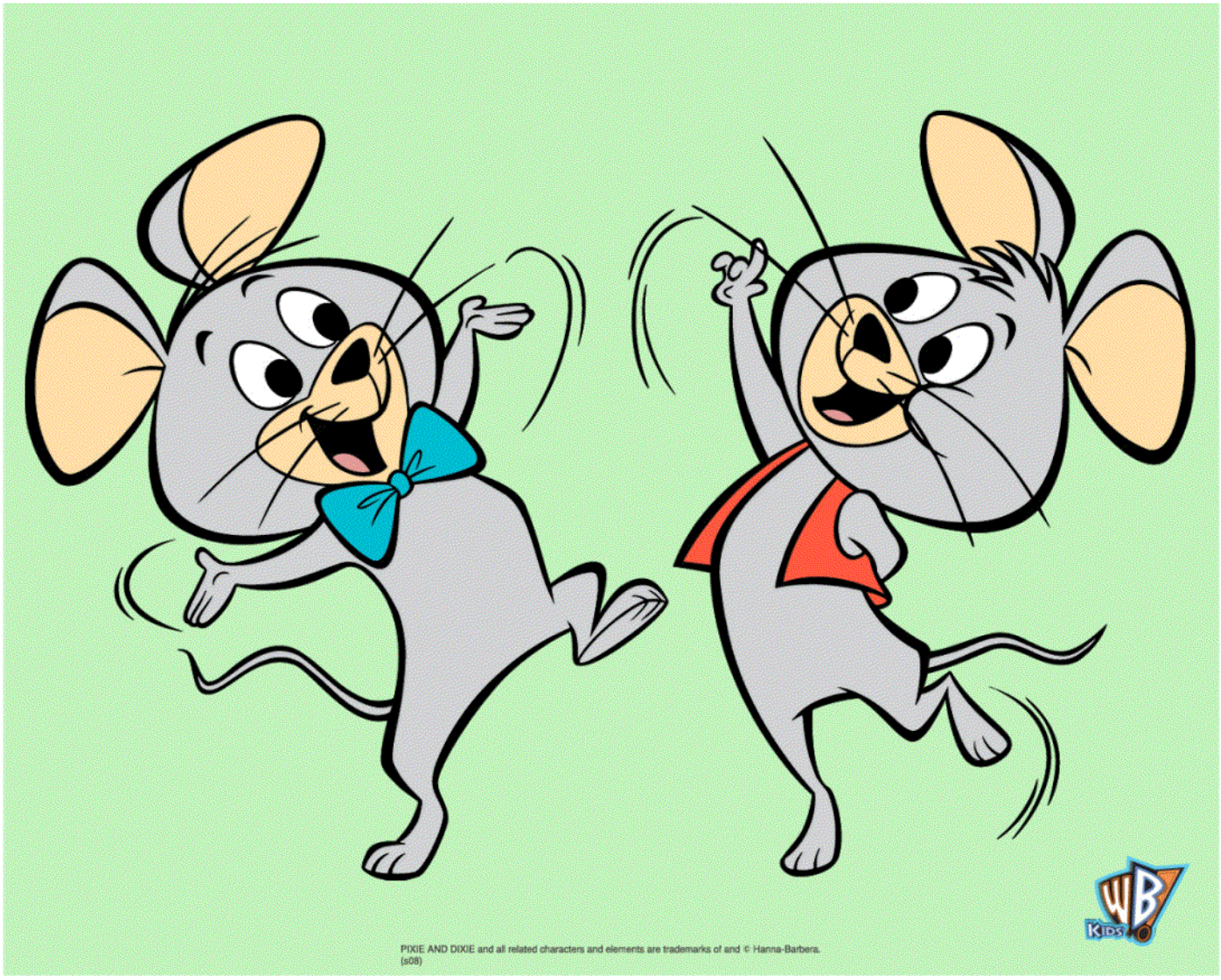
Restoration of a 1921 Westinghouse model RC

by
Jean Marcotte
for

SQCRA

Pixie, Dixie and...



mister Jinks.

Once upon a time were two mice, Pixie (female) and Dixie (male) wandering in a barn.

They came across a beautiful wooden house known as a Westinghouse RC radio from 1921.

They settled in that house and had a very prolific lineage.

But mister Jinks was on the watch!

This is the third edition of the International Restoration Radio Contest held by our association, the SQCRA. The way our association chooses the participant in the international constest is by the mean of a local restoration contest. The winner of the first prize is “the” participant of the international contest. Unfortunatly I won the first prize this year and I now have to prove that my radio is the best in the world. So let’s keep in mind that it is not the work of a group but of a single person.

Now, I am pretty much of a newbie in the field of restoration since it was only my second participation in the local contest.

On my first participation I ended 4th, just short of a beautiful ribbon, probably because my radio was not enough of a wreck.

So, in that very same event, I bought this Westinghouse RC in a doubtful condition and decided that it would be my contest radio for this year. I was not aiming for a prize then. It was a challenge for me to have such an old radio working as I had never worked in a radio of that era. Regeneration and variometer were like chinese to me.

First, a bit of history

Westinghouse cross-licensed with GE/RCA in 1920, offering the Superheterodyne patent and the Regenerative Detector patent as their end of the agreement. Commercial Radio Broadcasting was about to start with Westinghouse's KDKA radio station located in Pittsburgh, Pennsylvania going on the air in November 1920. The first radio offered to the public for listening to the new broadcasts from KDKA was some gear that Westinghouse had built for ham market (radio amateurs.) The hams were less than enthusiastic about the RA and DA sets as ham receivers. So, lucky for Westinghouse, here was a new market for these sets - the Broadcast Radio listeners. These neophyte-listeners weren't nearly as critical as the hams were and the RA and the DA sold quite well. By mid-1921, Westinghouse had combined the RA-DA into one cabinet and designated this model the RC. The RC was produced well into 1922. Westinghouse also offered an Antenna Tuner (RT) and an RF amplifier (AR) in matching boxes, that is, matching the RA-DA.

The circuit uses three 1A pure tungsten filament tubes, a UV-200 soft detector and two UV-201 hard amplifiers. Regeneration is via a tap switch. Performance is dependent on how good the tubes are. Pure tungsten filament tubes can't be rejuvenated and when the tungsten is exhausted of its ability to emit electrons, the tubes no longer function (even though they will "light up.") With good emission tubes the RC will perform adequately but it isn't very selective. This is due to the single-circuit tuner used. The addition of the RT and the AR improve selectivity and over-all performance. However, this "component" approach, while popular with enthusiasts, didn't appeal to the regular Broadcast listeners. (from www.radioblvd.com/20sRadio.html)

So here we start. We know the radio won’t be selective and won’t be sensitive nor powerfull.

So here we are with the radio in the state I found it.

Doesn’t look like a big wreck yet. The left part, the RA section is the tuner. It is a passive unit with a variometer, two variable condenser and a 31 position switch for the regeneration. By the way, all three controls are frozen.

The right part, the DA section, is a three tube unit, the detector tube and two audio amplifiers with the associated parts, the grid leak unit, a condenser, two audio transformers and two rheostats.

More pictures in the next two pages.

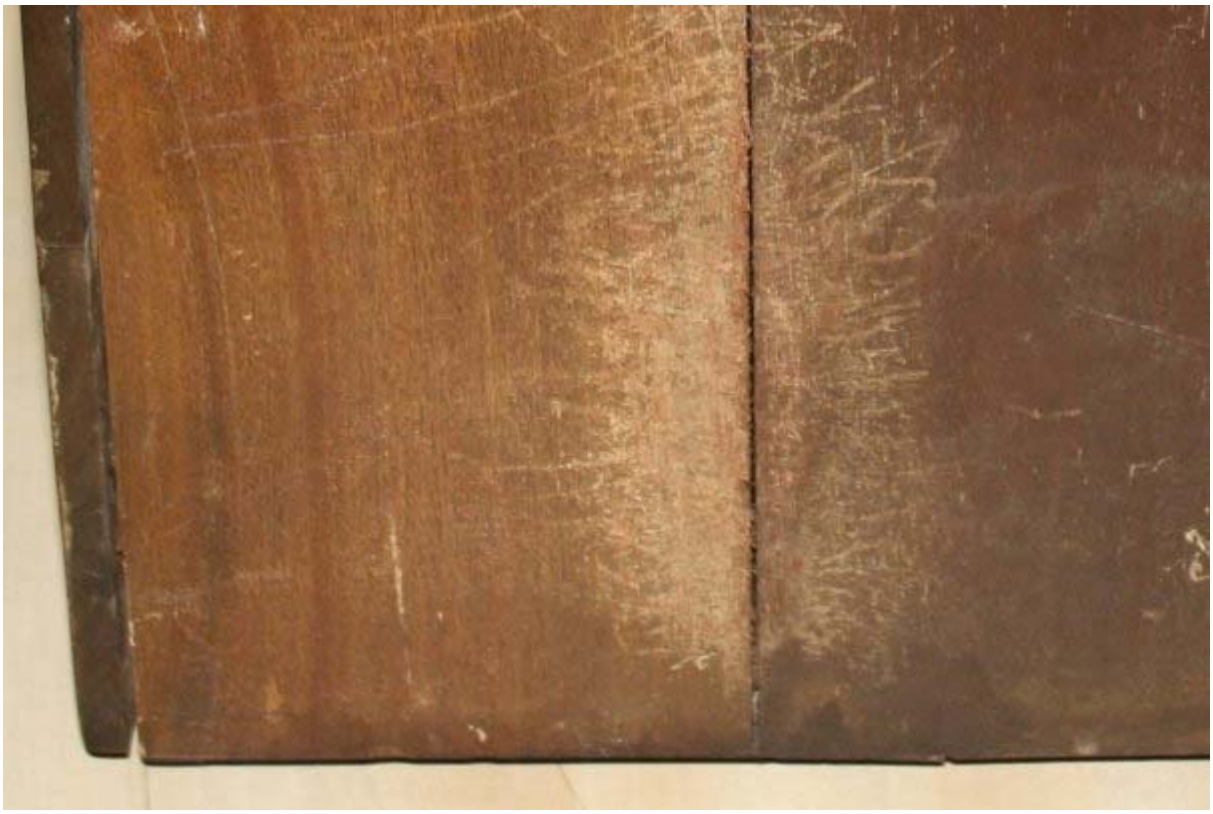
View of the top. The mice enlarged the hole to be able to enter.

