An SX-28A Restortion

Back in the Day

- Radio was center of family entertainment
- War was at hand
- News was far flung, dynamic, exciting, REAL
- AM and CW were King
- Ol’ Sol did its thing

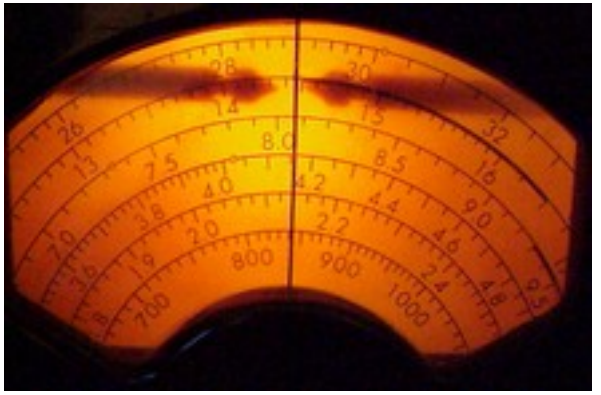
- And the average rent in California – $35/mo

https://www.census.gov/hhes/www/housing/census/historic/grossrents.html

Hallicrafters

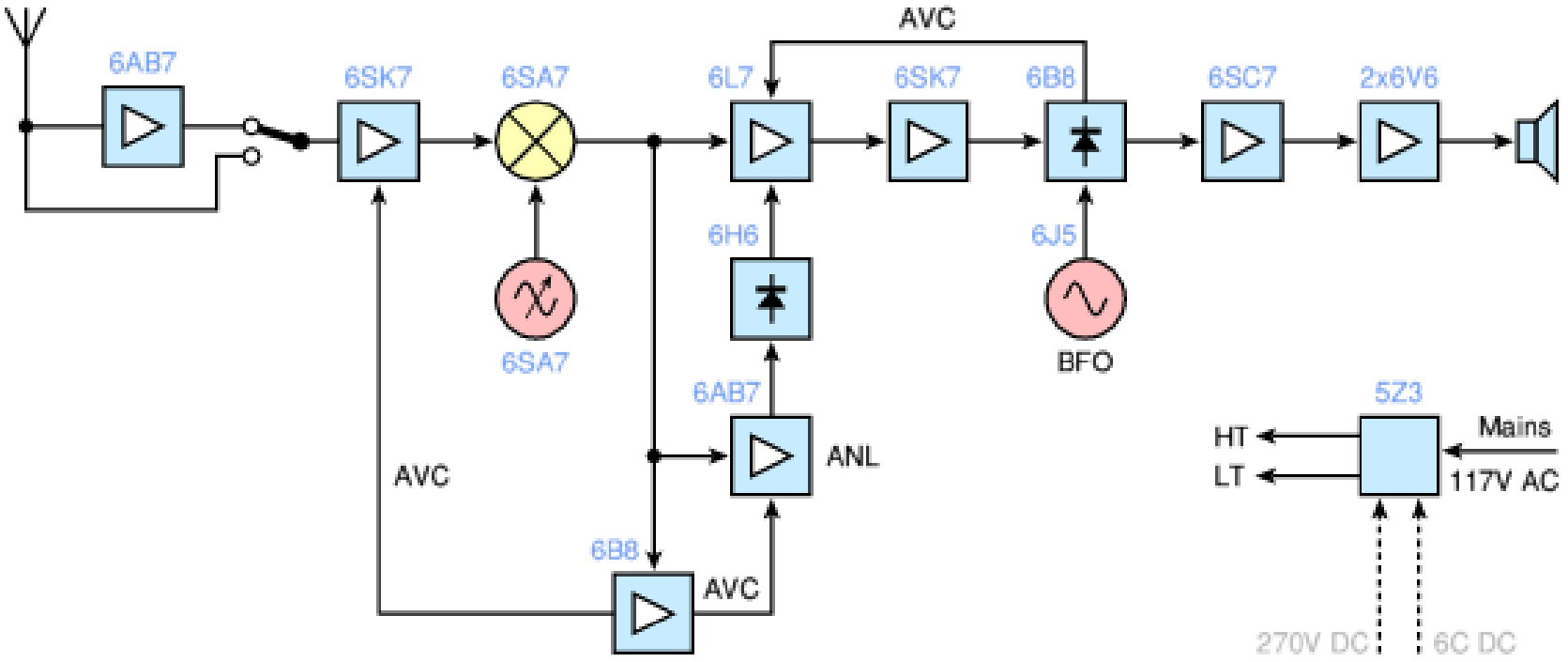
Introduces SX-28 receiver – July, 1940 all this for $160

- .5 to 42 Mc frequency range
- Mechanical Bandswitch, 5 ranges, bandset/bandspread
- 5-10 uV sensitivity, antenna trimmer
- AM, CW
- 1-2 RF pre-select stages,
- 2 IF stages – 6 selectivities
- AVC, ANL, BFO, S-meter, XTAL filter
- 6 watt push-pull audio, bass/treble
- Phono input



- https://www.radioblvd.com/SX28Notes.html

SX28 Block Diagram



SX28 – Intercept Radio

British Intelligence

GC & CS ops

‘Y’ stations

Beaumanor Hall

Intercept hut

stables/outbuildings

19” rack-mount – 220V

Intelligence sent to Bletchley Park

- https://www.cryptomuseum.com/df/sx28/index.htm

Papa’s radio

- s/n HA-25438
- Purchased likely in or around Sep, 1945

- In the front room – our family radio
- the house had built-in “areal”

- West-Coast commercial AM radio
- International Shortwave broadcast
- HAM bands – phone and cw

- Phonograph – 78, 45, 33

Papa was ...

- Ham Operator
- Army Radio Operator – U.S. Horse Cavalry
- Chief Engineer of local AM stations
- CW hound (60+ wpm head copy)
- Vibroplex magician

- “Radio Doctor” – curator of last resort
  - Watsonville Register Pajaronian – 1947

- … and a wonderful Dad

the Noobie

Novice (1972)

- Mentor: T.C.McDermott – N5EG
- Rig:
  - Modified HW-40, NC-303, ‘fan’ dipole
  - j-38 key
  - Hacked Vib with PbSn wrapped arm !

Built Heath HW-101, Cantenna, VTVM, Hustler 5BTV

- For Papa’s 60th birthday
- Biggest grin I ever saw

SX-28 received from older brother’s estate ~2008

- Stored inside (attic) – 80# dead weight
- Original manual

the Weathering

SX-28 active from 1945 – 1965

Components gradually aged

- Electrolytics
- Wax bypass Caps
- Bias resistors
- Tubes

Time took its toll

- cigarettes
- Dirt, dust, grime, and even furry critters
- Tweaks and good intentions

Eventually set aside in favor of FM and TV

How to Start ?

- Reactivate Ham license – 2008
- Join Radio Clubs – SCCARA, SLVARC

- Contact AM devotees – wisdom, “you-can-do-it”
  - http://ami-west.com/
    W6OM, KO6NM, KD6TKX, NI6Q, W6YEC, WA6HCX

- Internet search – how to repair, beware the pitfalls
  - https://antiqueradio.org/halli12.htm

- Documentation – SX-28A military spec TM 11-874

- Parts procurement – tubes, caps, carbon R’s
- Tools gathering – SLVARC auctions !

