February 2017

Reconstructing my Hallicrafters SX-28A

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I say "reconstructing" instead of "recapping" because in my youthful ignorance, I took a perfectly good receiver, stripped it and rebuilt it to my fantasy.

History

I was gifted this receiver at the young age of ten by a friend of the family, hoping that it might lead me to get interested in radio. This gift could be the reason I am what I am today.

Here is a youthful K9CPZ at my first station in 1956 comprising the SX-28A, a Heath AT-1 with a homebrew modulator, VFO and electronic keyer.

Over the following years, in my exuberance, I continued to modify the receiver with all the latest gadgetry to "improve" its performance.

Lately I recognized the error of my ways, and returned the receiver back to approximately its original configuration.

The Modifications, or the horrors I inflicted on this receiver

About the only area remaining relatively unmodified was the power supply and audio section. The entire RF/IF chain was replaced, a product detector included, along with a crystal calibrator and audio notch filter.

The revised front-end included a "hot" 6EH7 frame-grid pentode and a 6X8 pentode mixer including a triode buffer stage isolating it from the 6C4 local oscillator. The six metal octal front-end and first two IF stages were replaced with 7 and 9-pin miniatures. The Lamb noise blanker was removed to make room for other circuits.

The original and modified tube lineups give a good indication of what happened:

Stage	Original	Modified	
First RF	6AB7	6EH7	Frame grid semi-remote cutoff pentode
Second RF	6SK7	6BA6	Remote cutoff pentode
Mixer	6SA7	6X8	Triode buffer, pentode mixer
Oscillator	6SA7	6C4	Triode
First AVC Amp	6B8	-	Dual AVC system not used
First IF	6L7	6BC5	Lamb noise circuit eliminated
Second IF	6SK7	6AU6	

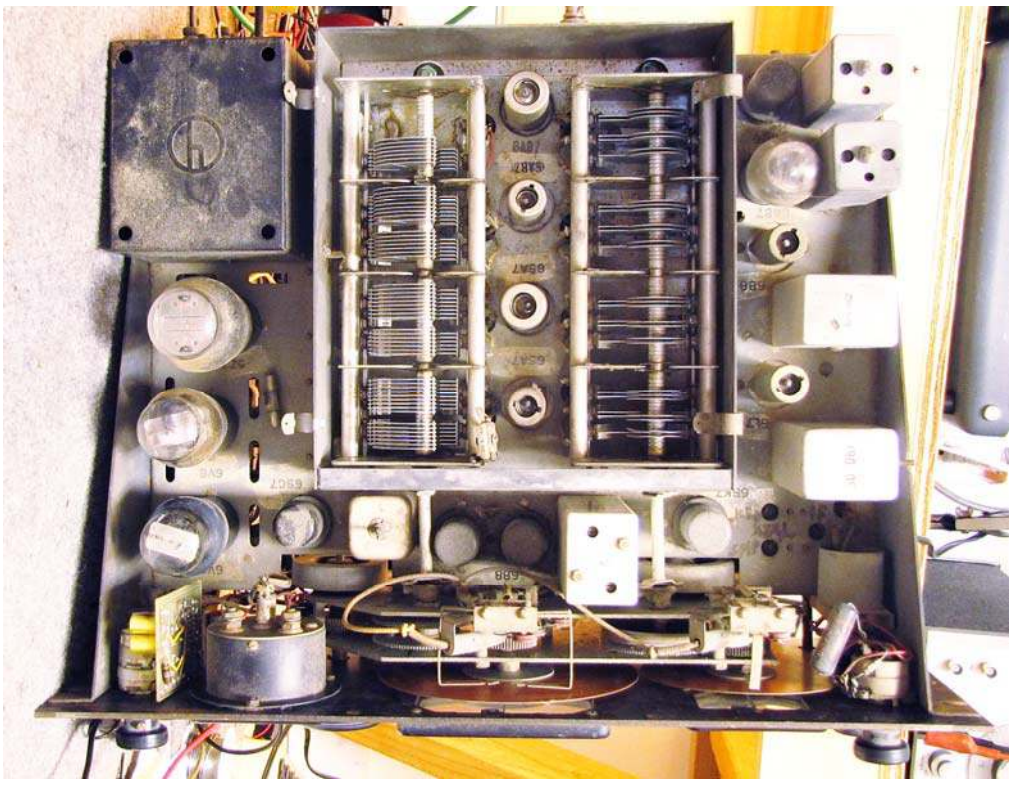
Third IF	-	6AC7	Added IF, detector driver
Detector	½ 6B8	1N38A	
S-meter Amplifier	½ 6B8	6SJ7	
BFO	6J5	-	
Product Detector	-	6SA7	Includes BFO
Noise Amplifier	6AB7	-	Lamb noise circuit eliminated
Noise Detector	6H6	-	Lamb noise circuit eliminated
Noise Limiter	-	2 x 1N34	Simple series diode clipper
First Audio	6SC7	6SC7	No change
Audio Output	2 x 6V6	2 x 6V6	No change
Voltage Regulator	-	VR-150	Added voltage regulation
Rectifier	5Z3	5Z3	No change
Crystal Calibrator	-	TTL ICs	
Audio Notch Filter	-	Analog Op amps	

The radio worked quite well! But it was no longer an SX-28A.