A view of the back.

Detail of the back showing numerous cracks.

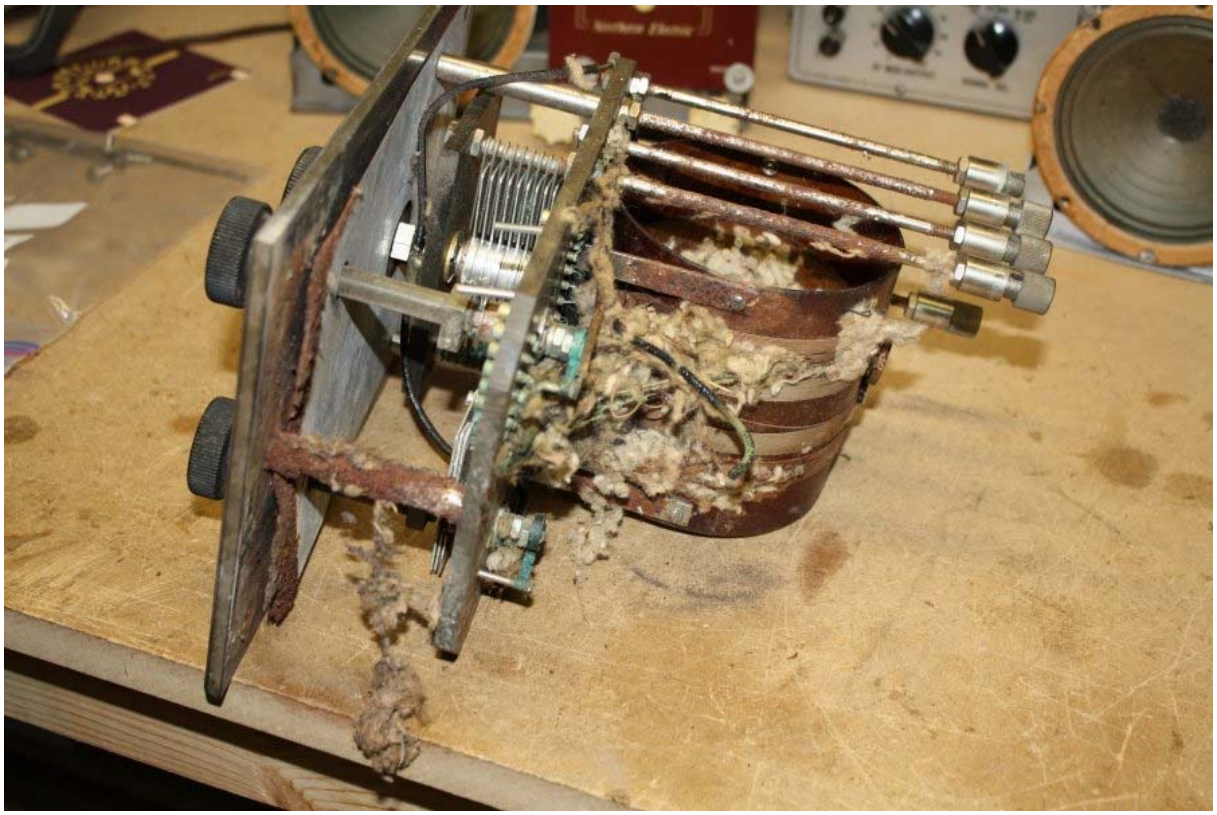
Left and right side. Cracks again and back unglued and warped.

Detail from the left side showing a large crack. This is where Mr. Jinks appears. He definitely could ear and smell the mice through the crack. He tried hard to get to them by digging with his claws in the wood and caused a fairly deep recess in the wall. Unfortunatly he was not smart enough to open the door on top.

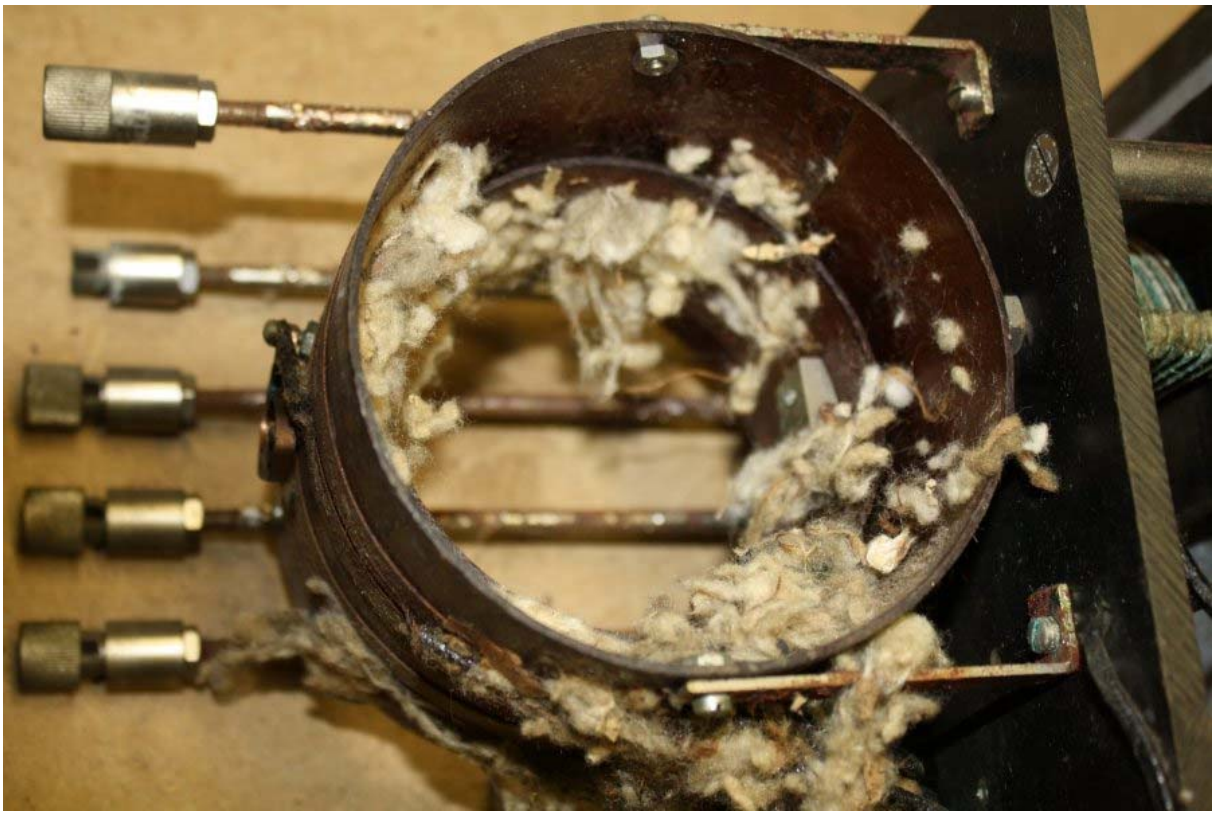


But enough for the case. Let’s open this baby and see what we will find.

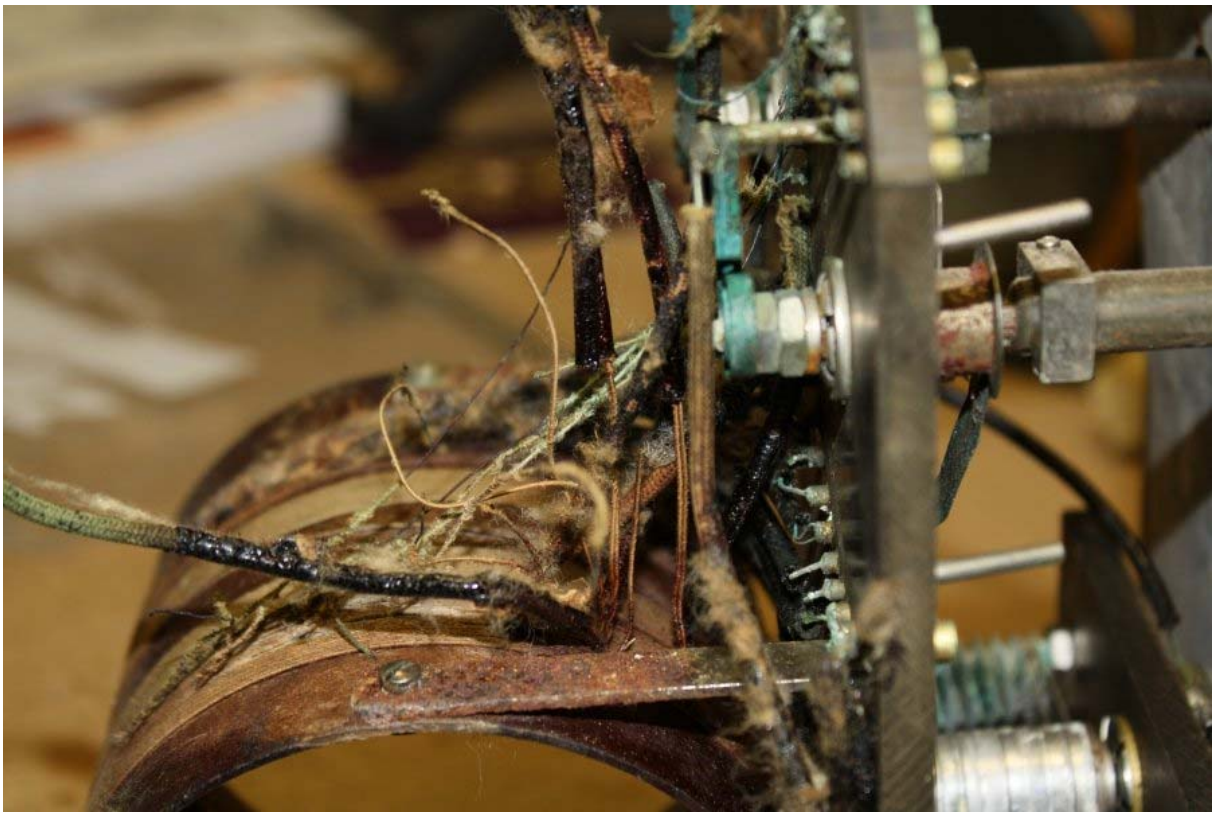
Views from the inside of the RA module.