Motivation & Help

AMI Friends

http://ami-west.com/AMI.Annual.Meet.2013.html

West-Coast AMI

Collins Radio Van

AM console

WA6HCX

Down the Rabbit Hole

Under the Covers

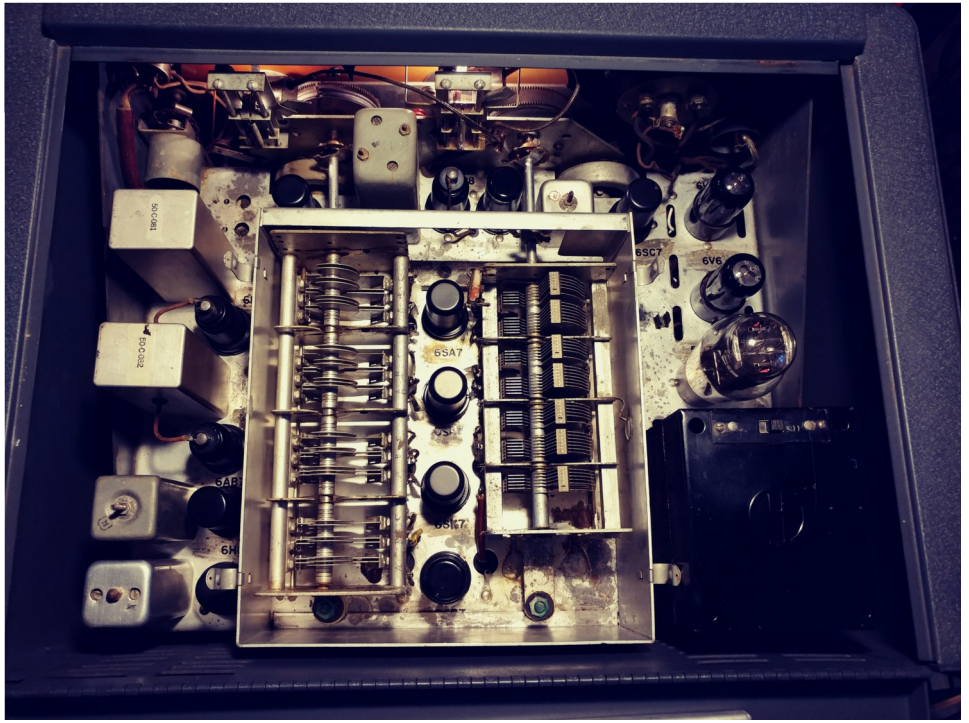
After the first 400 Q-tips …

- Dirt, mung, mildew, mousiness

- Front-side – panel, knobs, gears, shafts
  - Rule: do NOT touch any of the dial faces !
- Top-side chassis, Cans, Transformers
- Bottom-side – wires, caps, resistors

The Work Ahead – photos

- S-meter, Det, and IF
- BFO, ANL and pre-Audio
- Audio-PA and PS



IF1 and ANL/AGC

Deep in there

Deeper still

Aud1, BFO, S-meter, IF2

Around the corner

down under BFO

past S-meter

and into Audio1

What is Where ?

annotation of components

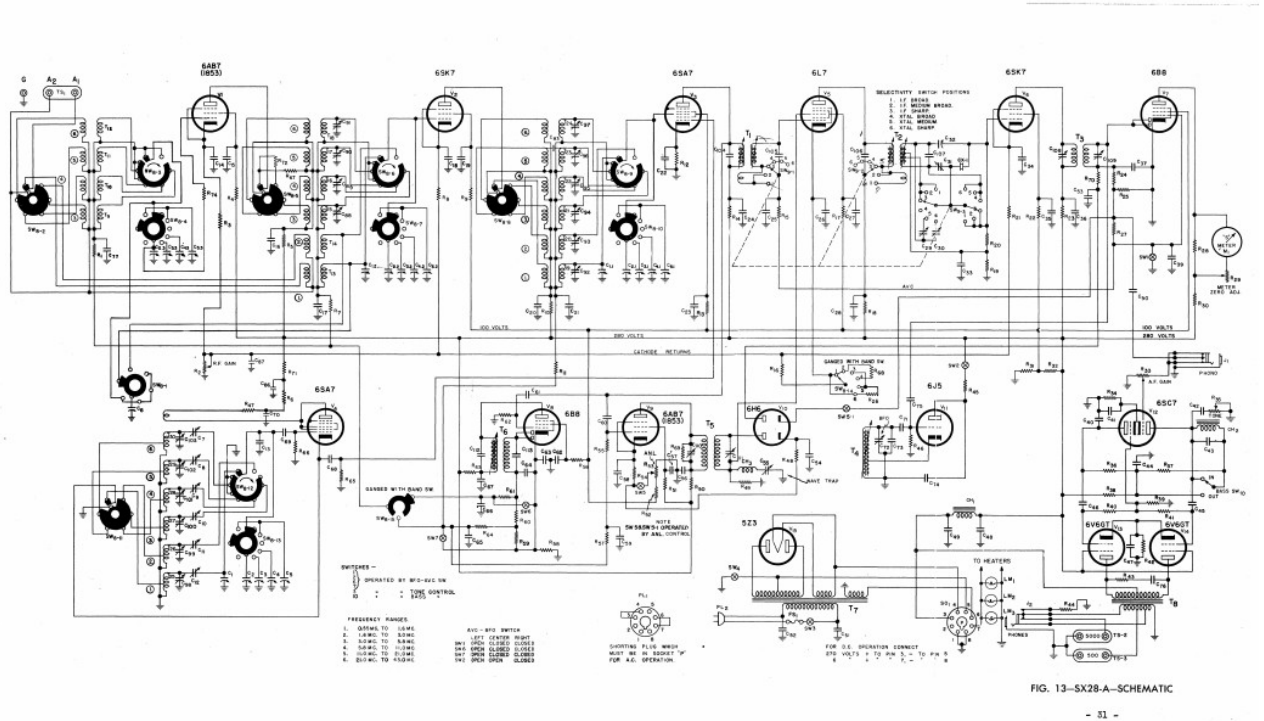
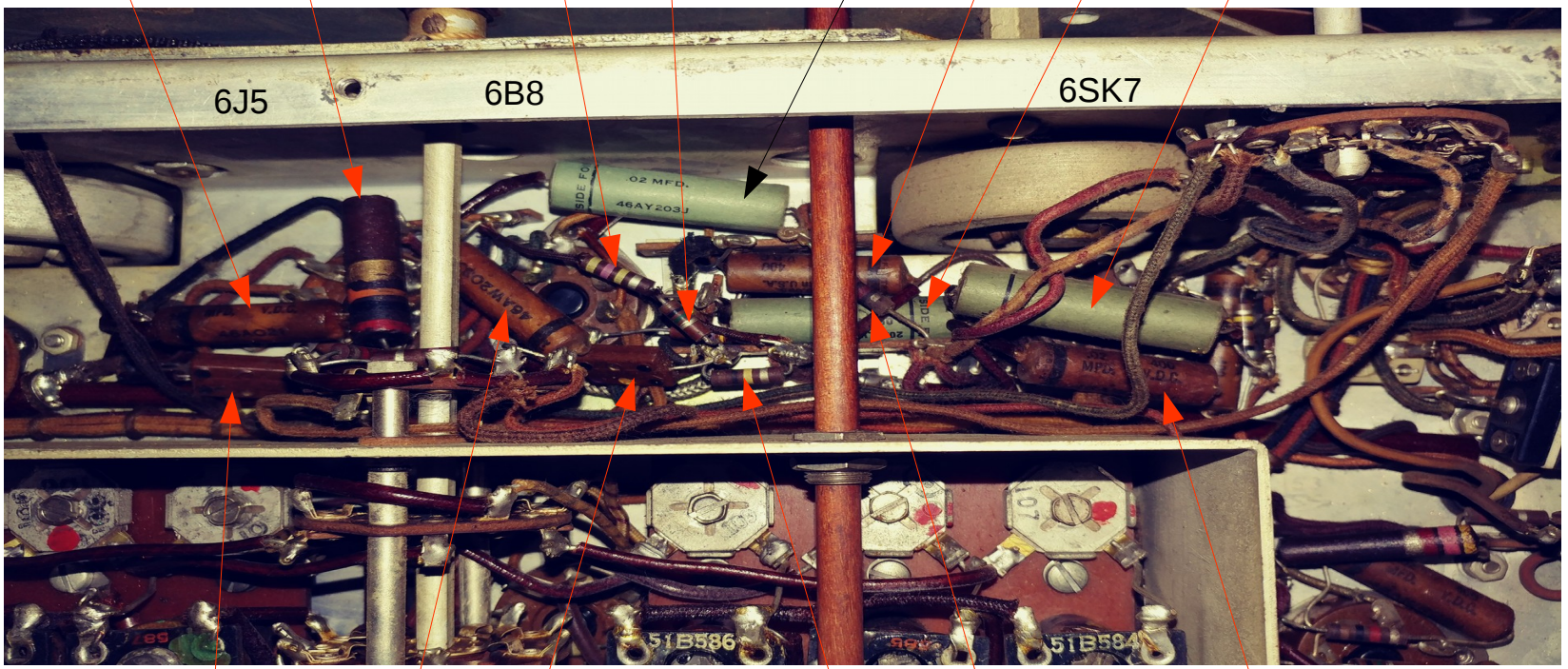


