

Repairing a Haunted Philco Model 70 Console

Gord Rabjohn, Halloween, 2020

The Philco model 70 is a common radio from the early 1930's, and comes in several different cabinets and with different chassis options. The radio I am discussing is a "HighBoy" cabinet with a fairly early chassis (without AVC). The radio chassis is marked "Robertson Pingle & Tilley Limited, Ottawa, Canada", (This is a music store located at several addresses on Bank St., but 154 Bank St. was their address when this radio was purchased. They later moved to 58 Sparks St. Ref: Feb 13 1935 Ottawa Journal) and I have had it for at least 35 years. The radio is a gift to a family member living in a 1926 house in Toronto. Repairing it was straight-forward and quite enjoyable, as it appears that this radio had never been repaired before. Exorcising the poltergeist proved to be a challenge.



The radio after electrical restoration

The Repairs

The Philco model 70 is a 7-tube AC superheterodyne radio with a 260kHz IF frequency. It uses '24 tubes in the RF, mixer, IF, and detector sockets, a '27 as the local oscillator, a '47 AF output and an '80 rectifier. It has no AGC, but the volume is controlled with variable bias on the RF and IF tubes and a variable attenuator at the antenna. The only serious problem with this radio (other than the electrolytic capacitors) was that the primary coil at the RF amplifier plate was open. The break was in the first turn, (I determined this by measuring the capacitance from each end of the broken winding to the coil under it. The one with lower capacitance was closest to the break) so I was able to unwind it past the break, and resolder it (This coil is not tuned with a capacitor so the number of turns was not too critical). Even the resistors were close enough in value that they did not need to be replaced.

I have made it known that I generally do not replace capacitors unless they are faulty, and some of you disagree with this approach, arguing that all paper caps are evil and should be replaced. You may be surprised to hear that this time, I decided to replace all paper capacitors exposed to high voltage. There are several reasons: Some were leaking DC current. The new owner of this radio was expecting to actually use it occasionally, and I didn't want it to fail. Also, the Philcos of this era have their capacitors

encapsulated in little bakelite coffins, which makes a cosmetically-perfect repair possible, if not a little messy. Also, replacing these paper capacitors should have removed all the evil, a point that will become important in the next section.

The electrolytic capacitors were sliced open (along the dashed line in the figure) and the contents were removed. By slicing the can at the top of the indent, the top can be reassembled over the bottom with a little overlap. The positive terminal is simply a bolt attached to the internal positive electrode. With some physical encouragement, this assembly can be replaced with a brass bolt, and connected to the positive terminal of the modern capacitor. The negative terminal is soldered to the base. The can is very neatly reassembled with epoxy holding it together (It could be soldered, as the can is a copper alloy, but the heat might damage the plastic mount). Note that the capacitor case is not at chassis ground, so it is mounted with insulating washers. I added a wire to ensure that the case was properly connected to where it should be. The rebuilt capacitor looks like the original.



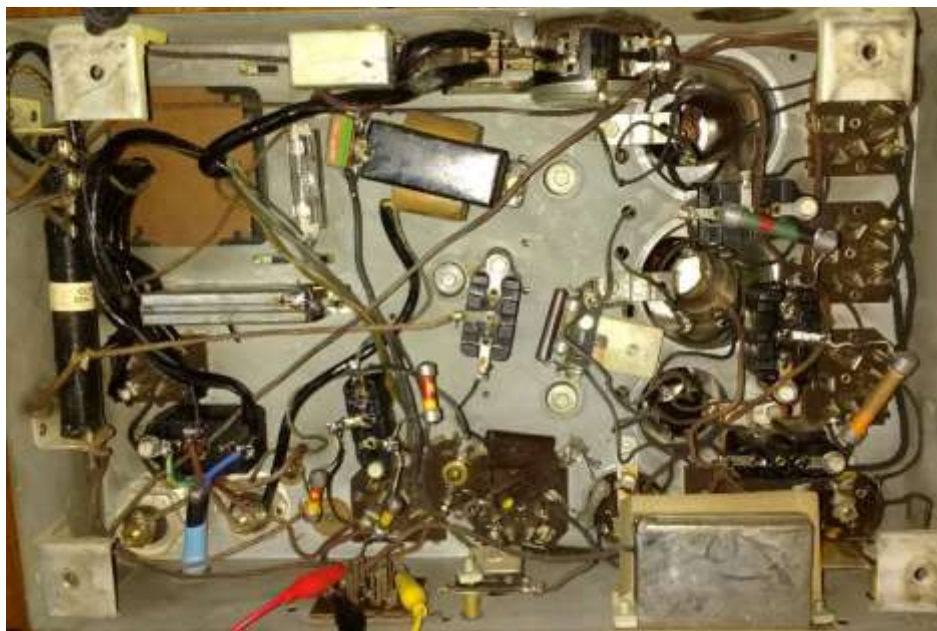
The restoration of the electrolytic capacitor: before, old guts, new guts, and after.

The paper capacitors in the “coffins” were heated in a barbeque (to keep the nasty smell outdoors) on a sheet of aluminum foil until the wax melted and the contents could be removed. In fact, this took surprisingly little heat. Modern 630V capacitors fit neatly inside the resulting coffin.