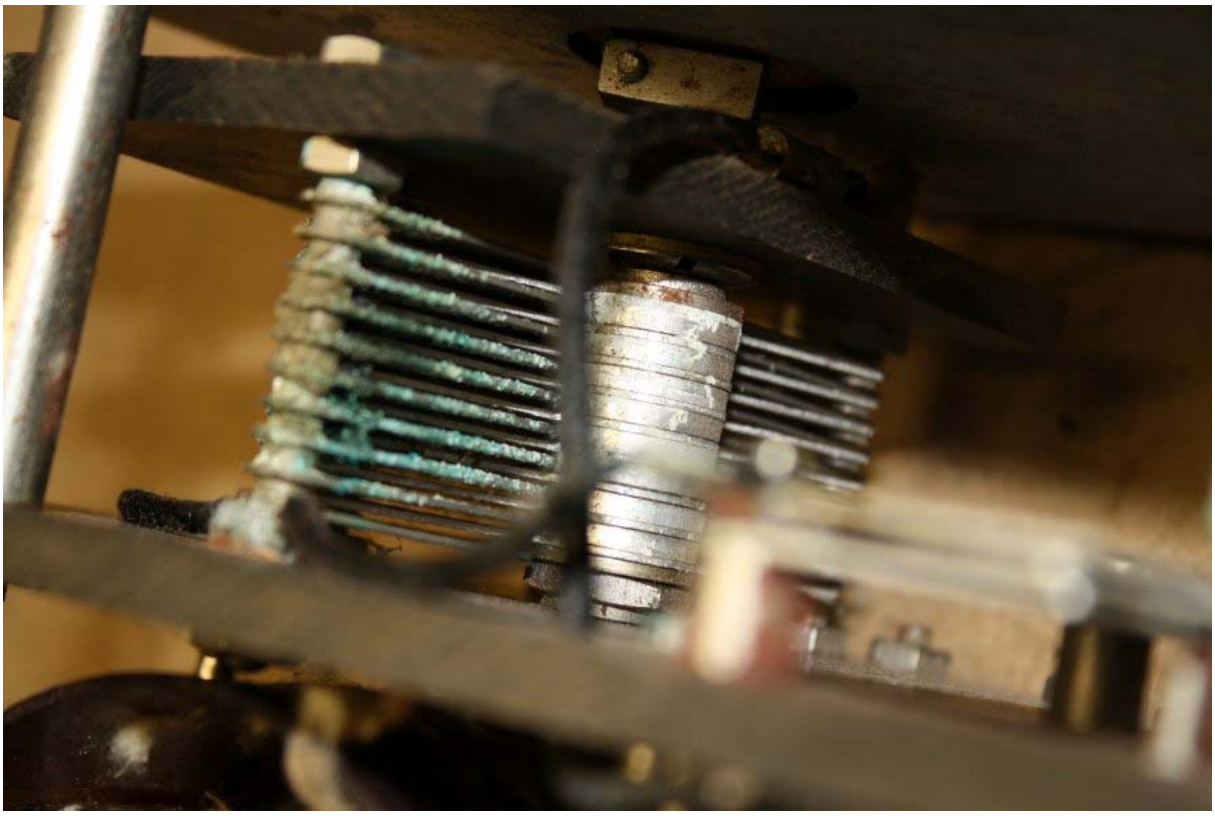
The variometer.



Such a simple circuit...



One of the variable condenser.



The other one. Now we know why the controls are frozen.

Restoration of the RA module.

The key part in this module is the variometer. It works in conjunction with the larger variable condenser (common shaft).

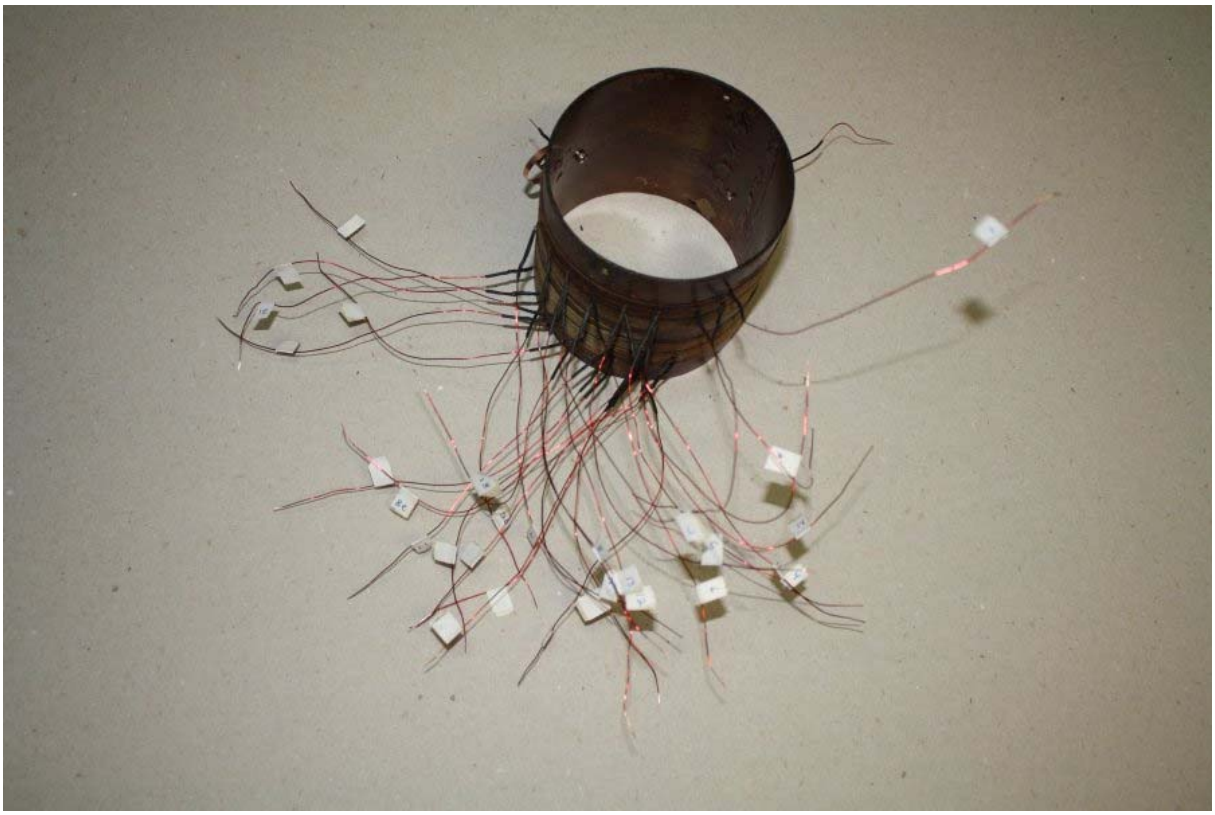
The fixed portion of the variometer has two coils separated in four windinds (see picture below). The two center windinds are the antenna coil and did not suffer from the mice.

The two outer windings are for regeneration and have 31 taps that go to the 31 position switch. Only 7 of those were still connected to the switch. The rest was eaten by the acid of the mice urine. Furthermore, the mice ate the insulation on most of the wiring because it was covered in lacquer and, apparently, it tastes good for them (I never tried).

So, my first challenge was to disasemble the variometer without damaging it further. After clean-up, I used what was left of the taps to solder new wires to go to the switch (see next page).

Variometer disassembled and cleaned.

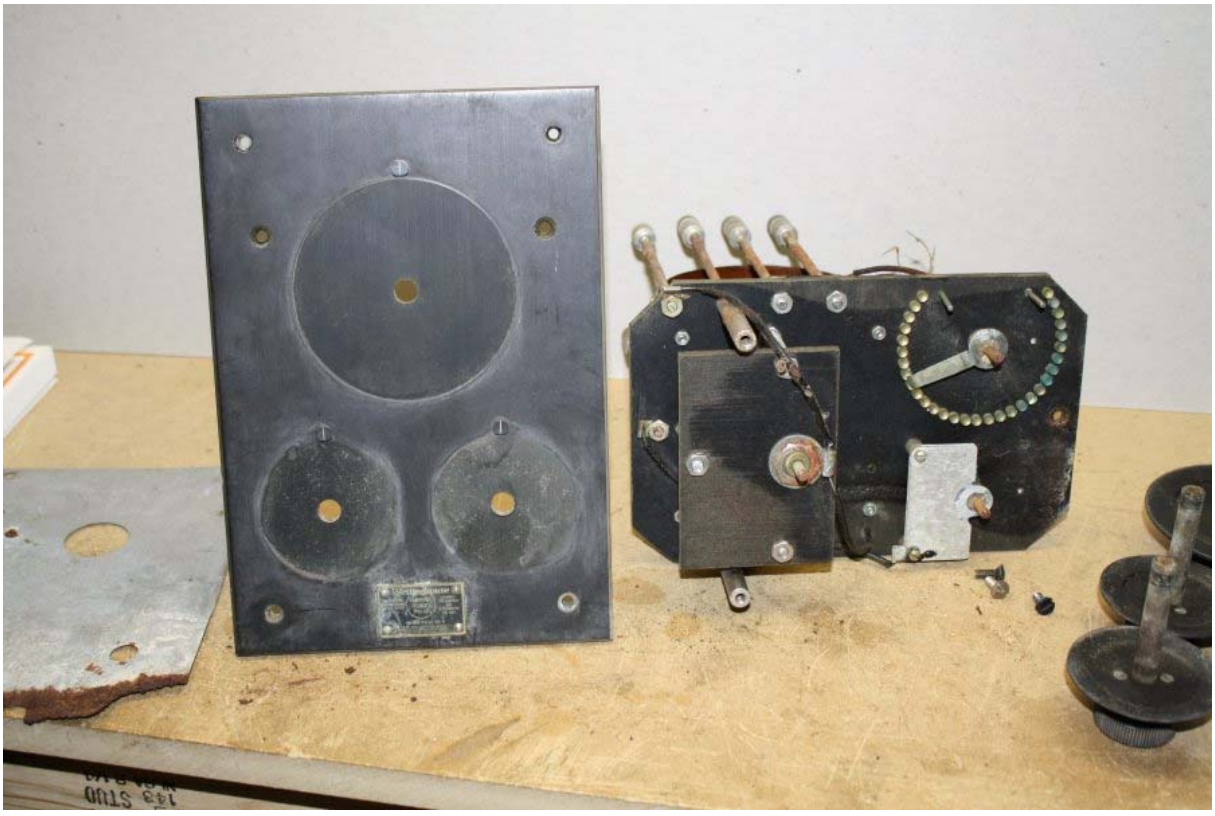
The fixed coils with 31 new taps well identified.