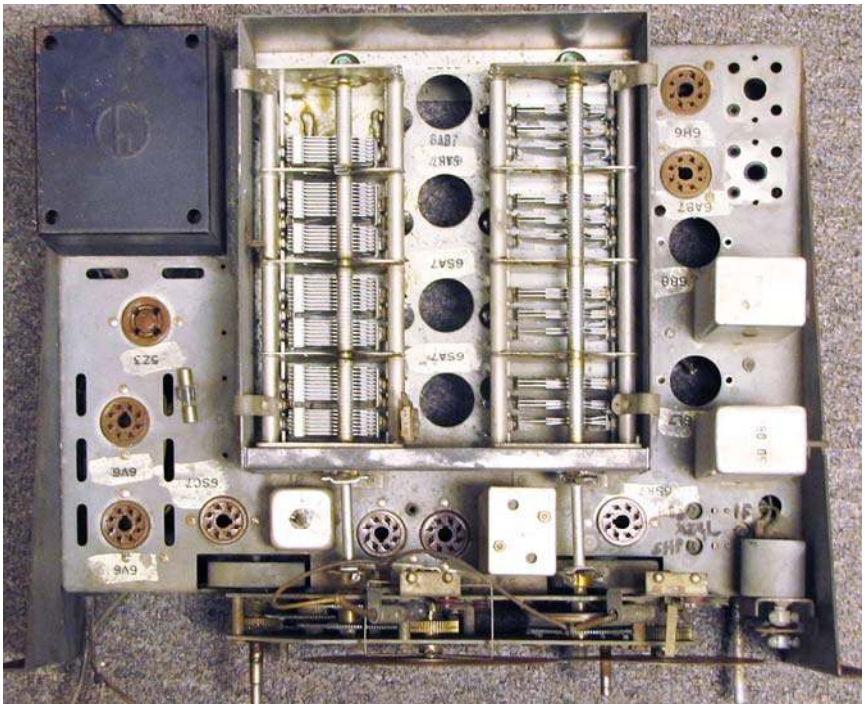
Rebuild

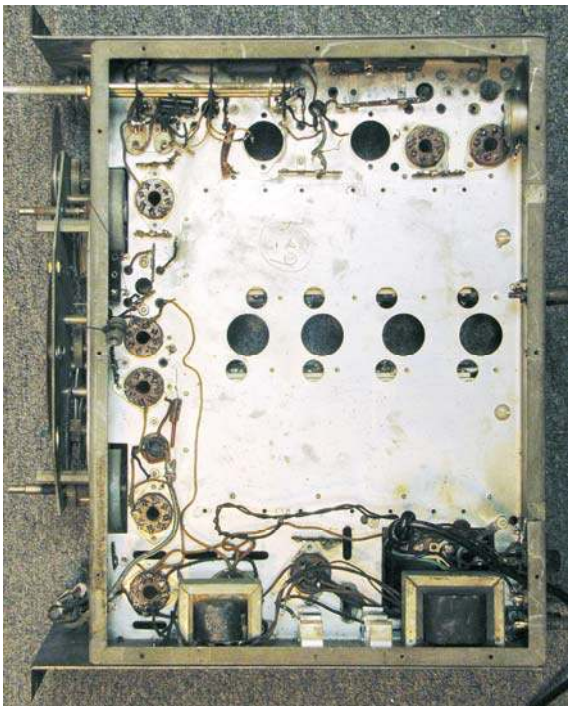
My preference now is to remove modifications, restore equipment to their original configuration and enjoy them as contemporary artifacts of their time. For the SX-28A, this meant stripping it down to bare chassis and rebuilding it from the ground up according to the original schematic. Fortunately, the IF transformers that had been removed decades ago were still in my possession, so the receiver could be approximately recreated as original, the largest difference being the wiring itself.

Here is the receiver with all its added modifications. Note the six miniature tubes in the RF/IF section, new IF transformers in the upper right, near a voltage regulator (and some dirt).

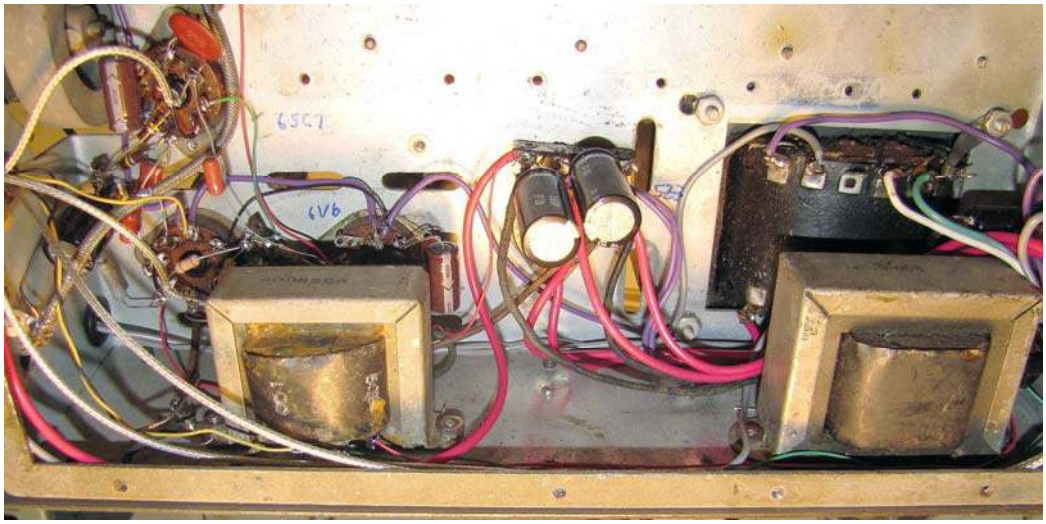


The first task was to strip the receiver and remove and replace the incorrect tube sockets, all the RF modules and the incorrect IF transformers.