FIG. 13—SX28-A—SCHEMATIC

V9 – S-meter/ANL

R56 1.5k
R58 220
R57 91K
R63 343K

Aud1-AGC-BFO



R24 116k
R45 30k

Under Aud1

R42 331
R43 1.3k

Equipment Needed

Hickok 288x rejuvination
- Wide range CW/AM/FM
- Re-cap, re-tube, re-align

H/P Generator
- Stable 455 kc source

Radio Shack DMM

Elecraft – ATN
- ATN – Control of signal injection levels
- K3 + dummy load – initial frequency checks

Various O'scopes, cables clips, leads
Pb-Sb solder – the real McCoy
Soldering and Tools – SLVARC auction goodies !

Vacuum Tube Tester – P-62T
Variac !

Commitment

Does anything work

- Variac slowly up – no smoke (GOOD)
- Tubes lite, HV ??,
- no ears, scratchy/stiff controls, no S-meter
- Tube check – all but 3 are bad/weak
- Unbelievably, some very weak AM heard !

Approach

Repair ‘easy’ areas, then ‘hard’ areas
- PS
- Outer ring of S/AGC, I/F, ANL, Audio, PS
- Inner sections of Ant, RF1, RF2, HFO

Rebuild of electrolytics – multi-section cans
- Hollow out dried up guts ‘n tar
- Replace with smaller versions inside can
- A bit hacky, but works fine

Debug and Fix
- Audio hum – inadvertent short
- Overlooked Caps and Resistors – DIRTFT

Rough Align
- IF, RF, Xtal, ANL

Fine Align to Xtal freq
- IF, Selectivity

Things we look for ...