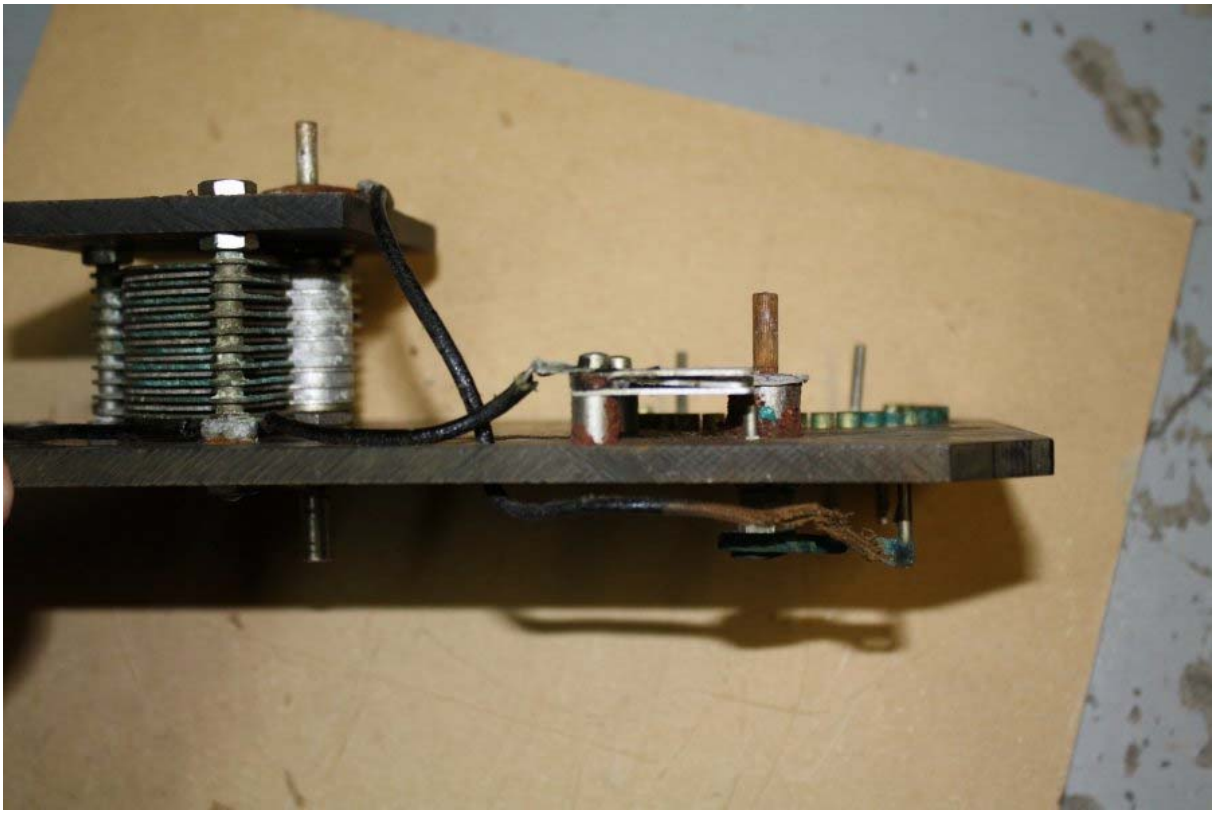
At this point, I realize that I took almost 600 photos of the radio, most of them to remember where all those wires go and some others to show the steps I had to take to end up with “the best radio in the world”.

In the next pictures I will try to demonstrate that each part of this radio had to be disassemble, cleaned, and reassembled. Any part containing iron was rusted and the parts made of copper or brass were green from corrosion. Even the screws needed cleaning. I don’t think I need to describe in words all the work I had to do. The following pictures should do the job better than me.

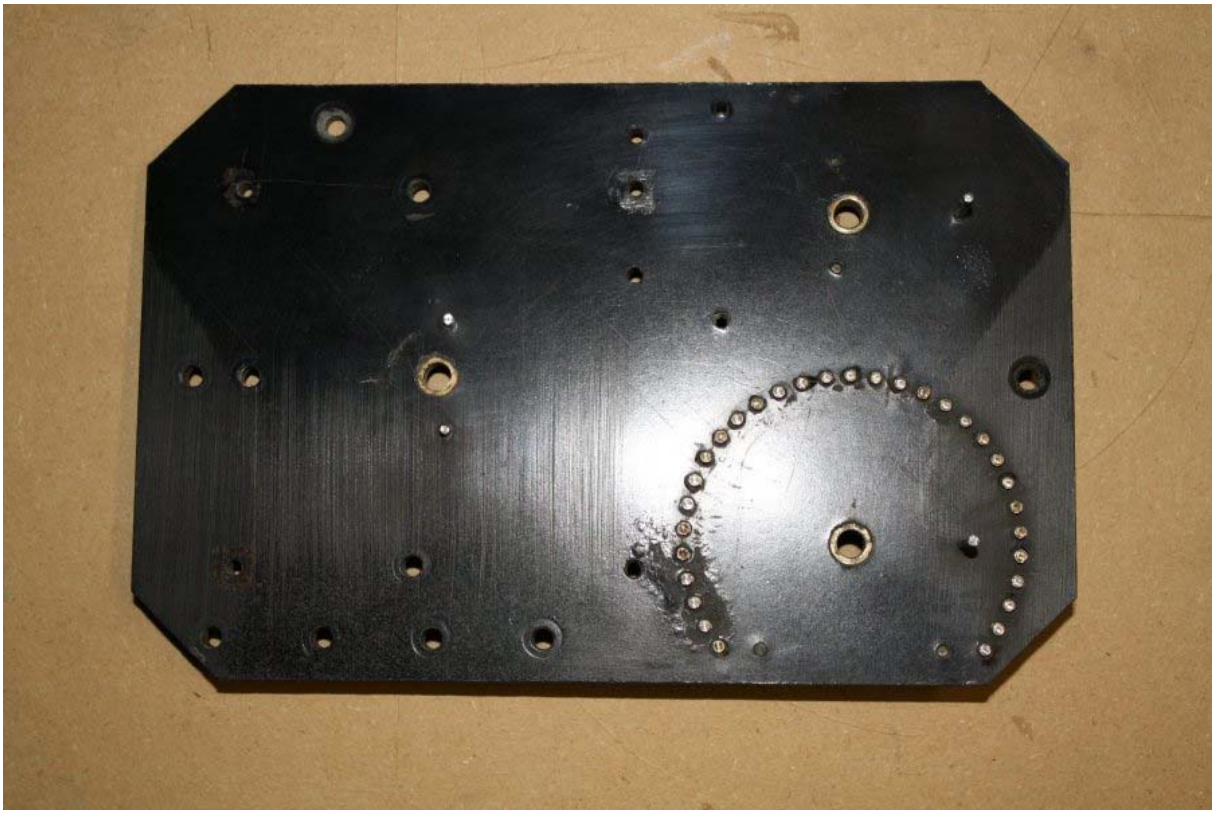
Controls, faceplate and shield removed.



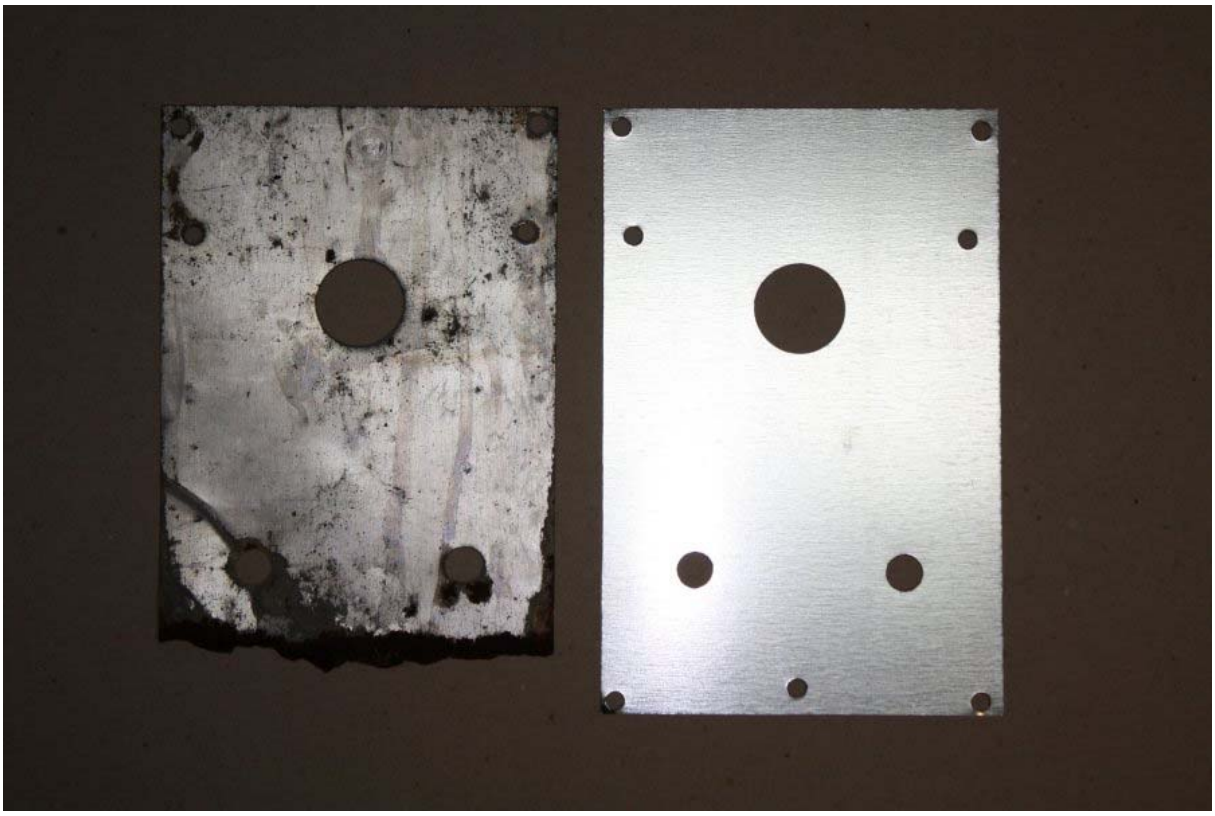
Main board of the RA with only the two variable condensers.