The receiver was then built back up, starting with the power supply and audio stages.

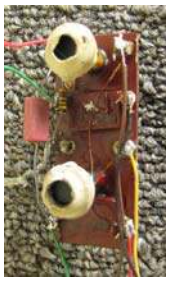


The electrolytic capacitors are replaced by units with high peak current rating on a newly-installed terminal strip to hold them. The audio stages are to the left with the 6SC7 first amplifier and phase splitter and the two 6V6 push-pull output amplifiers behind the output transformer.

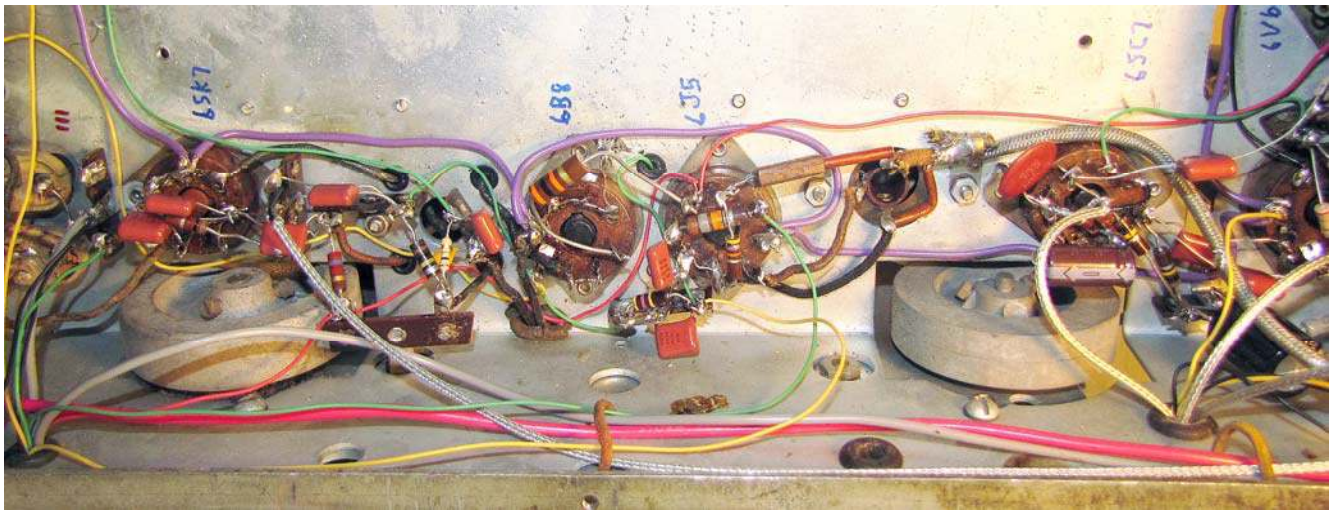
The next stages to be rebuilt start with the detector and work backwards in the IF amplifier chain up to the first IF stage. This way, each stage can be tested by injecting a suitable signal at each point and measuring the gain of each stage before the next stage is replaced.

Each IF transformer is uncased and capacitors replaced.

New leads replace the original wire leads in all of the IF transformers.



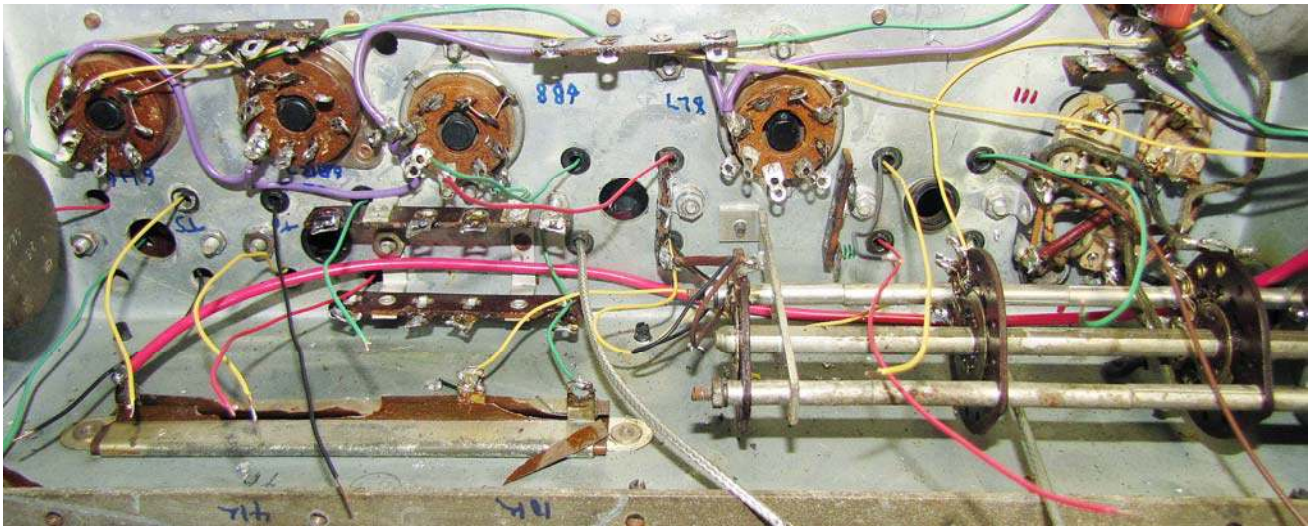
The second IF amplifier is the 6SK7 at the left behind the bandspread flywheel. Following it, to the right, are the 6B8 detector and the 6J5 BFO tube.



