Repair and Restoration of Antique Radio Equipment

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for
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Antique Radio Equipment

- Looks cool
- Unique sound quality
- 1930-40’s jazz sounds better
- Functional history
- Learn how things were made
Outline

* Step-by-step process
* Case study: Hallicrafters S-76 (1951-54)
* Case study: Colin B. Kennedy Model 20B Console radio (1929)
* Summary
Step-by-step process

1. **Do not power up your radio!**
   - yes, it does not work
   - more harm than good
2. Find service manual
3. Replace all electrolytic and paper capacitors
4. Replace anything that looks damaged (burned or exploded)
5. Try radio *(wear safety glasses)*
6. Signal trace through circuit, replacing resistors where needed
7. Radio will work
Hallicrafters
S-76

• Amateur Radio receiver
• 1951-1954
• 2 conversion heterodyne architecture
• 11 tubes
• 538 Kc - 32 Mc
• CW, AM, SSB (with steady hand)
• 41 lbs
• Design based on SX-28 (widely utilized during WW2)
Hallicrafters S-76: capacitor spewing wax

- Powered up S-76 without replacing electrolytic capacitors
- One electrolytic smoked and spewed wax
- Cathode capacitor on AF power output tube was shorted
- Replaced 2 paper capacitors that looked ‘rough’
- No other caps replaced, keeping radio original

Location of cap

New cap

Cap replaced

Wednesday, October 21, 2009
**Hallicrafters S-76: signal tracing**

- Signal generator connected to RF input
- Signal traced using 10x probe
- Signal stopped at front-end mixer tube V2
- Had to check the voltages on the tube pins
- Voltage chart included in all service manuals
- Requires proper impedance volt meter, 20K/volt Simpson 260
- If the voltage is outside of ±5% then replace the resistor(s) soldered to that pin
- Old carbon resistors INCREASE in value with age
- R17 and R18 had to be replaced (and others)

**VOLTAGE READINGS**

<table>
<thead>
<tr>
<th>Item</th>
<th>Tube</th>
<th>Pin 1</th>
<th>Pin 2</th>
<th>Pin 3</th>
<th>Pin 4</th>
<th>Pin 5</th>
<th>Pin 6</th>
<th>Pin 7</th>
<th>Pin 8</th>
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</thead>
<tbody>
<tr>
<td>V 1</td>
<td>6CB6</td>
<td>0V</td>
<td>26VDC</td>
<td>0V</td>
<td>6.3VAC</td>
<td>260VDC</td>
<td>26VDC</td>
<td>205VDC</td>
<td>26VDC</td>
</tr>
<tr>
<td>V 2</td>
<td>6AU6</td>
<td>-3.8VDC</td>
<td>0V</td>
<td>0V</td>
<td>6.3VAC</td>
<td>255VDC</td>
<td>70VDC</td>
<td>4.6VDC</td>
<td>0V</td>
</tr>
<tr>
<td>V 3</td>
<td>6C4</td>
<td>85VDC</td>
<td>0V</td>
<td>0V</td>
<td>6.3VAC</td>
<td>85VDC</td>
<td>8.1VDC</td>
<td>0V</td>
<td>0V</td>
</tr>
<tr>
<td>V 4</td>
<td>6BA6</td>
<td>0V</td>
<td>26VDC</td>
<td>0V</td>
<td>6.3VAC</td>
<td>260VDC</td>
<td>115VDC</td>
<td>26VDC</td>
<td>0V</td>
</tr>
<tr>
<td>V 5</td>
<td>6BE6</td>
<td>-1.8VDC</td>
<td>1.4VDC</td>
<td>0V</td>
<td>6.3VAC</td>
<td>260VDC</td>
<td>85VDC</td>
<td>0V</td>
<td>0V</td>
</tr>
<tr>
<td>V 6</td>
<td>6BA6</td>
<td>0V</td>
<td>26VDC</td>
<td>0V</td>
<td>6.3VAC</td>
<td>250VDC</td>
<td>220VDC</td>
<td>26VDC</td>
<td>0V</td>
</tr>
<tr>
<td>V 7</td>
<td>6AL5</td>
<td>0V</td>
<td>-1.1VDC</td>
<td>0V</td>
<td>4.3VAC</td>
<td>0V</td>
<td>0V</td>
<td>-1.1VDC</td>
<td>0V</td>
</tr>
<tr>
<td>V 8</td>
<td>6SC7</td>
<td>0V</td>
<td>115VDC</td>
<td>-1.5VDC</td>
<td>-6.1VDC</td>
<td>-3.3VDC</td>
<td>95VDC</td>
<td>0V</td>
<td>6.3VAC</td>
</tr>
<tr>
<td>V 9</td>
<td>6G6GT</td>
<td>0V</td>
<td>265VDC</td>
<td>260VDC</td>
<td>0V</td>
<td>280VDC</td>
<td>6.3VAC</td>
<td>1.6VDC</td>
<td>0V</td>
</tr>
<tr>
<td>V 10</td>
<td>VR-1506D5</td>
<td>0V</td>
<td>0V</td>
<td>140VDC</td>
<td>260VDC</td>
<td>140VDC</td>
<td>0V</td>
<td>140VDC</td>
<td>0V</td>
</tr>
<tr>
<td>V 11</td>
<td>SY3GT</td>
<td>280VDC</td>
<td>280VDC</td>
<td>0V</td>
<td>280VAC</td>
<td>0V</td>
<td>280VAC</td>
<td>0V</td>
<td>280VDC</td>
</tr>
</tbody>
</table>
Radio started to work
Performed alignment
straight-forward procedure in manual
Tested radio to full sensitivity specification
Success! Long wire antenna; listening to amateur radio stations and many short-wave stations

Hallicrafters S-76: alignment

Alignment Instructions—Read carefully before attempting alignment

To set dial turn tuning gang fully closed and set the zero on the logging scale under the dial index line.