Main board stripped of all parts and cleaned.

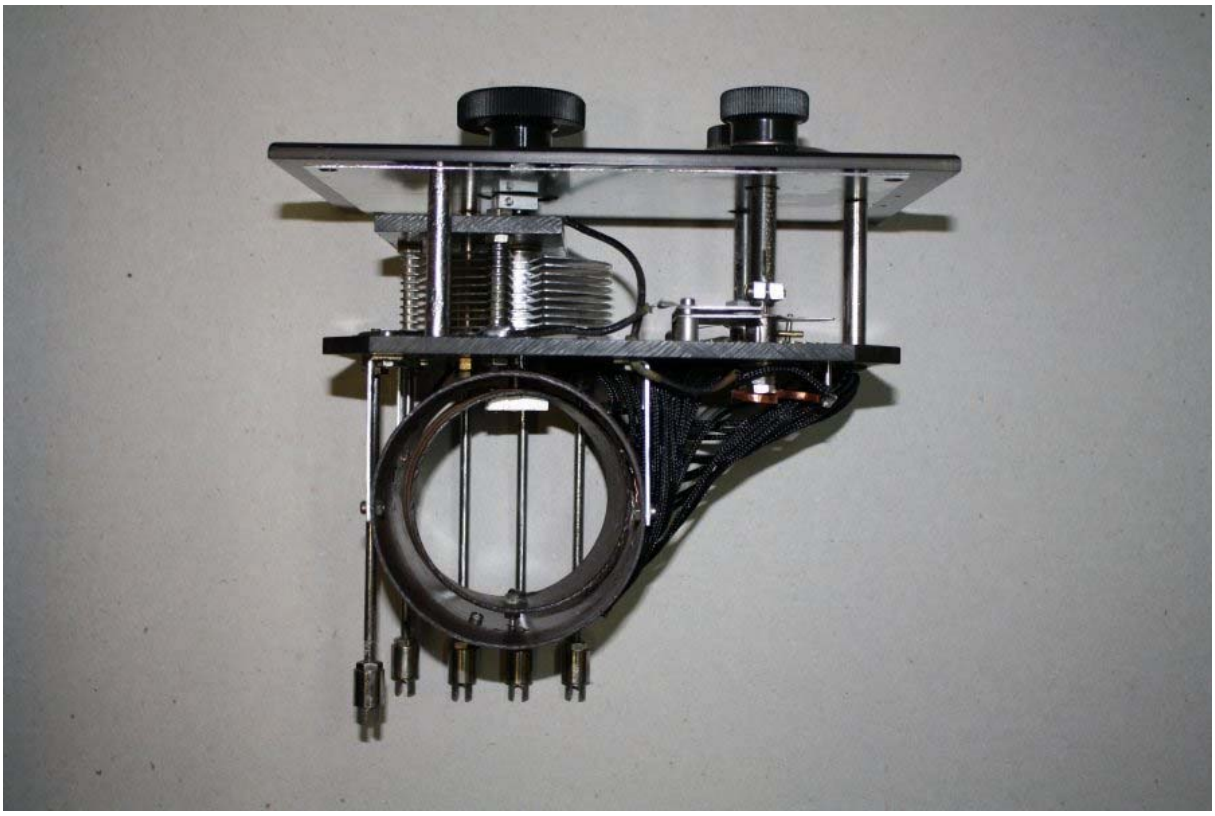


The original shield and the replacement.



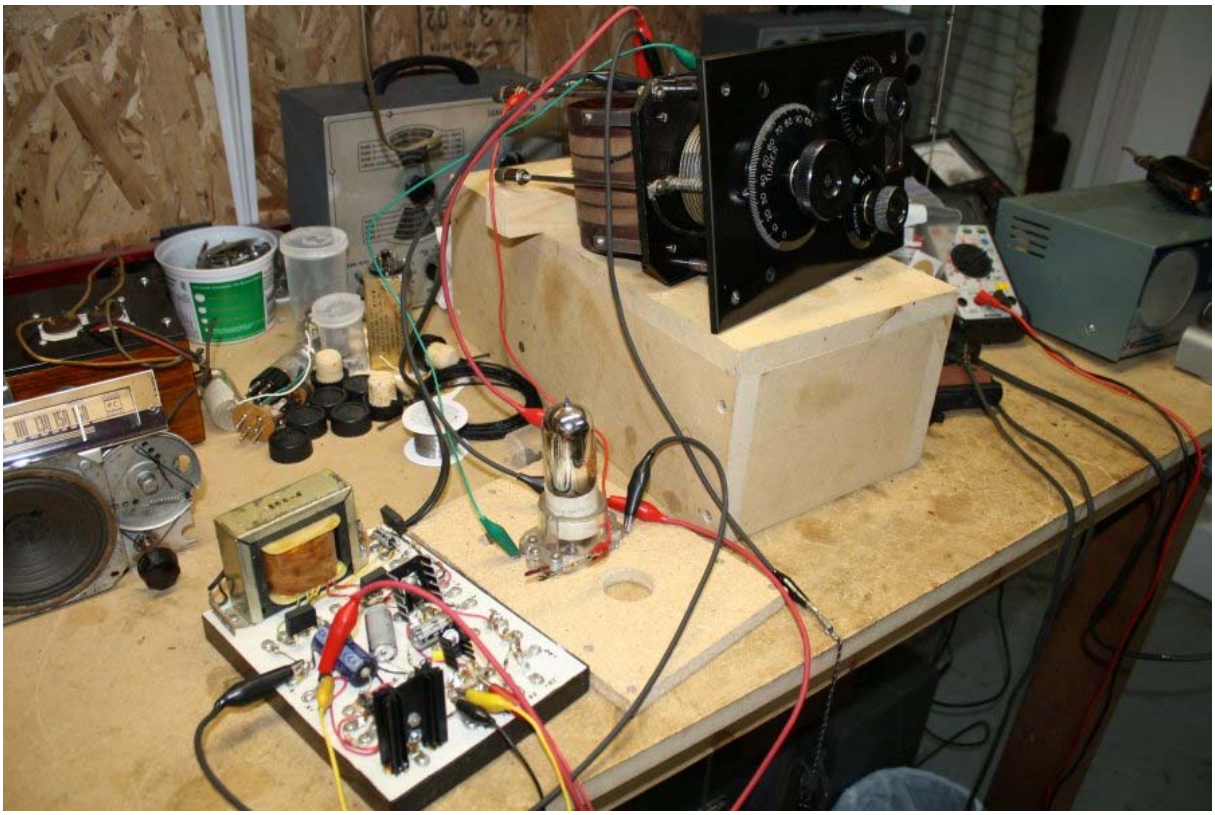
The three collars holding the knob’s shafts were cracked.

The RA module with all parts cleaned, polished and reassembled.



Another view.

This is pretty much all I can say or show for the RA module (although I could have added a hundred more photos of all the bits and pieces of the restoration). At that point, I wanted to know if the module was working as it should. I am by no way a technician or even less an engineer in electronics. So I wired my EICO signal tracer to the RA module to see if I could get radio signals from it. I was overwhelmed with joy when I heard my favorite AM station. Then I realized that the regeneration control had no effect on the reception so I thought I had missed something.I sat back and tried to figure out what because no coils were open and all the contacts were OK. It is when I looked again at the schematic that I realised that regeneration comes back from the detector in the DA module. Like you wonder why your radio is not working and you find out it is not plugged in (was I then proud of myself). So I replicated the detector stage of the DA on a breadbord and, using headphones and an Arbe II power supply, had it working as it should.



Restoration of the DA module.

The DA module consists of three tubes mounted on a plate that is suspended by rubber bands to avoid microphonic interference. The front tube is the detector and can be a 00 or a 01. The other two are audio amplifiers and are, of course, 01's. The later version of this model used 01A's for the amplifiers but retained the 00 as detector. For my part, I did not have any 00, but I had two 01's. One was dead and the other one had a good filament but zero emission. I have about a dozen of 01A's but none would go in the green section of the tube tester. I ended-up using the three Deforest Audion DL4's that were in a Crosley 52 radio that I bought a few years ago. They are direct replacement for 01A's and are know to be superior in RF use wich is not the case here.

If I were to use a 6 volts supply for the filaments as was the case with storage batteries at the time, I would have had to change the rheostats for ones with a higher resistance or rewind mines with a finer wire. In front of me, on a shelf was a 5 volts 1 amp. regulated power supply. That solved the problem and at the same time I was able to keep the original rheostats in the radio.

My radio came with three 199's tube with tube adapters. They probably didn't last more than five minutes in that radio for they received the full 6.3 volts. None had a good filament.

The rubber bands holding the plate were dry and broken and the fine flexible wires that linked the sockets to the rest of the module were all gone. Again, such a simple schematic but so much wire in that module, a very interesting puzzle.

I expected a miracle but was rewarded with both transformers open, primary and secondary. I am not equiped for rewinding transformers and they use around 15 000 turns of number 42 wire wich is just a tad smaller than one of my hair.