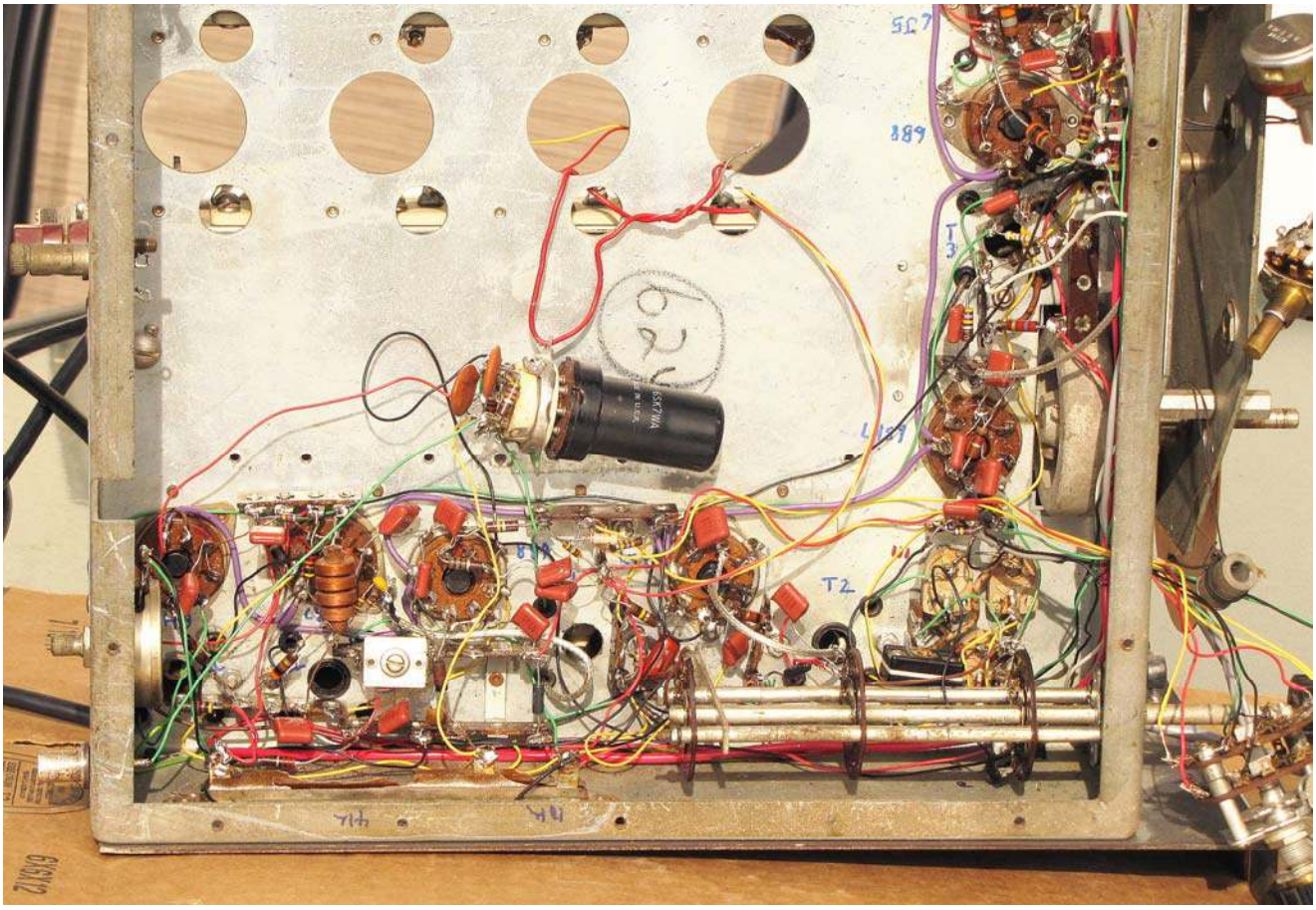
These are connected to the 6SC7 first audio stage, seen at the right behind the main tuning flywheel.

A 455 kHz signal is injected into the grid of the 6SK7 to make sure that following stages are working correctly and have the correct gain.

After these stages have been wired and checked, installation begins on the rest of the first IF amplifier and the rather complex Lamb noise blanker. The crystal filter and bandwidth switch are at the right.



The Lamb circuit detects large noise pulses, rectifies them, and then applies them to a grid of the 6L7 first IF amplifier, cutting the amplifier off. This circuit works very well on impulse noise and suppresses it before it is amplified by the narrow-selectivity IF chain, which broadens impulse noise. This circuit uses several tubes, and is not found in many receivers due to its added expense. These days, impulse noise from automobile ignition systems is largely gone, so the Lamb limiter is of less value in noise reduction.

