Regenerative Receiver Project

Presented by

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Regenerative Receivers

- Patented 1914 by Edwin Armstrong
  - Patent battle ensued with Lee De Forest, who ultimately won
- Popular in the 1920s through WWII
- Evolved to solve the problems of previous architectures
- Fewer tubes than earlier TRF receivers:
  - less expensive to own as tubes were expensive
  - lower power requirements since batteries were expensive
- More selective and sensitive
- Easier to tune (but still not easy by today's standard)
- High impedance headphones were used
  -

Features

- A regenerative receiver can receive:
  - AM (amplitude modulation)
  - CW (morse code)
  - SSB single sideband
- In order to do this, the circuit contains:
  - Rectifying detector
  - Positive feedback amplifier
  - Heterodyne oscillator

Simple Regen Circuit

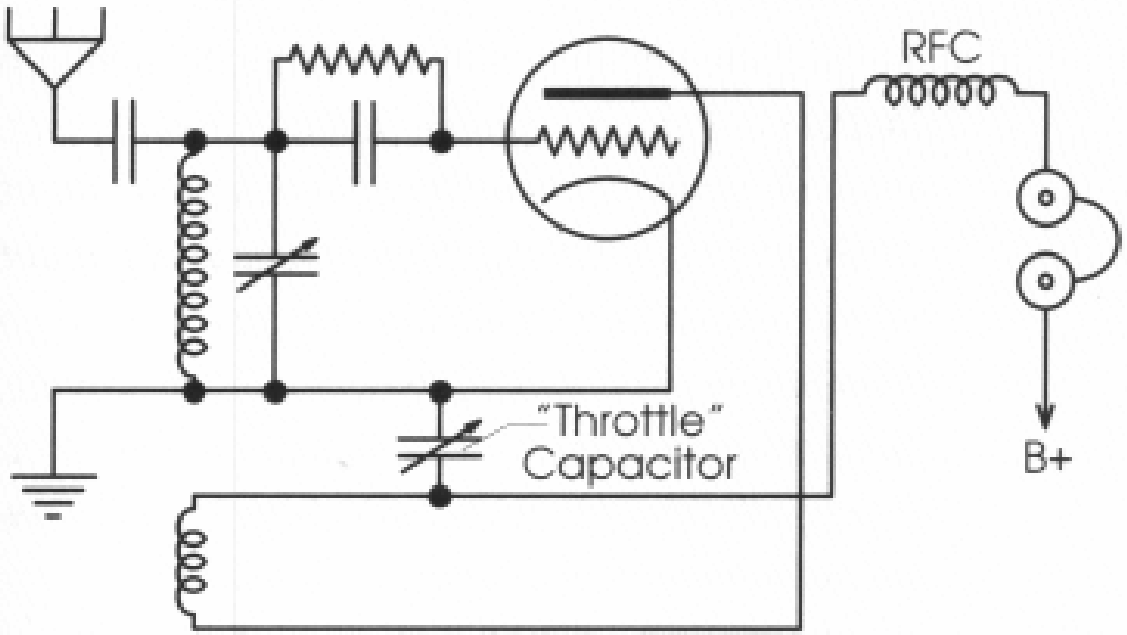


Figure 3.1 – My favorite way of controlling regeneration using a throttle capacitor

Circuit Components

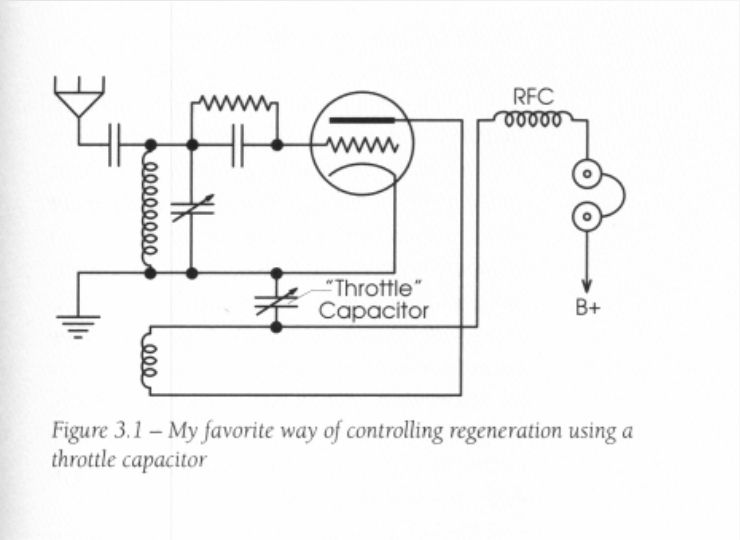


Figure 3.1 – My favorite way of controlling regeneration using a throttle capacitor

- Antenna – typically 100 feet of end fed horizontal wire
- Antenna trimmer capacitor – 5-10pF
- Inductor/variable capacitor – tuned circuit
- Resistor/capacitor connected to the tube grid
  - “Grid leak” detector