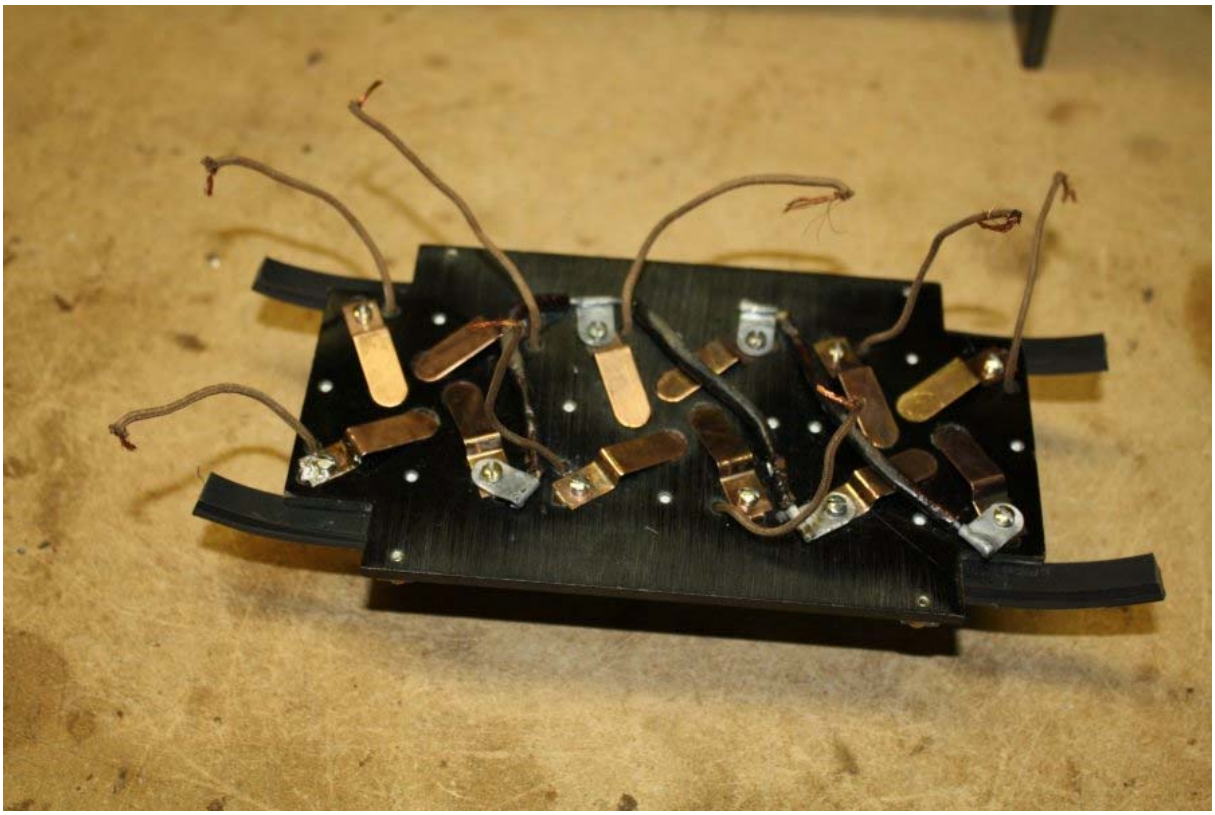
Now let's go inspect the DA module.

A view from the side.

A more inviting view from the bottom.

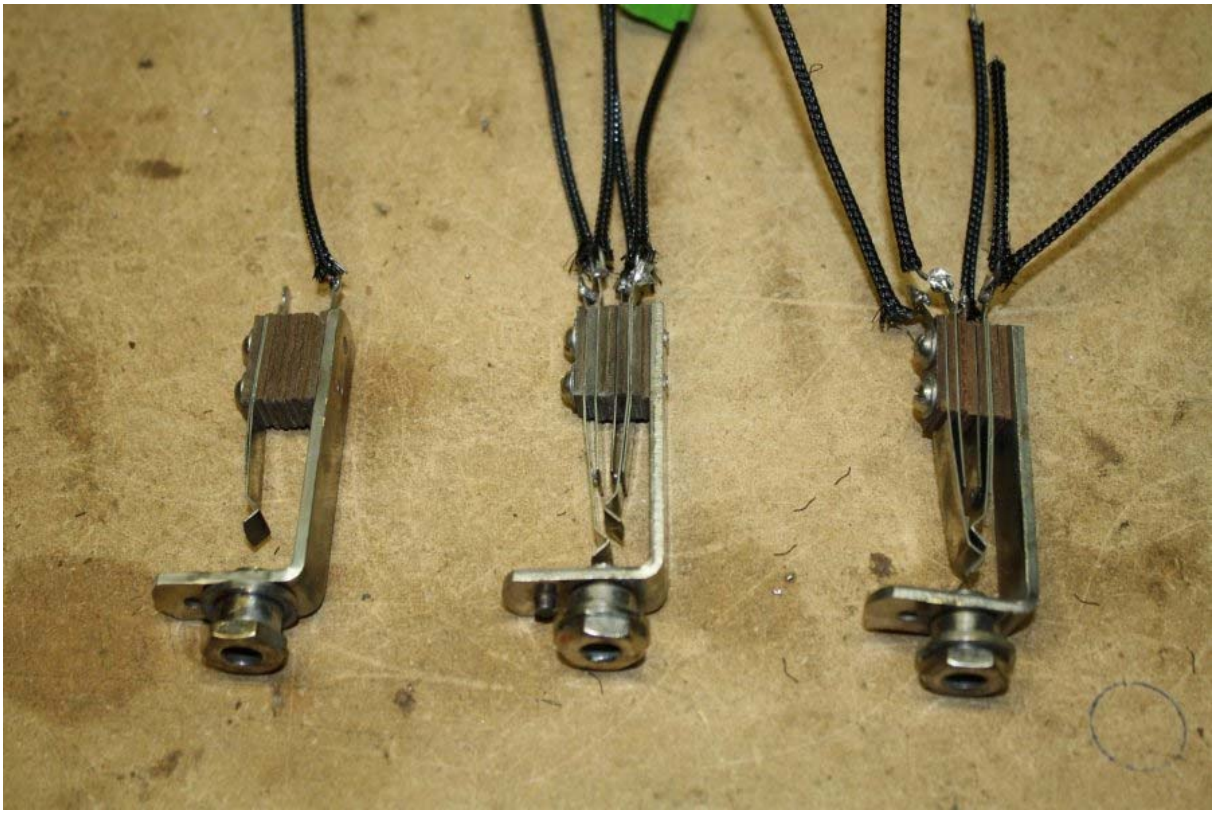
Sockets, dried rubber bands, tubes and adapters.

Bottom view with new flexible wires and new rubber bands.



Grid leak detection cartrige was open. Easy to fix for once.

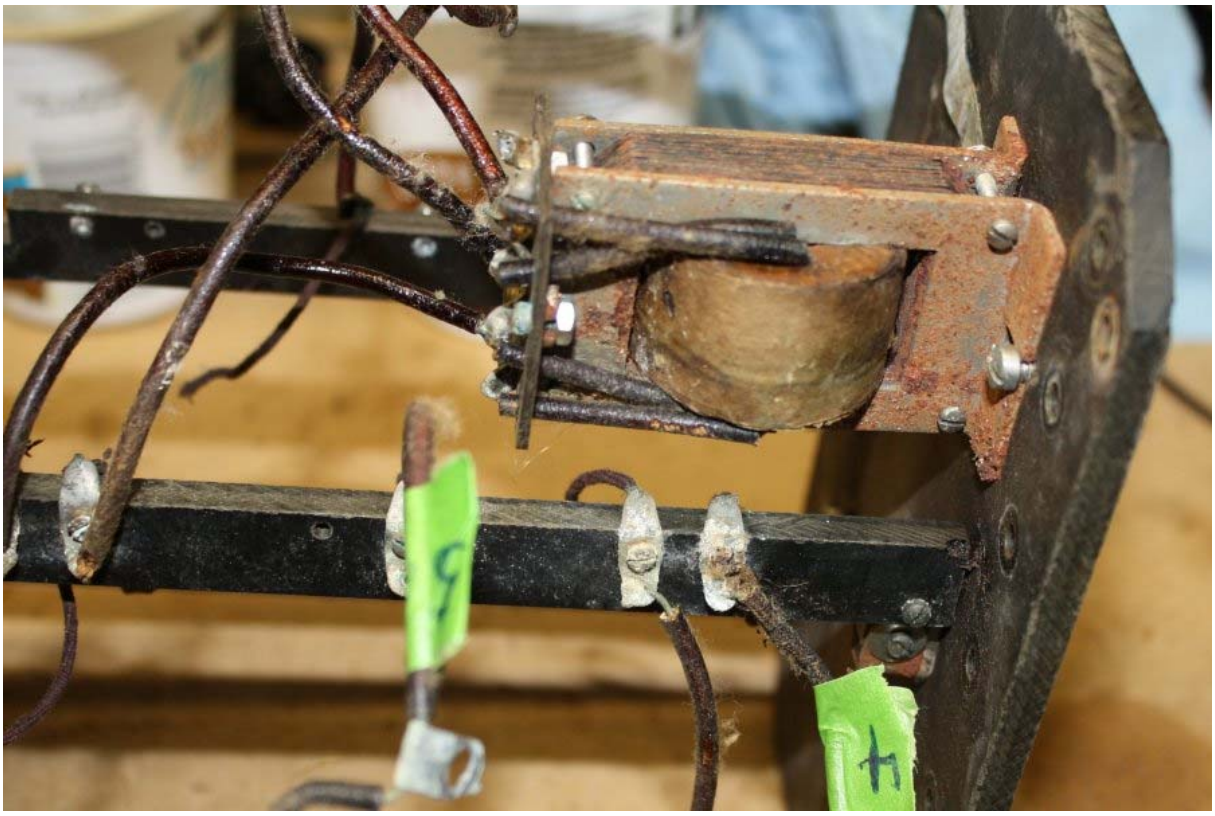
The three jacks after cleaning.