Turn the noise limiter and AVC switches to "off", send-receive switch to "receive", CW/AM switch to AM, and the band selector to "band I".

Turn both main tuning and bandspread capacitors to half meshed.

During alignment of the 50KC IF's, (step 1), remove the first oscillator tube, (V3), from its socket to prevent signal interference.

Connect a 3.2 or 500Ω speaker.

<table>
<thead>
<tr>
<th>DUMMY ANTENNA</th>
<th>SIGNAL GENERATOR COUPLING</th>
<th>SIGNAL GENERATOR FREQUENCY</th>
<th>BAND SWITCH POS.</th>
<th>RADIO DIAL SETTING</th>
<th>CONNECT VTVM</th>
<th>ADJUST</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 0.003FD</td>
<td>High side to terminal I on L5. Low side to chassis.</td>
<td>50KC (nom.)</td>
<td>2</td>
<td>Tuning gang half meshed.</td>
<td>Use VTVM DC Probe to Point A. Common to chassis.</td>
<td>A1, A2, A3</td>
<td>A1, A2, A3, A4</td>
</tr>
<tr>
<td>2. &quot; High side to stator on center section of main tuning gang. Low side to chassis.</td>
<td>1050KC</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
<td>A5, A8, A7, A6, A9</td>
<td>Replace V3, Adjust A5 for maximum deflection. Then return signal gen. for maximum deflection. Adjust A5, A7, A6, and A9 for maximum deflection, at the new frequency. Rotate the selectivity switch (from step 5 to step 7). The reading on the VTVM should decrease progressively, if not repeat step 1.</td>
<td></td>
</tr>
<tr>
<td>3. &quot; High side to terminal</td>
<td>50KC (nom.)</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
<td>Use speaker as indicator</td>
<td>Turn CW/AM switch to &quot;CW&quot;. Remove pitch control knob. Turn pitch control shaft for zero beat indication on speaker. Replace knob with indicator line straight up. Turn switch back to &quot;AM&quot;.</td>
<td></td>
</tr>
</tbody>
</table>

Turn the BAND SPREAD, VOLUME, TONE, and SENSITIVITY controls fully clockwise. Turn the SELECTIVITY switch to 3.

Leave all other controls as set.

| 10KΩ carbon resistor | High side thru 330Ω to antenna terminal "A". (connect line) | Low side to chassis. | 30MC (400Ω Mod.) | 4 | DC Probe to Point A. Common to chassis. | A10, A11, A12 | Adjust for maximum deflection. |
| " | " | " | 14MC | " | " | A13, A15 | A13, A16, A15 | Adjust for maximum deflection. Repeat steps 4 and 5 until no further improvement can be made. |
| " | " | " | 11.5MC | 3 | " | A16, A17, A18 | Adjust for maximum deflection. |
| " | " | " | 5.1MC | " | " | A18, A20, A21 | Adjust for maximum deflection. Repeat steps 6 and 7 until no further improvement is made. |
| " | " | " | 4.6MC | 2 | " | A21, A22, A23 | Adjust for maximum deflection. |
| " | " | " | 1.925MC | " | " | A25 | Adjust for maximum deflection. Repeat steps 8 and 9 until no further improvement is made. |
| " | " | " | 1400KC | 1 | " | A26, A27, A28 | Adjust for maximum deflection. |
| " | " | " | 600KC | " | " | | Adjust for maximum deflection. Repeat steps 10 and 11 until no further improvement can be made. |
Colin B. Kennedy
Model 20B

- AM broadcast band receiver
- 1929
- TRF architecture
- 7 tubes
- Phono input
- Unrecognizable parts
- Frail cloth wires
- Globe tubes
Model 20B: Re-capping

* Replaced all *electrolytic* and *paper* capacitors

* Resistors and some capacitors are nearly unrecognizable

Sprague ‘Midget’ cap, with nasty bubbles coming out of it

Power supply caps

Top, left-side

Unrecognizable resistors

Paper caps

Bottom

Wednesday, October 21, 2009
had to replace cloth cord
infamous for electrocuting antique collectors
utilized 3-wire computer power cord
grounded chassis for safety
added 3A in-line fuse for fire protection
old cloth and organic rubber wires crumble easily when strained
protection against possible future shorts

Model 20B: safety
bottom, after restoration

added: 3A fuse
added: grounded computer cord
Model 20B: poor documentation

Difficult restoration: only remaining schematic does not match what is in the radio

Regardless of this, it was a success. Listened to the Red Sox game, first time in decades that this radio has tuned in a ball game.
Model 20B: IPOD doc

- Problem: very little music on AM band
- Feature: phono-input tied directly to grid of detector triode
- IPOD wired directly in
- 1920-40’s jazz playlist
- Podcasts; talk radio that you want to listen to
Summary

- Instant conversation piece
- "Real radios glow in the dark," anonymous, generally accepted philosophy in antique radio community
- Unique sound quality for your vintage jazz collection
- Potential for upgrade; IPOD doc
  - celebrating '29 CBK's 100'th birthday soon
- Resources:
  - expert advice: www.antiqueradios.com
  - tubes and parts: www.tubesandmore.com
  - more information about these radios: www.mit.edu/~gr20603 click on Restoration of.... S-76 or 20B
  - e-mail me with your questions: gregory.charvat@ll.mit.edu