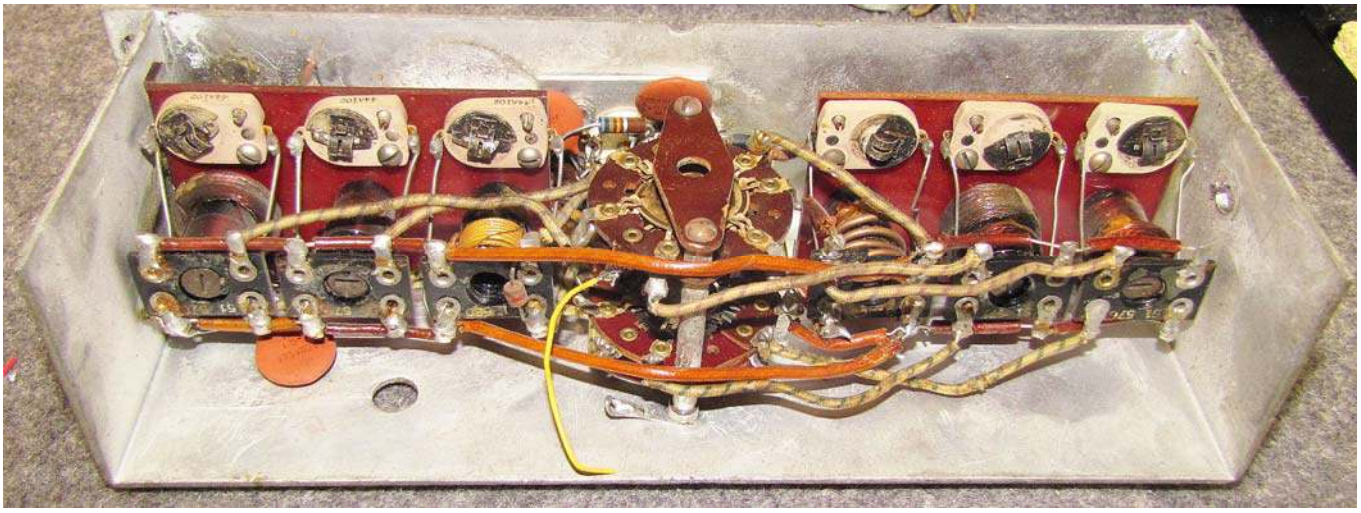


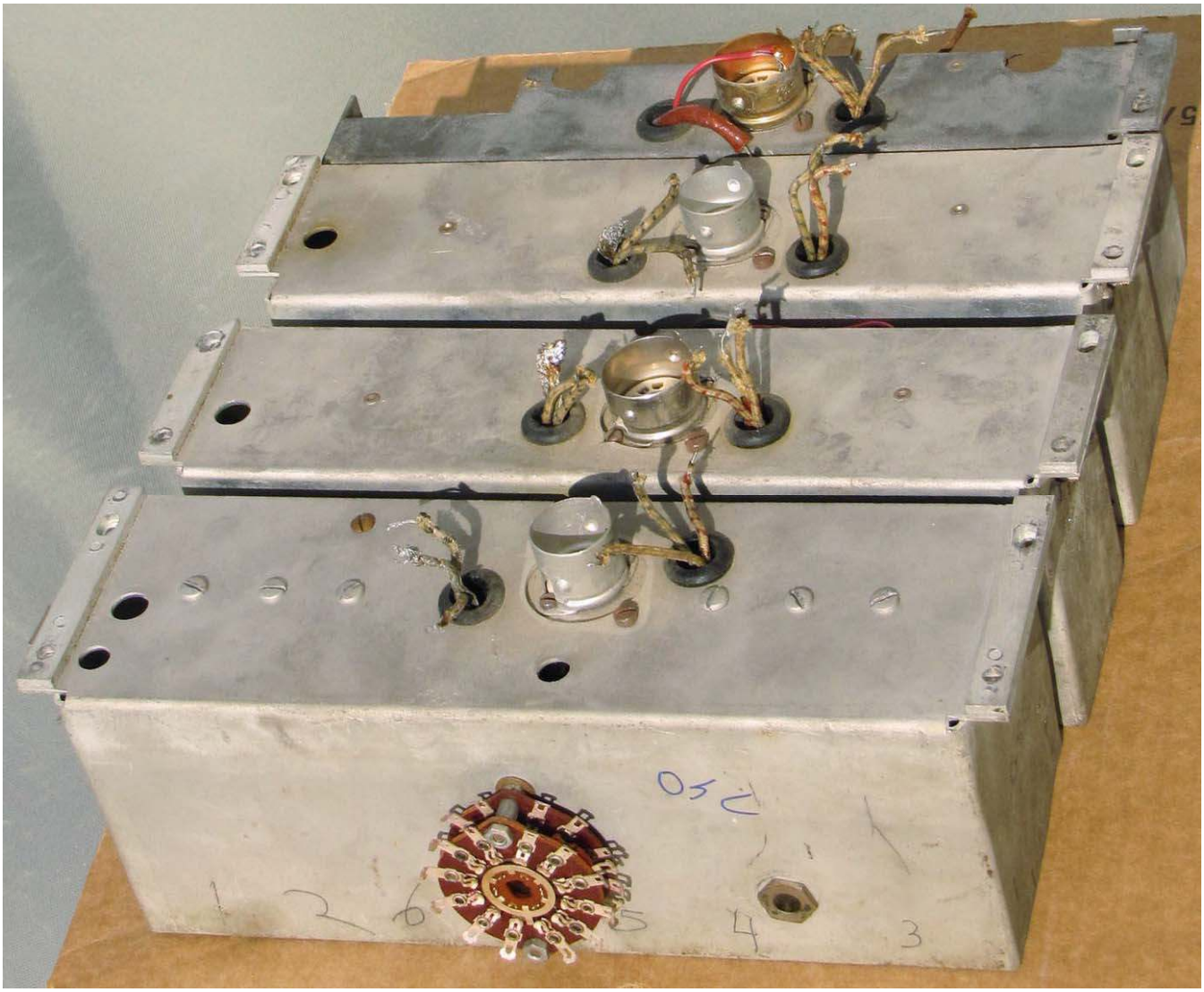
The rest of the IF strip and the Lamb noise limiter is shown here. Off to the right is the mode switch for the AVC and BFO. The original switch was lost, so a 2-wafer switch was configured to support the same functions.