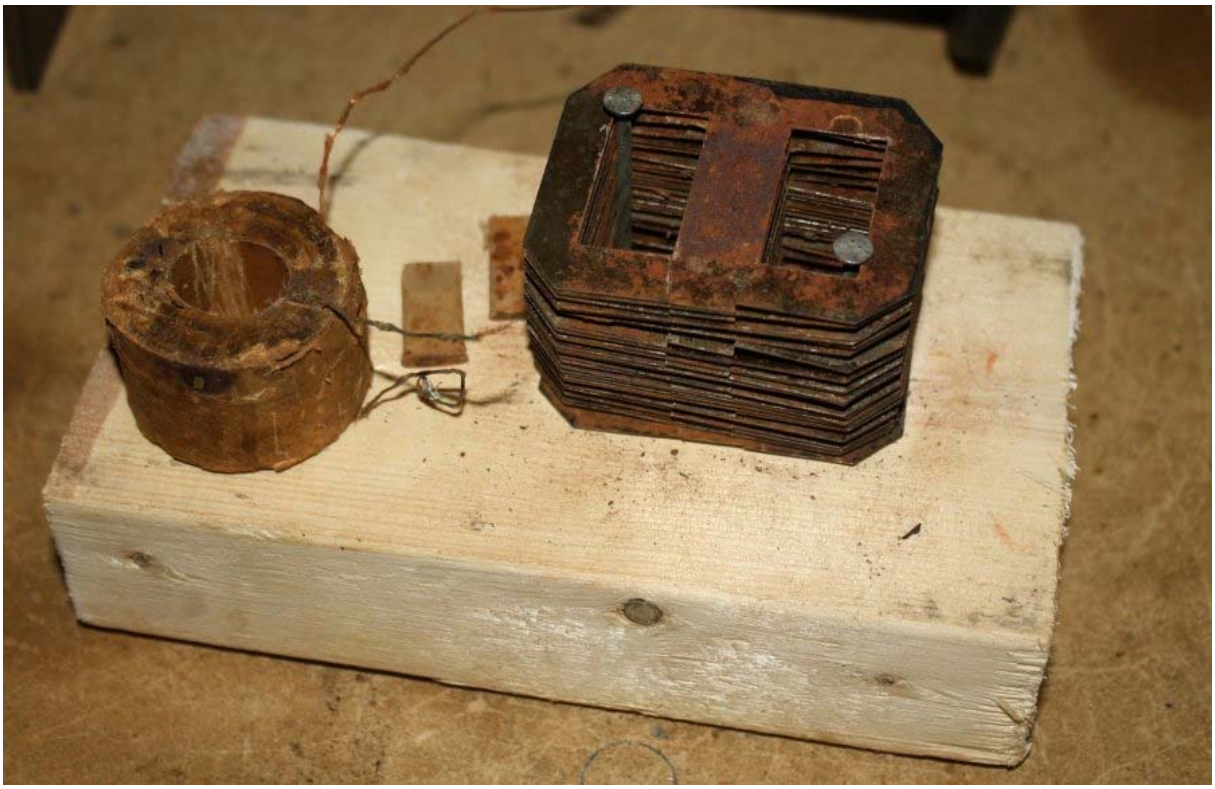
Rheostat dismantled for cleaning.

The amplifier rheostat had two breaks in the winding. Now fixed.

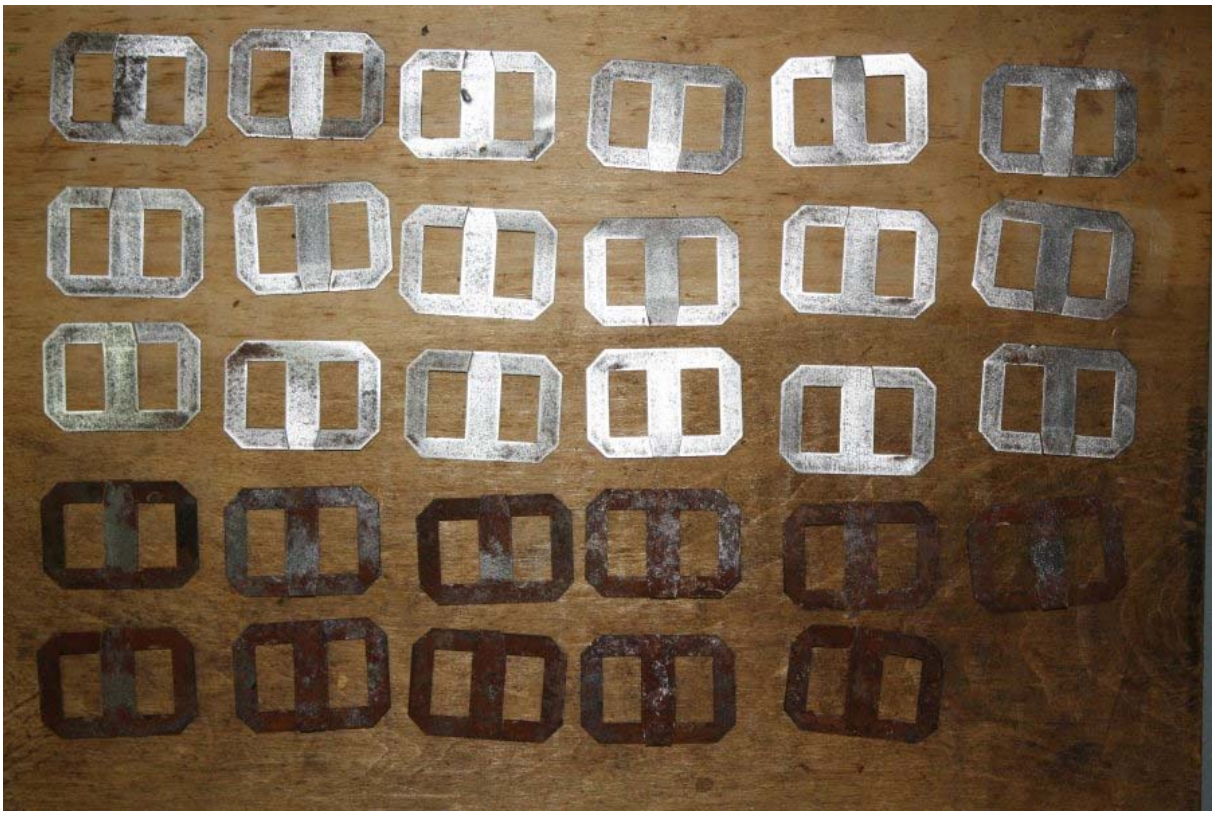
One of the two transformers.



Now dismantled.

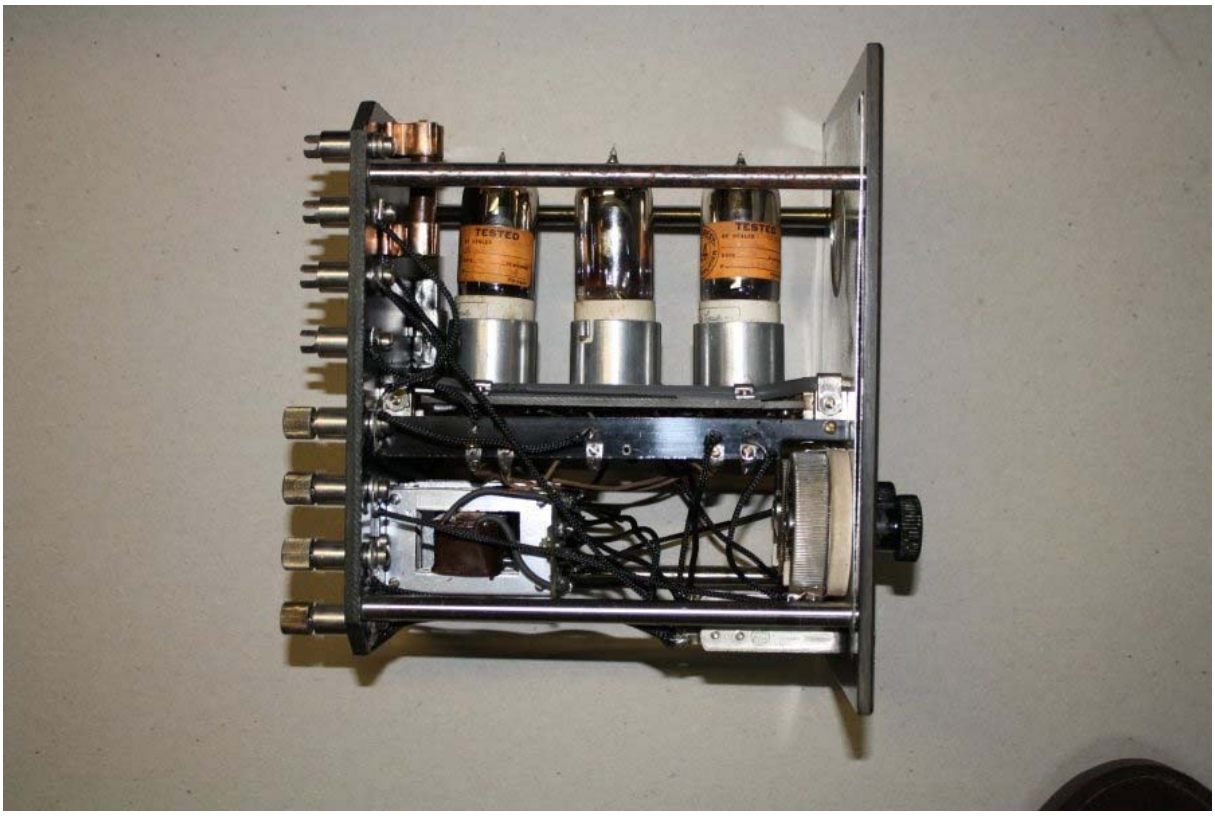


In the middle of the cleaning process. This is only one transfo.