Restoring the paper capacitors. The modern capacitor is later pushed all the way in, making it invisible.

A small rip in the speaker was repaired, and new grill cloth was glued on (Thanks René). The gromets holding the variable capacitors were replaced. One '24 tube was microphonic, so it was replaced. The tone switch was tightened up. Of course, the power cord was replaced with a modern grounded 3-prong cord, and a fuse was added. Dust was removed, tubes were polished, the volume control was cleaned, and everything was made to look pretty.



Once these repairs were executed, I realigned the IF transformers, then left the radio to run for several hours in the basement. It now worked perfectly. Better than new. Even the volume control was smooth and clean. The cabinet needed some work, but the new owner wanted to restore the wood, so I did a rudimentary clean-up with a vacuum, soap and water, and a razor blade. I reassembled the radio into its cabinet in the living room and turned it on to burn it in for a day. This is when the ghost made itself known.

The Poltergeist

I had the radio running at low volume without an antenna, tuned to a local station at 1310kHz. I went to the basement, and discovered that turning the basement light on caused the volume to increase very suddenly and significantly (this was one-way, turning it off again made no difference). When I returned upstairs, the radio volume returned instantly to the previous low-volume state as soon as I came within about 4 feet of it. This could be repeated, and I got lots of exercise on the stairs until I discovered that turning the radio's power on and off again (either with the switch or the wall plug) also put it into the high-volume state (where it would stay). The volume would drop when I stood in the magic location 4 feet from the radio (and the volume would stay low). This was a "binary" effect with hysteresis, not a fade. By hysteresis, I mean that the state of the radio depended on what happened before. If I had most recently cycled the power, it would be loud. If I had most recently stood in the magic location, it would be quiet. Either it was loud or quiet, never in-between. This effect was repeated reliably day and night.

I played with this for hours. I discovered:

- It was most noticeable on 1310kHz. It was much less prevalent on 1200kHz, and stable at 580kHz.
- It was not sensitive to vibration. Tapping or knocking the chassis or tubes or wiggling wires had little effect.
- It was independent of the setting of the volume control, as far as I could tell. (If I turned it up too much the high volume became unbearable. If I turned it down too much, the low volume became inaudible)
- Adding a short antenna made the effect less obvious, but it was still there.
- I measured key DC voltages in both states, and they did not change. I had to invert the chassis and extend the speaker wire to do this, but this action made little difference.
- I was able to measure some RF voltage swings. The IF output followed the volume changes; the RF voltage at least 10X larger in the high-volume state. This suggested that the problem is earlier on in the radio circuit.
- If the RF amplifier tube was removed, the effect disappeared. (The radio still worked at very low volume, but this could be increased with an antenna into the subsequent '24 mixer)
- It was very noticeable when plugged into one wall plug (I'll call it circuit "A"). When plugged (via an extension cord) into another circuit (on a different breaker, call it circuit "B") the volume generally remained in the low state, possibly even lower than the low state when plugged into "A". The effect was diminished but not entirely gone. Circuit "B" is entirely modern. Circuit "A" is modern back to the breaker panel, but it does have some old "knob and tube" beyond the plug. So, both are properly grounded. I verified that the socket was wired correctly. I believe that the old wiring in circuit "A" is sometimes acting as an antenna
- I tried an isolation transformer, and the effect went away (it seems to remain in the low volume state), but there was a significant buzz.
- I moved the radio to the second floor, plugged it into a modern circuit, and the effect was not present.

-I injected a modulated signal from an RF generator set to 1310kHz, so I could hear the radio station superimposed with the signal generator. The generator's tone remained constant, but the 1310 radio station volume changed as before.

-I looked for parasitic oscillations with an oscilloscope (in the living room) and with a spectrum analyzer (in the basement where it always worked properly) and found no unexpected signals.

-Other nearby radios worked fine (even a Philco model 71 cathedral, which is vaguely similar)

-The wire to the antenna Fahnestock clip was routed under the chassis close to the AC mains circuit, and this appears to be intentional. I rerouted this wire to be direct from the volume control to the antenna Fahnestock clip, hugging the inside of the chassis, and the effect reversed itself! Now, interrupting the power put it into a low volume state, and standing at the same location 4 feet away restored volume.

-Note that this radio has no AVC, unlike almost any more recent radio. AVC would make this effect much less noticeable.

I decided to pack the radio up and take it to Toronto (yup, I gave up!), to see how it did there. If I needed to bring the radio back to Ottawa, it would be advantageous to leave the cabinet and electrodynamic speaker in Toronto. So, before I left, I checked the chassis with a different (permanent magnet) speaker and a resistor to replace the field coil. This configuration worked perfectly.

When the radio was set-up in Toronto, it worked perfectly, and it sounded great playing some vintage programming from Zoomer radio at 740kHz. So, I left the radio in its new home. Presumably, the poltergeist will find a different radio to possess. This leaves me somewhat disturbed with a lingering mystery. It clearly has something to do with the knob-and-tube house wiring coupling into the radio through the line cord to the RF amplifier. That would all make sense if it was not binary, but what causes the binary "loud-or-quiet" operation with hysteresis?

If anyone has encountered anything like this, I'd love to hear your experience and your solution!