Failed Resistor

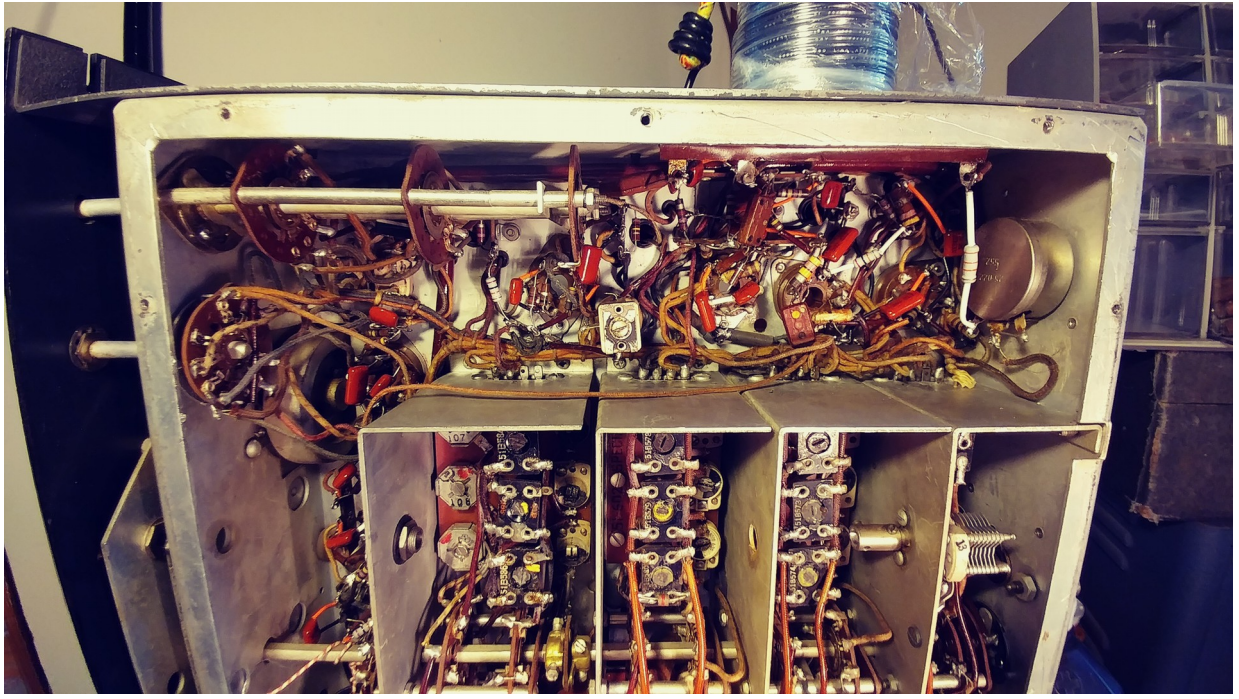
Yes, Virginia, SilverMica can fail

SM kills 2W resistor

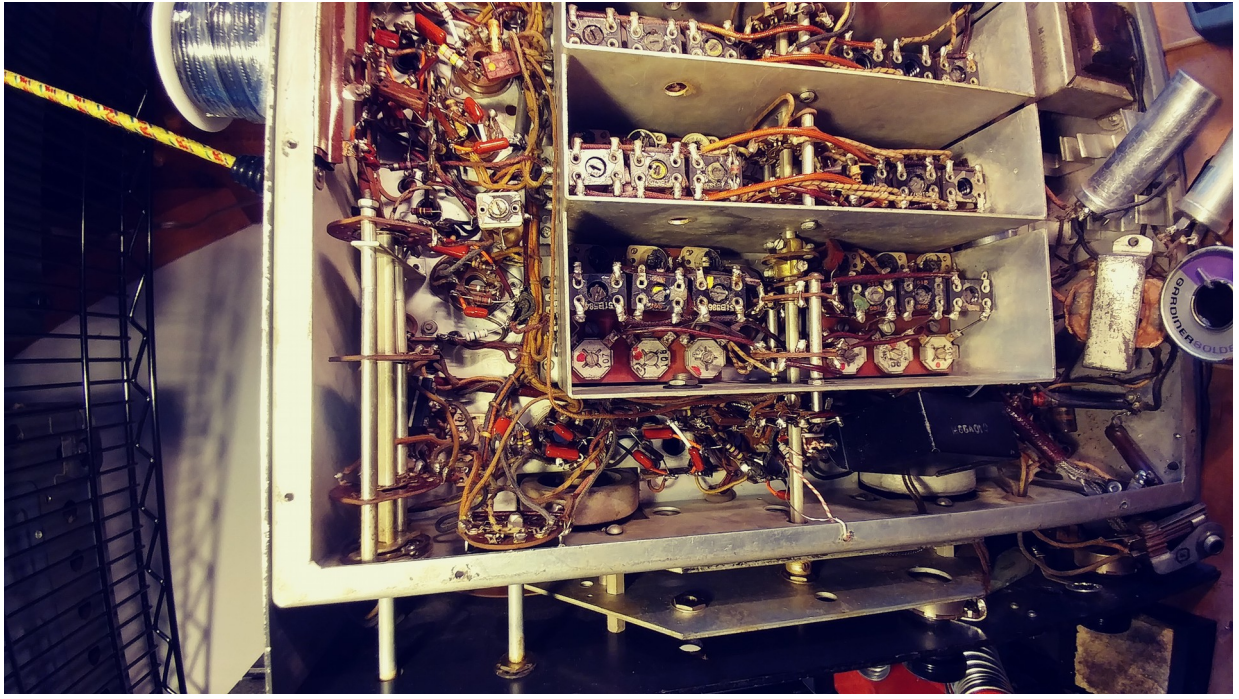
On with it

Gut and rebuild electrolytics

Re-do of Top

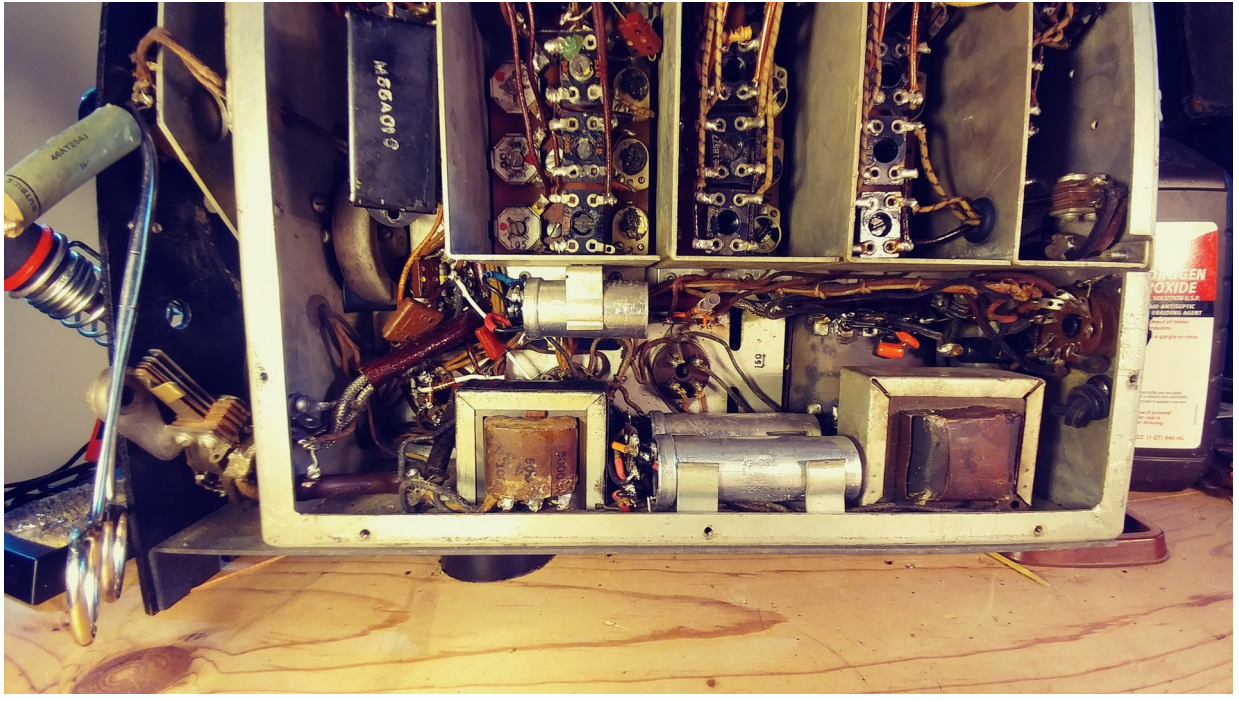


Along side



AF Nest fixed up

And bottom



now to the hard part

Tilt-out and Repair inner sections

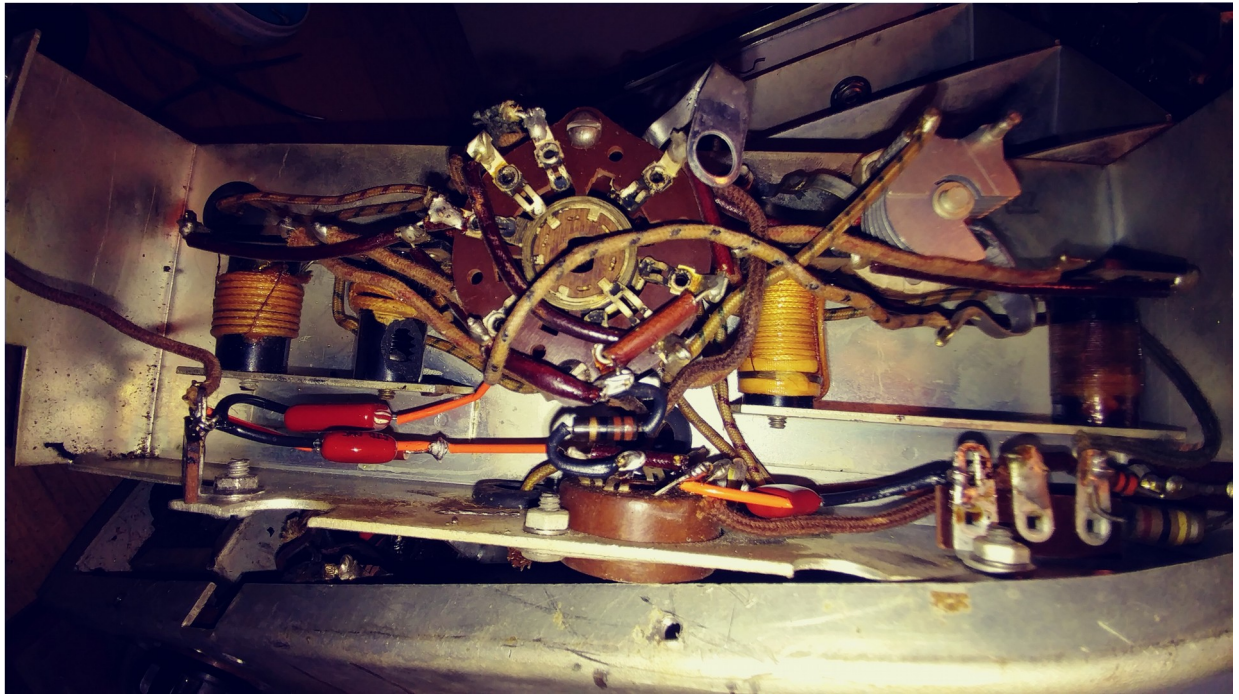
- RF
- IF0
- IF1
- HFO

RF tilted out

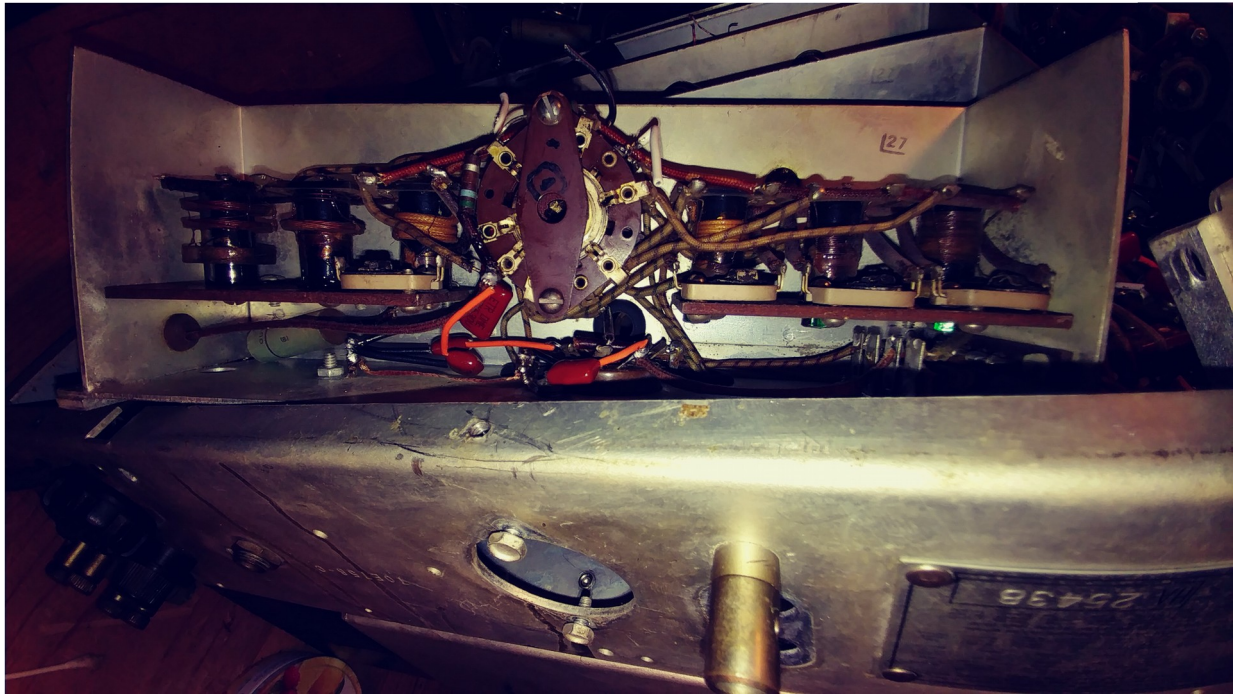
Into the RF Uglies

RF tumor excised

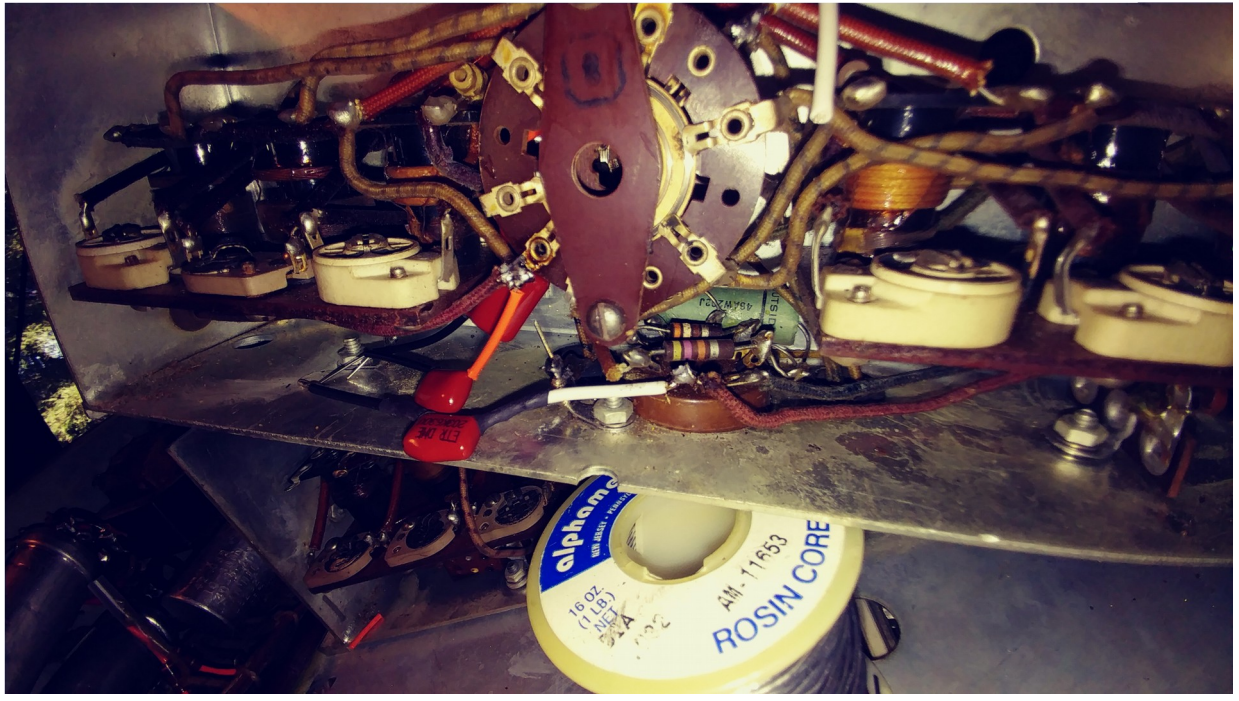
RF fixed nice



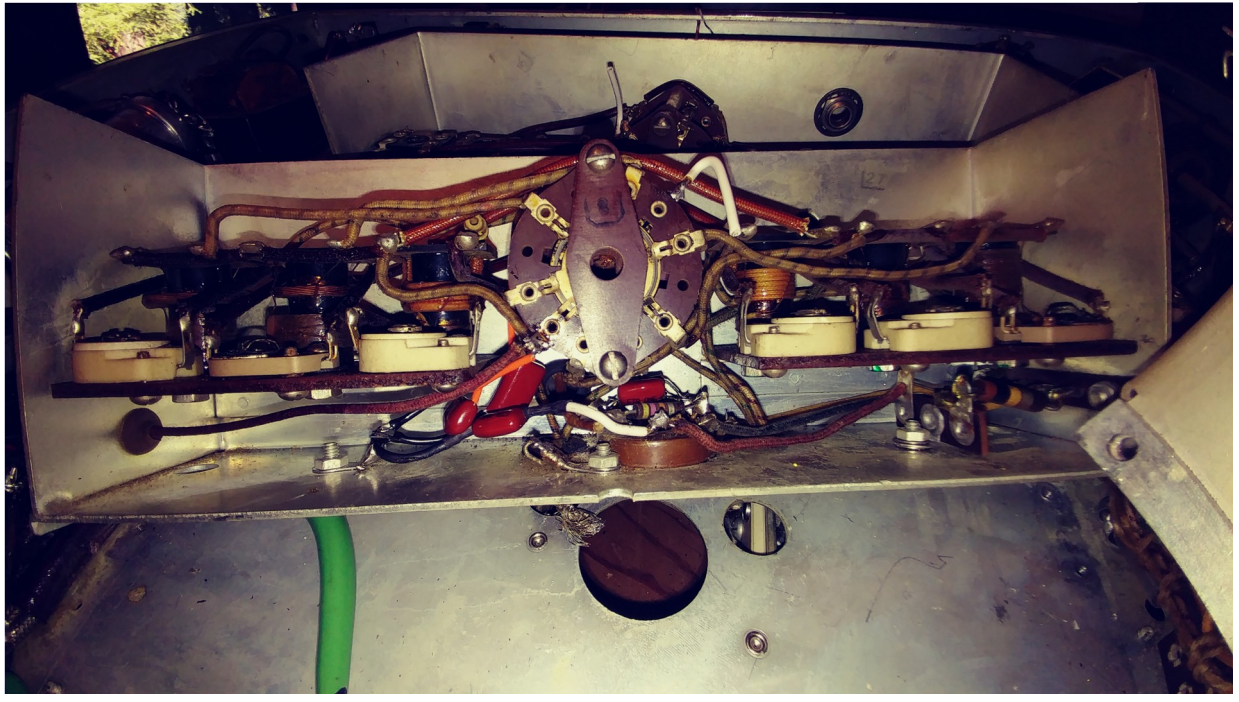
IF1 ready



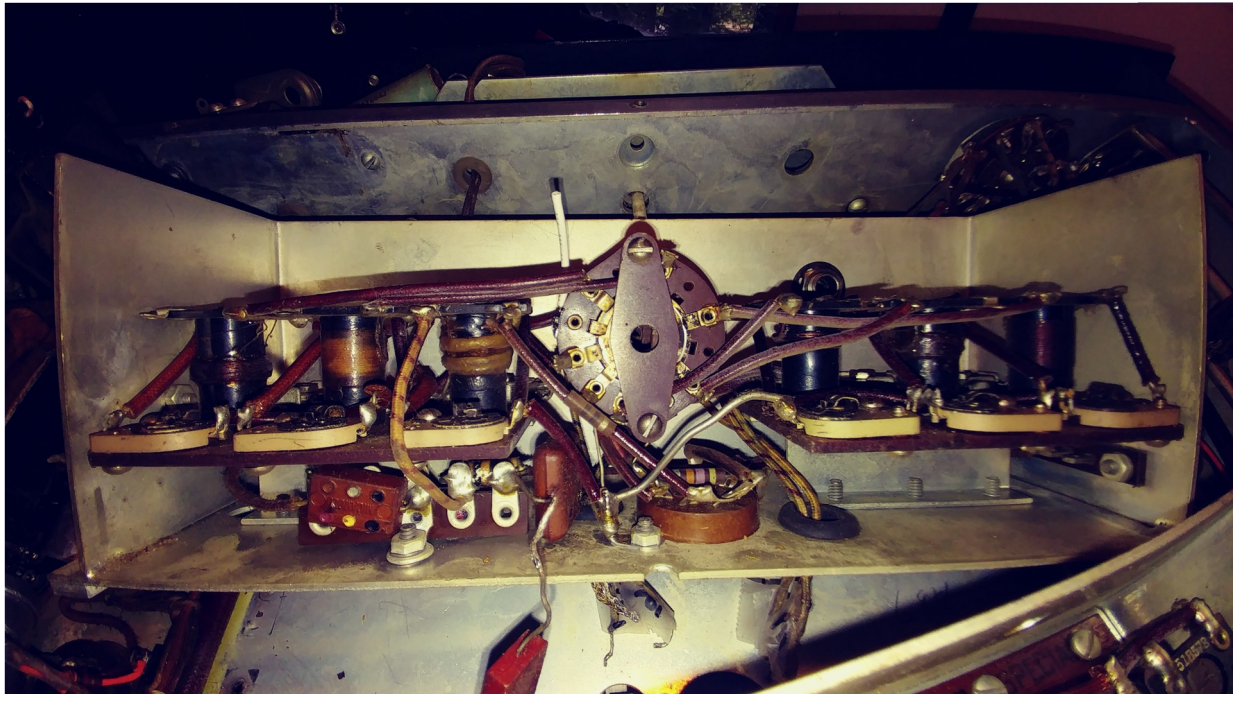
IF2 deep



IF2 surgery done

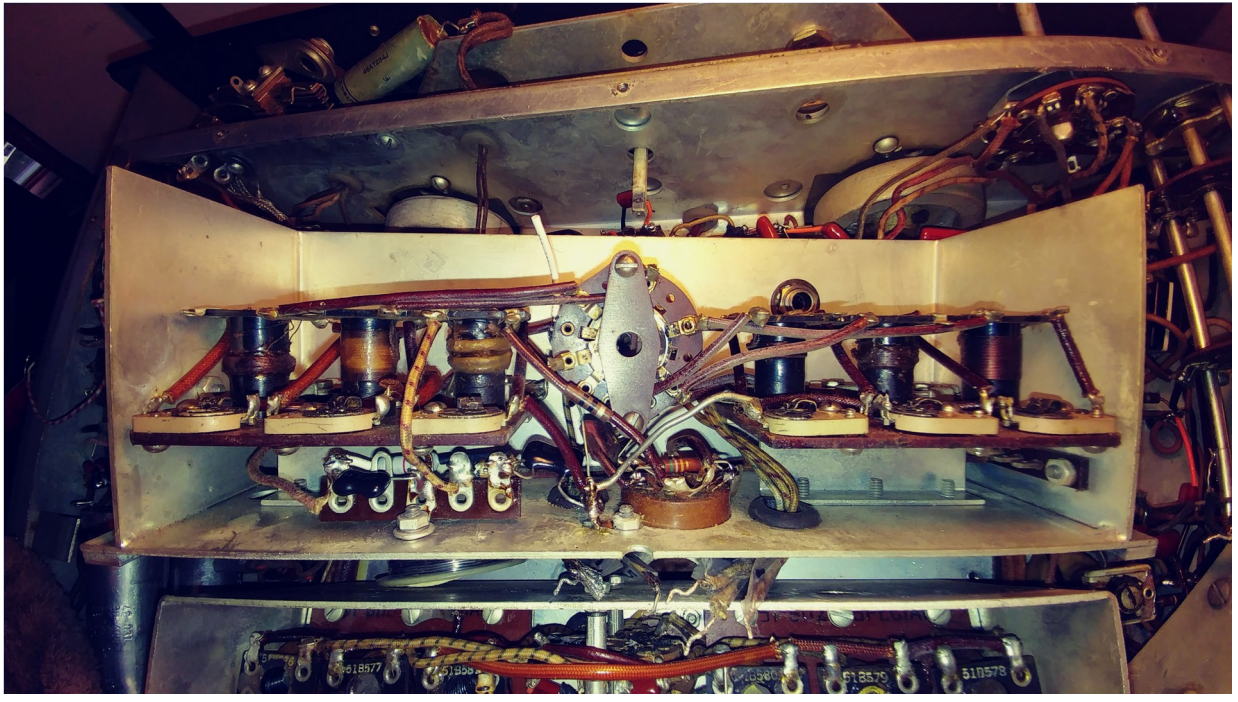


HFO Heart of Darkness



HFO deep network

HFO ready to go



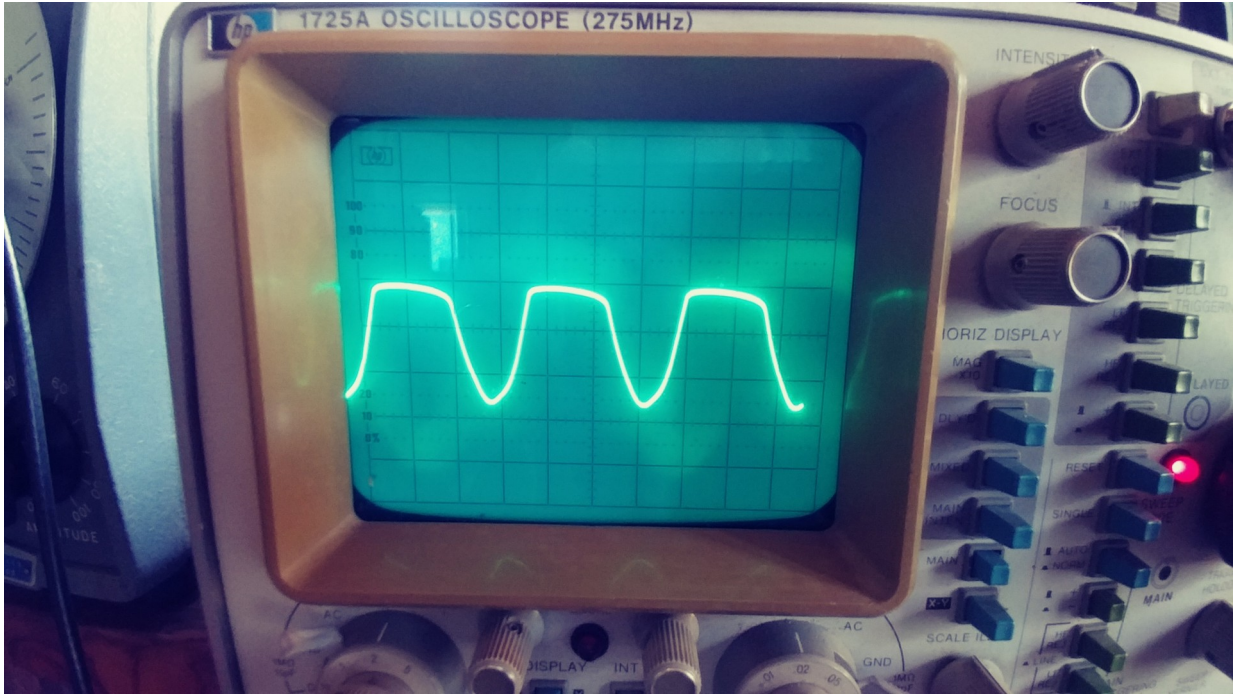
Testing and Debug