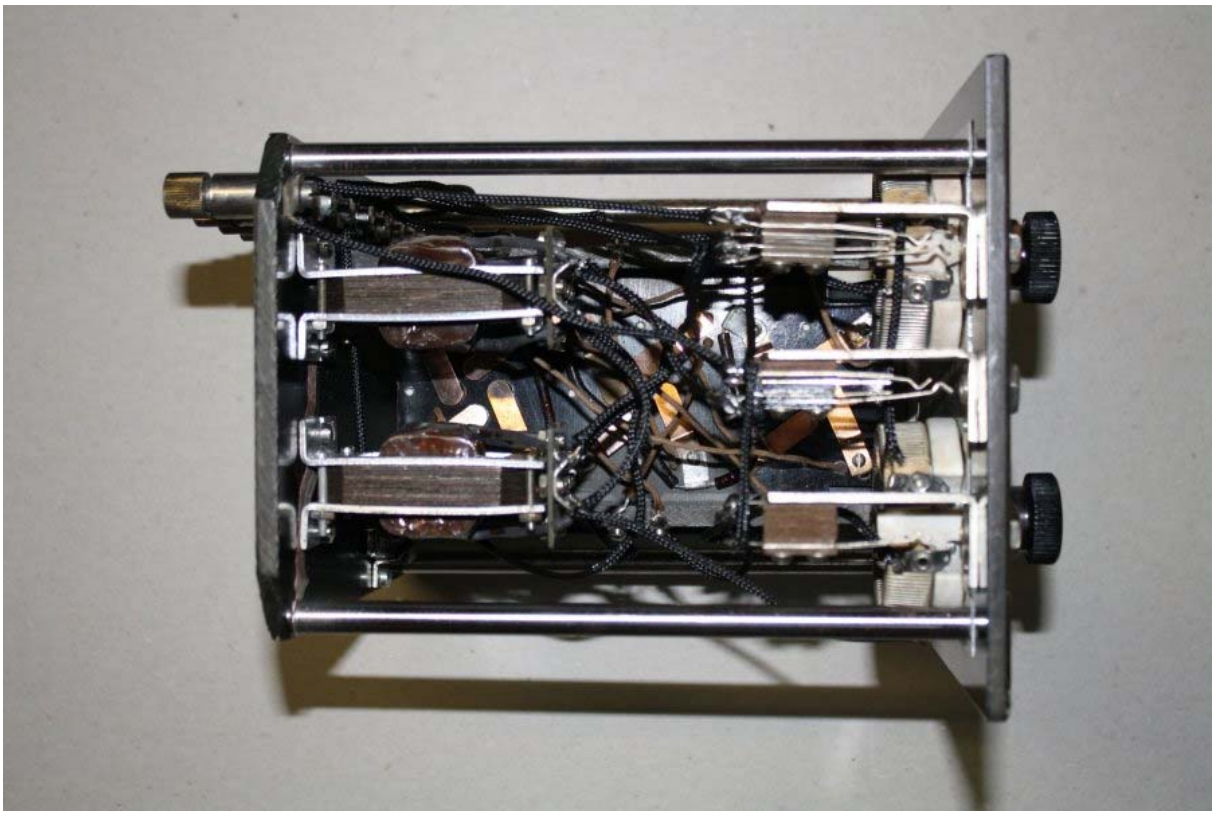


Both transformers rebuilt with new Hammond coils.

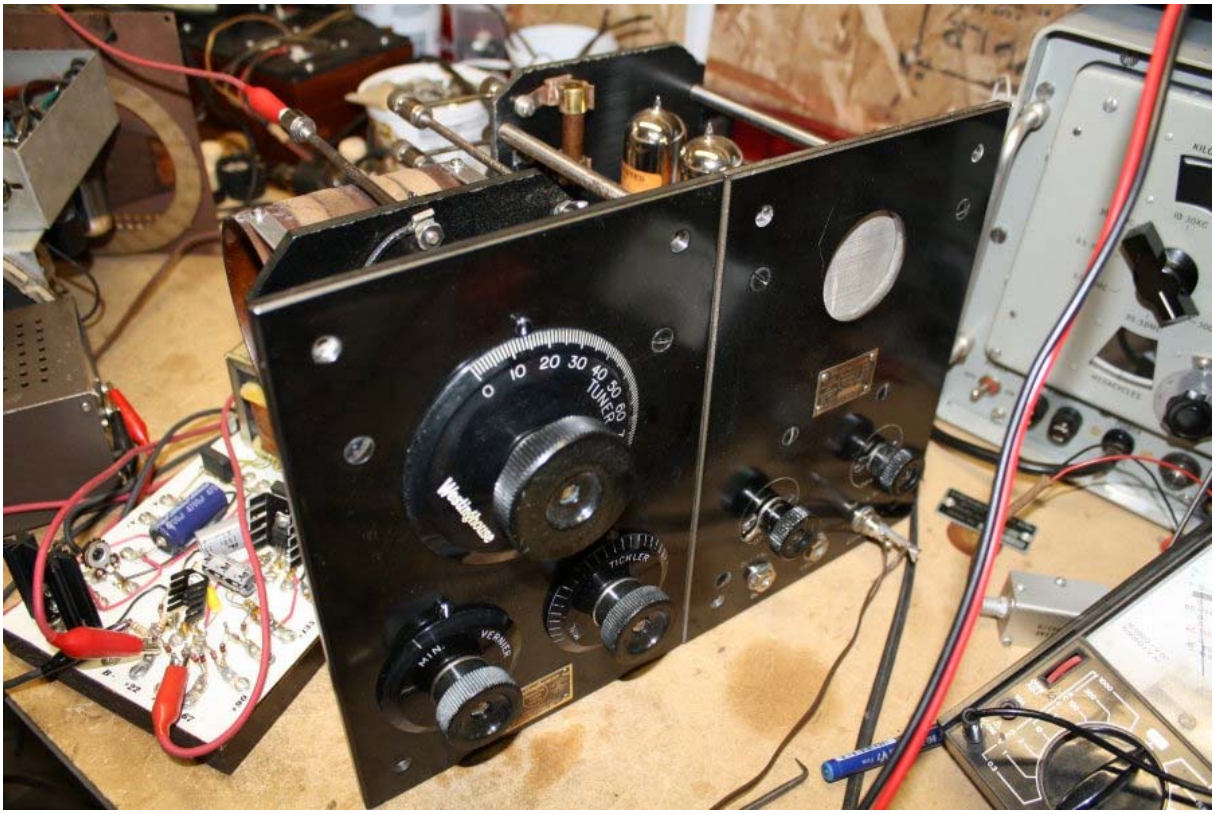
Everything back in place.



I finally figured out where all those wires go.



After mating the two modules I made some testing using the Arbe II power supply. I used the following values for the tubes, 5 volts for the filaments, 22.5 volts on the detector tube plate and 45 volts on the amplifier tubes plate. I was initially deceived by the results. Very noisy reception and unacceptable hum. I determined that the hum was coming trough the filaments. This is were I swichted to the fixed 5 volts power supply and that cured the hum problem. Next I tried to use two 9 volts batteries for the detector plate to remove the Arbe II power supply from the antenna circuit (through regeneration). Not much of a change but I realized I had miswired the batteries, connecting them to the amplifier plates instead of the detector plate. I then remembered that when I bought the radio there was a jumper between the B+ of the detector and the B+ of the amplifier, so they were working at the same voltage. I put back the jumper in place and used only the two 9 volts batteries. I got fairly good reception with acceptable volume in the speaker and a less noise. After further testing I determined that 27 volts was probably the best figure.



Restoration of the wood casing.

The casing, although quite simple had a few issues. The hole on top wich had been enlarged by the mice, the cracks in the wood, the warping of the back and finally, Mr. Jinks' damage on one side.

I took the casing apart. A piece of the back remained glued to the top panel. I started with Mr. Jinks' damage. The scratches were deep and the crack was wide. The wood panels are made of mohagany and are 5 mm thick. The scratches were over 1 mm deep. I had three options. Replacing the panel with new wood, filling the scratches and gluing veneer or thinning the original panel by sanding it. I chose the third option because it is the easiest, keeps the look of the original panel and I can always revert to option two or one if I am not satisfied. Another benefit was collecting the dust from the belt sander and mix it with glue to create a filler for the cracks. The panel ended a little less than 4 mm and was still sturdy enough. The broken panels were glued back togheter and warping controlled in the process with numerous clamps. The enlarged hole was filled with my homemade filler.

Straightening and gluing back the panels.

This is an “unconventional” use of a 12AX7 (filament open).

The final product.

Reassembling the cabinet was straightforward. All parts fitted easily with no more warping on any of the panels. After a final sanding, I applied a few coats of shellac with a brush as it was the finish used in those days. Notice the difference in shade of the tube door. It varies according to the angle from wich we look at the radio. This difference can be seen in the pictures taken before the restoration but less obvious because of the amount of dirt on the top. So I did not try to correct this.

A few pictures of the final result.

About the video

I first must apologize for the quality of the video. My source was my old digital camera and it cannot do any better that what you see. Another problem is the automatic volume control on the camera wich works against the effect of the regeneration on the volume of the radio. And as I am standing beside the camera, the radio gets the priority and my comments are lost in the sound of the radio (again AVC). So here is a summary of my comments.

But before, let me explain in what conditions this demonstration took place. The radio is in my workshop in the basement of my house. My house is located in the suburbs of Montreal, about 20 Km from the transmitters you will hear. The antenna I use is a lenght of wire 3 meters long stapled to the floor joists of the first floor of my house (not even a meter above ground). It is amazing the see how such an old design performs in those conditions.

And now my comments :

The radio has five controls. The larger knob on the RA module is obviously for selecting stations. A strong station can be heard over as much as one third of the rotation of the knob if there is no other station in the way. That’s how selective it is.

The bottom left control on the RA is a vernier to help isolate stations. Not much use when you have a strong station but very useful to isolate a weak one (the third station heard in the video).

The bottom right control on the RA is the regeneration (or tickler). This is the heart of the radio. It is your main tool to get some selectivity out of this radio. It takes a while to get the twist but after a while you can pick-up some weak station and isolate them from the strong ones. It also acts as a volume control on stronger stations. It will also affect other radios in the vicinity since you are literally “transmitting’” the signal you are receiving.

Final comments

The thing that has not yet been said.

All along the restoration, I had a very faithful companion making sure I would not work long hours in a row and get tired and miss something. It was the incredible stench coming out of the chassis and cabinet. I would not work more than one hour per day and quickly put everything back in a sealed box to make sure the whole house would not get impregnated by that stench. After I finished the RA module, it took me three months before I had the courage to get at it again.

The real first prize.

Of course I was proud when I won the first prize at the local contest but the real first prize is when you put power on the radio and your hear the sound of a radio station coming out of a 93 years old piece of technology. And the way it is now, with proper care, it will obviously get beyound 100 years old and maybe another 100 or more. I have a lot of respect for those who designed and built such radios then.

I wish to thank everybody involved in this contest for their participation either as an organizer, contestant, a judge or simply members interested by the contest. It helps create stronger links between our clubs and pushes restoration techniques further ahead.

Jean Marcotte for SQCRA
Montreal