Note the tube suspended in air above the IF strip. This tube, a 6SK7 pentode, temporarily takes the place of the 6SA7 mixer, not yet installed, and loads and drives the primary of the first IF transformer with the correct driving impedance so that the IF gain can be measured and the primary of the transformer can be correctly tuned.

The SX-28A uses an unusual dual AVC system. One system senses the signal strength right after the mixer, before the narrow-band IF and controls the gain of the RF amplifiers. This system starts to function significantly off frequency before any strong stations are within the narrow bandwidth of the IF strip. A second independent AVC system detects the signal strength at the end of the IF strip and controls the gain of the IF amplifier. This system helps to control RF overload and cross-modulation in the RF amplifiers by reducing the RF gain for strong off-frequency signals.

Finally, the modified RF modules are returned to their original configuration with octal tubes.

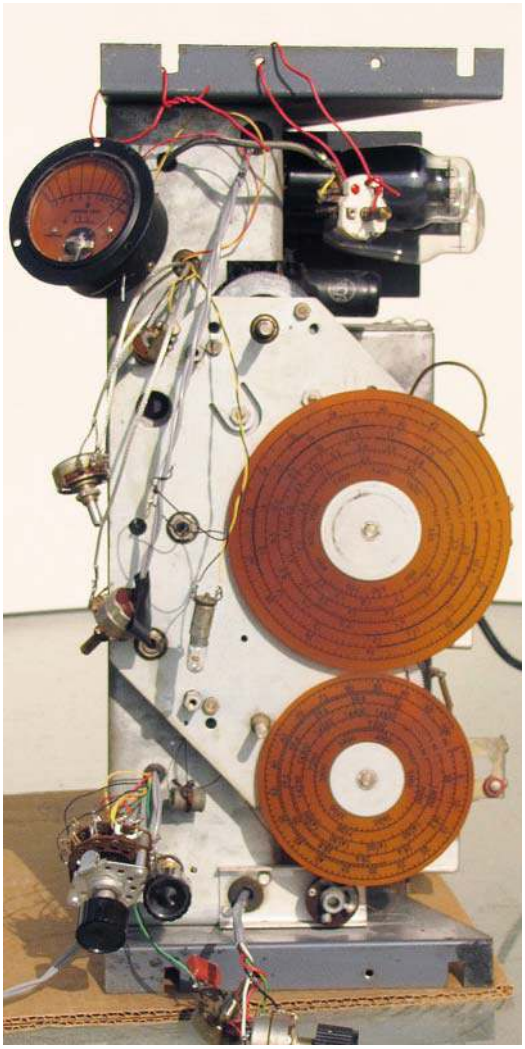


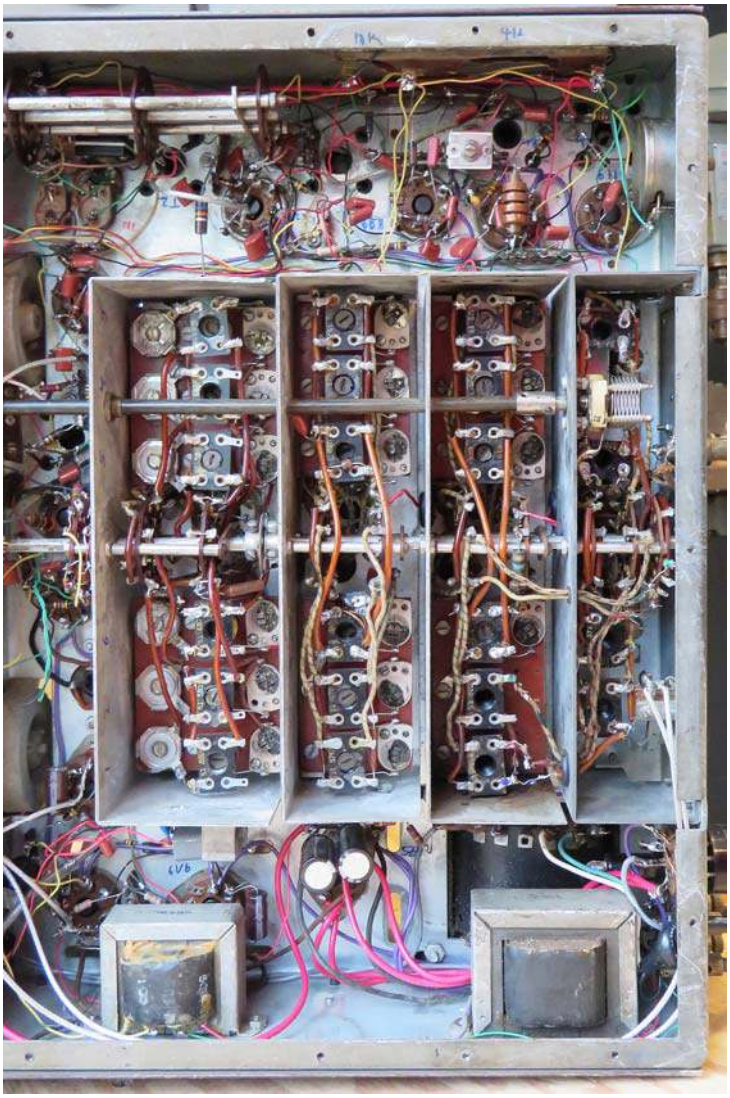


The miniature tube sockets are removed and the original octal sockets reinstalled. The original wafer switch at the front of the oscillator module has been lost. It controlled the IF gain separately for each band, as well as the RF AVC action for each band. New switch sections were found and configured to support these functions.