Some of the Tools

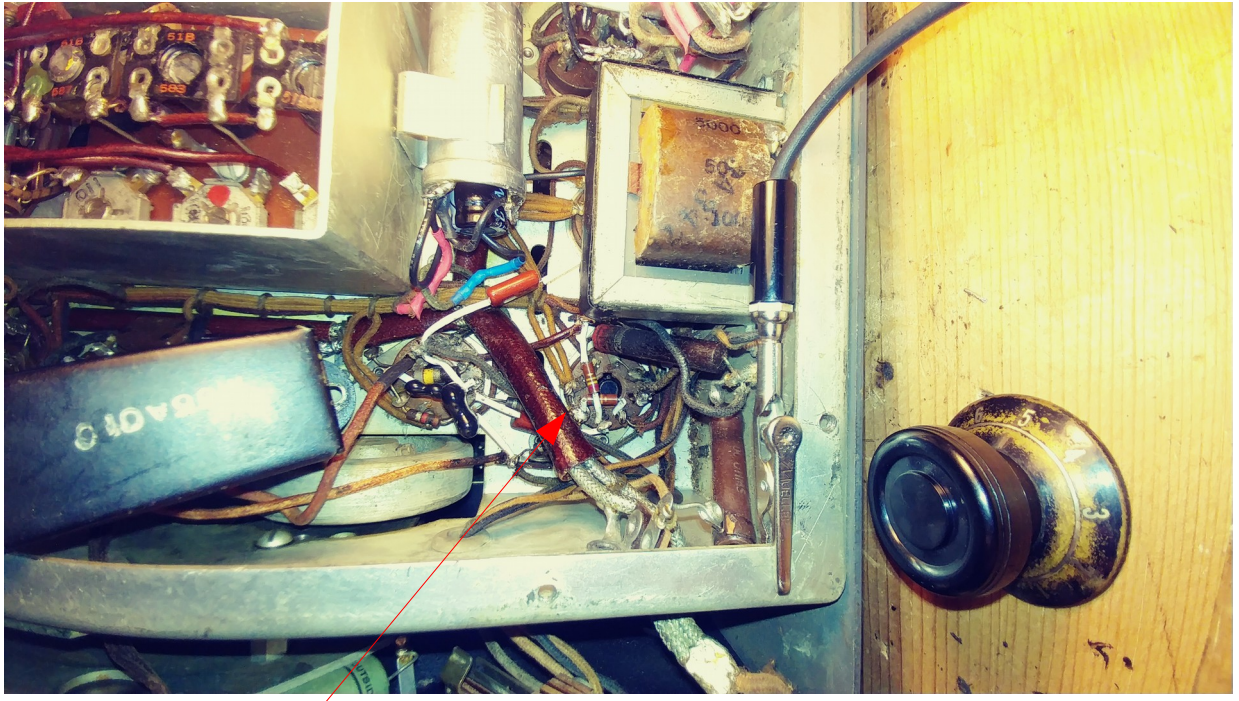
Hickock 288x

H 200CD Audio Gen @ 455 kc

Hum in the Rat’s Nest

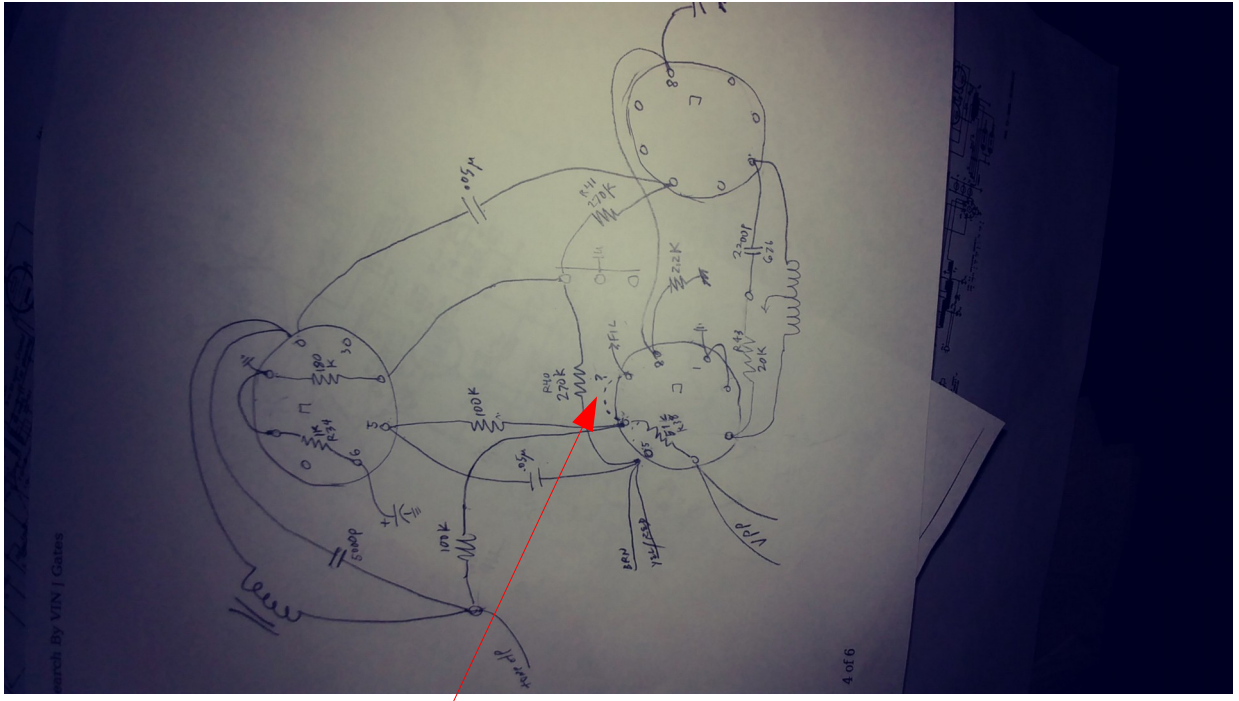


It’s in there, … somewhere



Short to filament

Rat’s nest, hand drawn



this isn’t supposed to be there ...

More faulty resistors

Bone Pile

- All tubes replaced
- Almost all caps
- Many resistors

Alignment

- Try by-the-book
  - A few kinks – broken/missing coil slugs
  - Slugs loose, some at range extremes
  - Repair some with Cyano-acrylate + Baking Soda !

- Then use better/simpler method
  - Bill Feldmann N6PY
    - http://www.radiomanual.info/schemi/Surplus_Radioamateur/Hallicrafters_SX-28_IF_alignement_procedure.pdf

Alignment

- Set IF to 455 kc
- Rough-In IF/RF stages
- Drag HFO somewhere close
- Fine up the HFO and RF stages
- Find the XTAL freq
- Re-Tune IF to Xtal
- Tune the ANL to Xtal / IF
