderson-products.com**. The sales information says that it is "carbon blended in a non-toxic binder".

Repairing the band indicator

The band-change switch has a lever off to one side of the control shaft and this controls a spring-loaded slide assembly via a length of dial cord. This slide assembly has two small labels which are alternatively visible through a clear window on the righthand side of the dial scale and indicate the band selection (ie, broadcast or shortwave). AWA used a somewhat similar idea in their 7-band receivers of the same era.

This slide assembly wasn't working in the old Breville 730 as the control cord had broken. It had been replaced during the life of the set with single conductor tie wire instead of dial cord but this wire had eventually fractured at the eyelet. Re-stringing the assembly with dial cord soon got it working again.

The tuning gang was also a little worse for wear so it was the next job on the list. First, a small hand blower was used to remove the dust that had accumulated between the plates. This revealed that some of the plates had corrosion on them, so these were carefully cleaned by pushing some fine emery paper between them.

The chassis itself was in quite good order and was simply cleaned using the blower and a small brush.

Testing

Having fixed all the obvious faults in the set, Marc then decided to power the set up to see if there were any other faults in the circuit. As it turned out, the set started up normally and stations could be clearly heard. A quick check then revealed that all the voltages were normal and no components showed any obvious signs of distress.

Even at this early stage, the set's performance was quite good and tweaking both the antenna and oscillator circuits made it even better. In fact, its shortwave performance is better than average for a set of this calibre. However, there were a couple of other issues to be dealt with. One dial globe was dead and more importantly, it was obvious that the volume control pot was worn out and would have to be replaced.

The IF alignment were then checked using a signal generator and a frequency counter (to adjust the signal generator exactly to frequency). Because Marc had no information on adjusting the first IF transformer with its three windings, he decided to proceed with the tone control in the "Normal" position. Before adjusting anything though, each IF transformer was marked so that he could easily return it to its original position should his alignment technique with the uncommon 3-winding IF transformer go awry.

As it turned out, the alignment went smoothly and the first IF transformer was easy to adjust in the standard selectivity position (ie, Normal).

New volume control

With the set now performing well, Marc decided to replace the worn-out on/off-volume control. Unfortunately, he was unable to obtain a direct replacement with a long shaft, so he was forced to use one with a splined shaft and make up an extension shaft on a lathe.

This proved to be a complete success and the new volume control worked smoothly, without crackles. The chassis was then reinstalled in its cabinet and the restoration was complete.

Summary

Breville produced many fine radios and the model 730 was one such set. It performs well and the broad response of the IF amplifier stages (when switched to "Wide Range") means that the set was able to reproduce a wider range of audio frequencies than most other similar sets.

The set is also easy to service, with all parts readily accessible. However, the inability to isolate the RF section when a turntable is connected to the audio amplifier section is a rather puzzling omission, especially since it would have been so easy to do. All that would have been required is an extra position on the band switch, which could then have been labelled "Short Wave", "Broadcast" and "Gram".

In summary, the Breville 730 is an excellent receiver with many interesting features and is a worthy addition to Marc's collection. SC