The capacitors in each of the RF modules were replaced. The receiver is shown here without front panel with all controls temporarily hooked up, along with the S-meter for an initial checkout

The audio volume and RF gain controls hang off to the left, the ANL control at the bottom, and the BFO variable capacitor at to near the 6V6 output tubes. The AVC/BFO switch hangs off at the lower left.

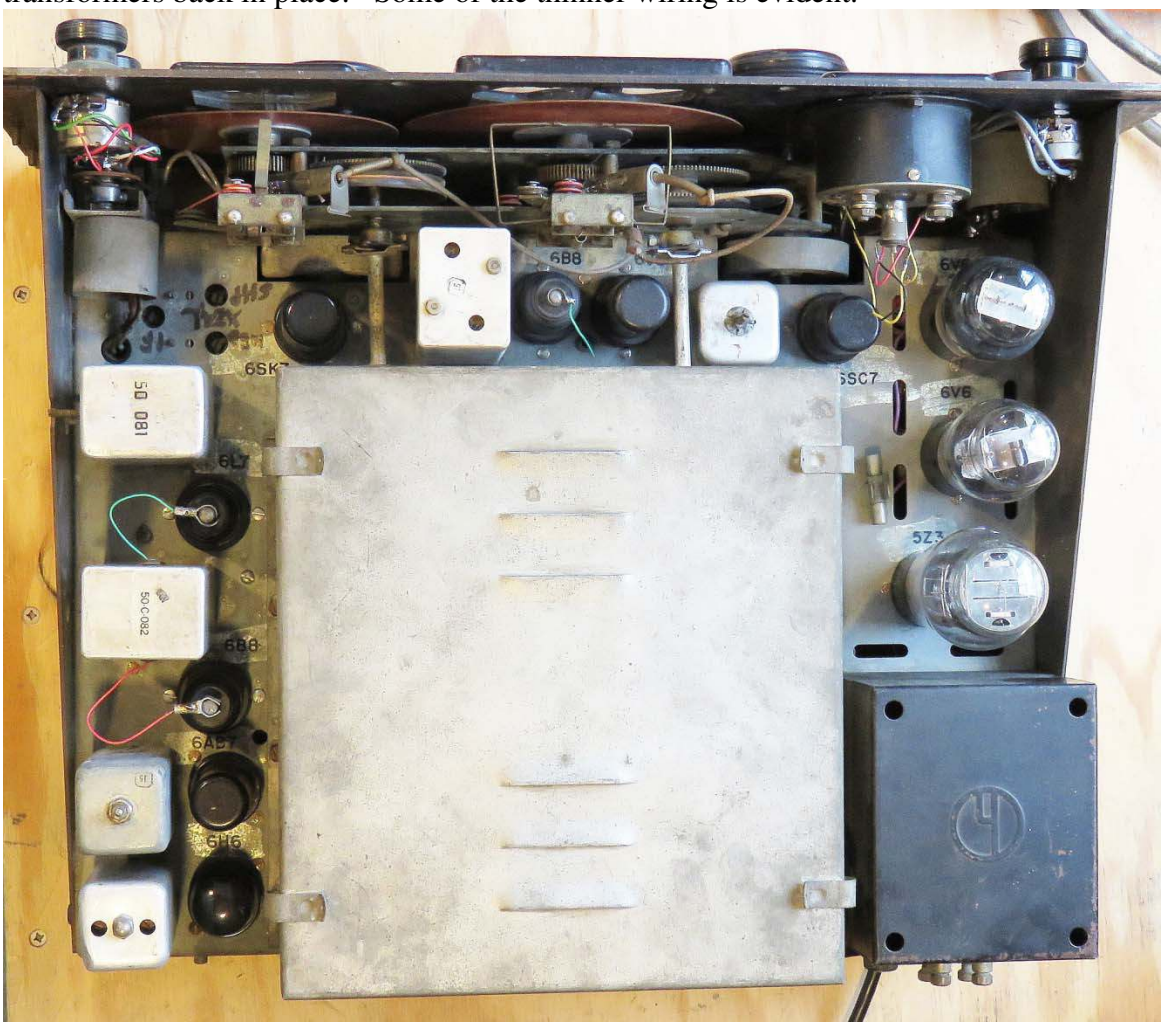




After final assembly, the bottom of the receiver shows the RF/Mixer/Oscillator coil assembly.