- tune ANL wavetrap @ 455
- Fine up the Selectivity

Let There be Light

First Steps

- Local AM KNRY – classic 50's and 60's
  - Nice, but some distortion
  - Chase and fix, realign
- 540 – 1600 Kc sounding good !
- Regional AM – 3870 nets
  - Weak, off-freq dial
  - Tweak up RF and HFO
- CW on 80, 40 and 20
  - Wobbly and weak
  - Tweak up the IF and Selectivity
  - Clean up the BFO control
- SSB
  - BFO reinject and side-slip tune
  - Adjust BFO control so can +/- frequency !

- Filter response shape
  - Using 288x
  - 1000 kc – 20 kc spread using 60 cyc 'hum' FM modulation
  - Asymmetric 60 cyc distorts sweep & display

Back in the Case

General Appearance

Operation

Noisy/discontinuous Pots

Dial band indicator cables

Thermal Drift and Mechanical modulation

Yes, it’s still as heavy as it was when born !

SX28A – Tuning Around

Commercial AM and SW – good reach

Amateur AM – fair … ol' Sol still weak

Tuning dial Freq not linear – sauce for the goose

Amateur SSB – interesting dance

- Adjust BFO control so can up/down IF freq
  - BFO tuning cap is ½ mesh at '0' knob setting

- Use I/F 'Med' selectiviity
- Adjust BFO 'upside' or 'downside'
- Center I/F on desired USB/LSB side

- Tweak to taste

SX28A – Sleight of Hand

Purposeful QRM

AM net operation – 3870 KC

Intentional interference – SSB QRM

- AM (25w carrier ?) out of San Diego
- SSB (500w ?) out of 5-land
- SSB QRM – 1.5 Kc down-side of AM carrier

Initial Rcvr ‘normal’ settings

- RF Gain = 9
- AF Gain = 3
- AVC ‘on’
- IF ‘Broad’

Thumping and swamping

Fighting Back – Adjust Rcvr settings

- IF ‘Medium’
- RF Gain = 4
- ANL = 2
- AF Gain = 5

Adjust Bandspread ‘up’ ~ 1.5 Kc

- Keep AM carrier in IF passband
- Put SSB on lower edge of filter skirt

Hah !

A note about the ANL

how does this thing work

ANL is a Lamb circuit – broadband impulse

- 1930's ARRL Noise Silencer
- http://jptronics.org/Collins/bulletins/collins.noise_blanker.html

Broadband amplification at first mixer

Null out the 455 kc (ie. look for broadband noise, not signal !)

Rectify and scale noise level (0-9 ANL pot)

Re-inject inverse scaled noise at Detector

Essentially a de-sense mechanism

We'll have to wait 60 years for DSP processing (hi)

Final Notes

- Deaf on band 5 (21-42 Mc)

- Discover 6ac7 instead of 6ab7
  - 6ab7 is ‘remote c/o’ – spec’d for sx28
  - 6ac7 is ‘sharp c/o’ – oft-used replacement
  - Bias and operation different

- Ordered and under trial

- https://en.wikipedia.org/wiki/Pentode

- Note: remote cutoff pentode – aka ‘variable mu’ grid
  - Grid winding varies the spacing
  - Larger dynamic signal range

73