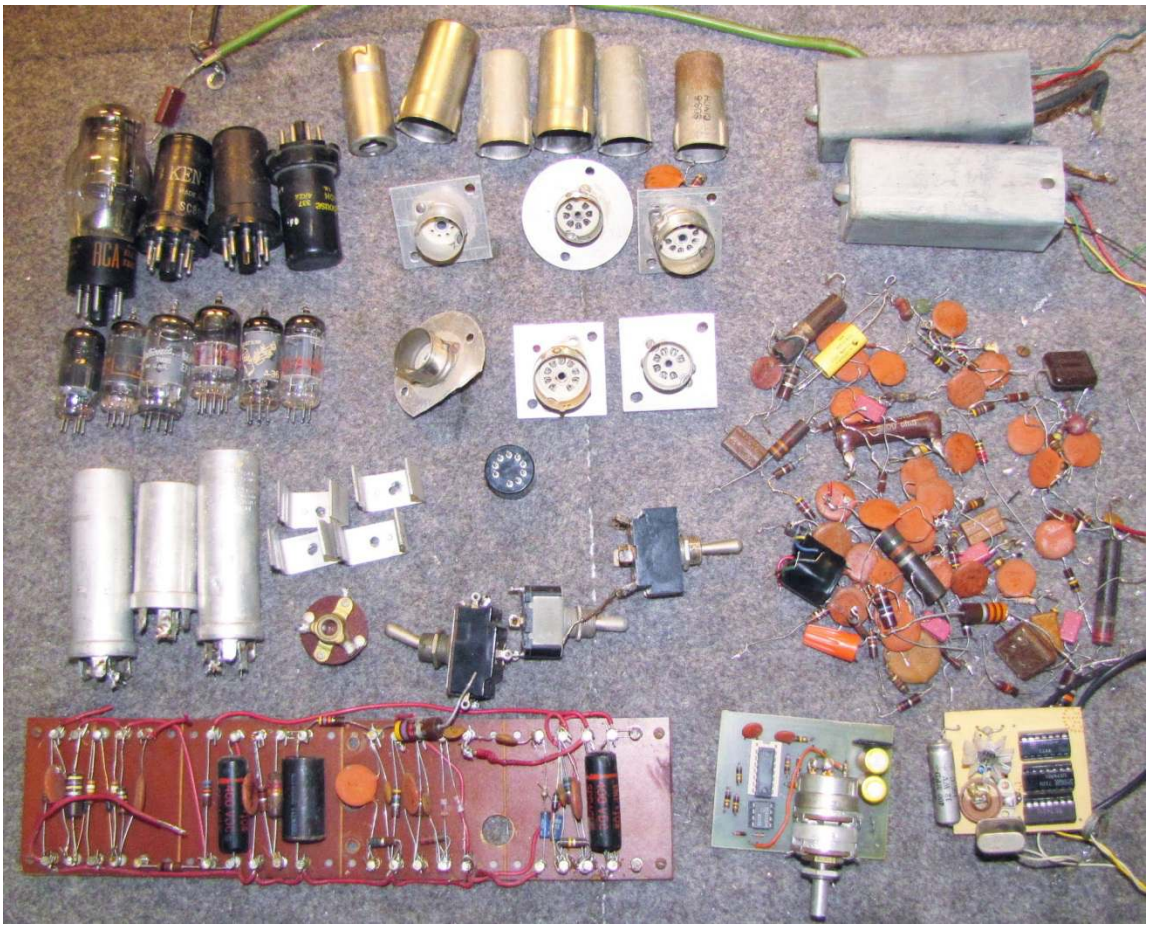
With smaller passive components and wire with thinner insulation, the receiver appears much roomier underneath than the original.

Looking down from the top, the receiver now looks more like the original, with the original IF transformers back in place. Some of the thinner wiring is evident.

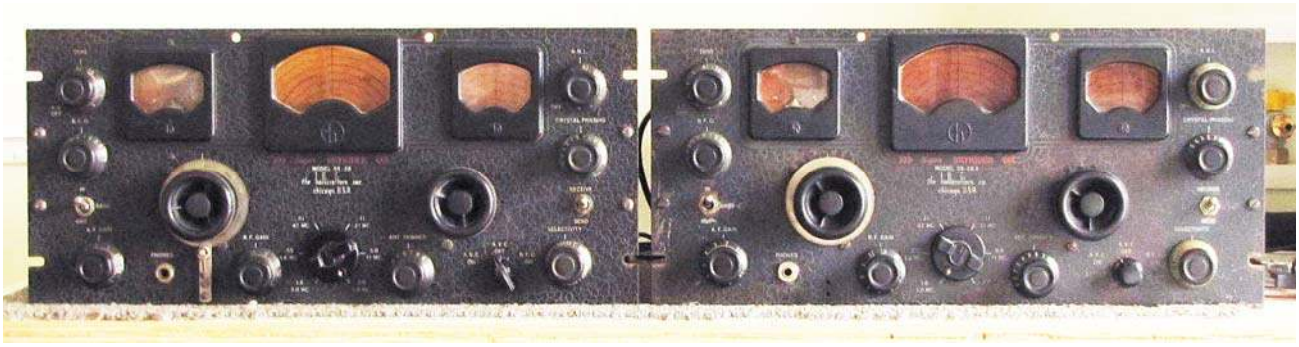


With the RF shield cover removed, the original metal octal tubes occupy the RF section, oscillator at the top, first RF stage at the bottom.

What parts came out of the receiver after the un-modification?



Six miniature tubes and their hardware, many passive components, a pegboard with several components from the modified IF/audio sections, an op-amp audio notch filter, and an IC-based crystal calibrator giving 100 and 500 kHz markers.



The SX-28A now sits proudly next to my unmodified restored SX-28 (both out of their cases). Both receivers work very well and are fully competitive with other premium receivers of their vintage.