Circuit Components

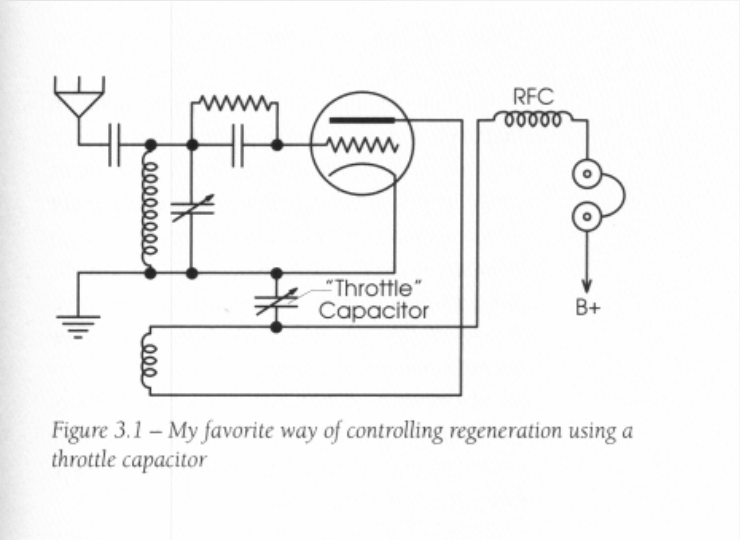


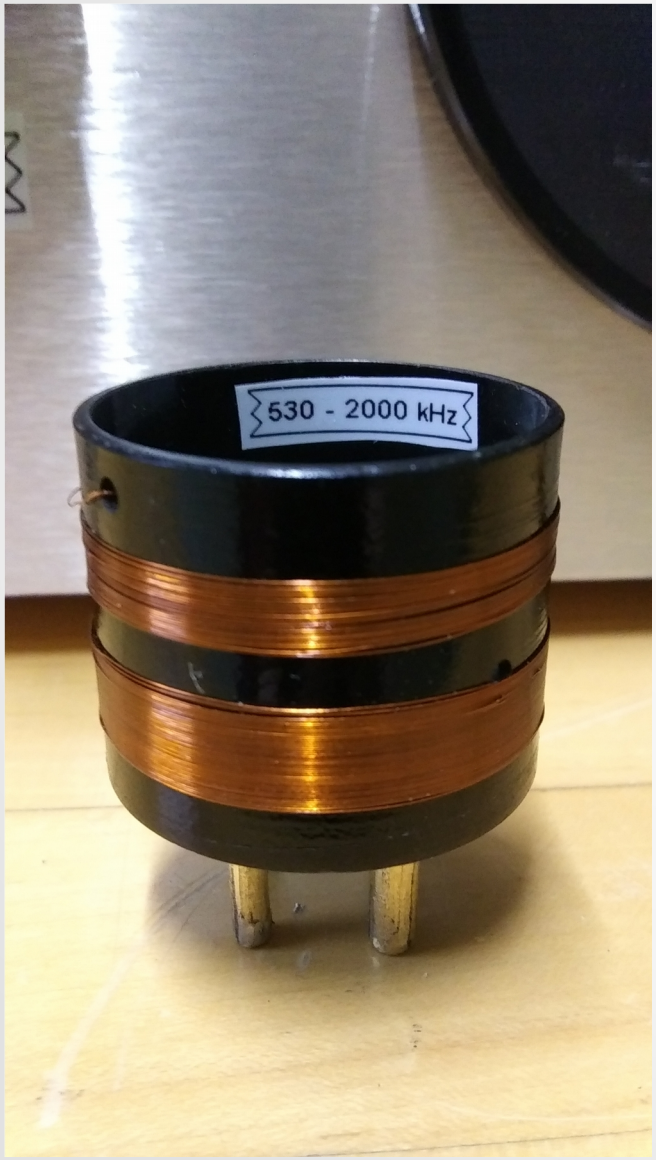
Figure 3.1 – My favorite way of controlling regeneration using a throttle capacitor

- Triode tube (6C4)
  - A signal on the grid is amplified and appears on the plate of the tube
- Throttle capacitor – used to adjust regeneration (amount of positive feedback)
- Tickler coil – provides positive feedback, which leads to high gain and oscillation
- RFC – RF choke, keeps radio frequency energy out of headphones
- Headphones – high impedance, approx. 1Kohms – 2Kohms
- B+ - plate power supply (90Vdc)

Gather the Parts

- Dive into the junk box!
- Most of the parts are old and came from flea markets, etc.
- Tuning: two capacitors in parallel
  - Coarse tuning: 55-880pF (2x440pF)
  - Fine tuning: 5-35pF
- Do the math to figure out the value of the inductor for the desired frequency range.
- 6C4 tube – thanks Steve (W1KBE)
- Grid leak: not critical, try 1.5MΩ and 50pF
- RFC – 2.5mH
- Tickler coil – derived by magic (experimentation)

Building the coils

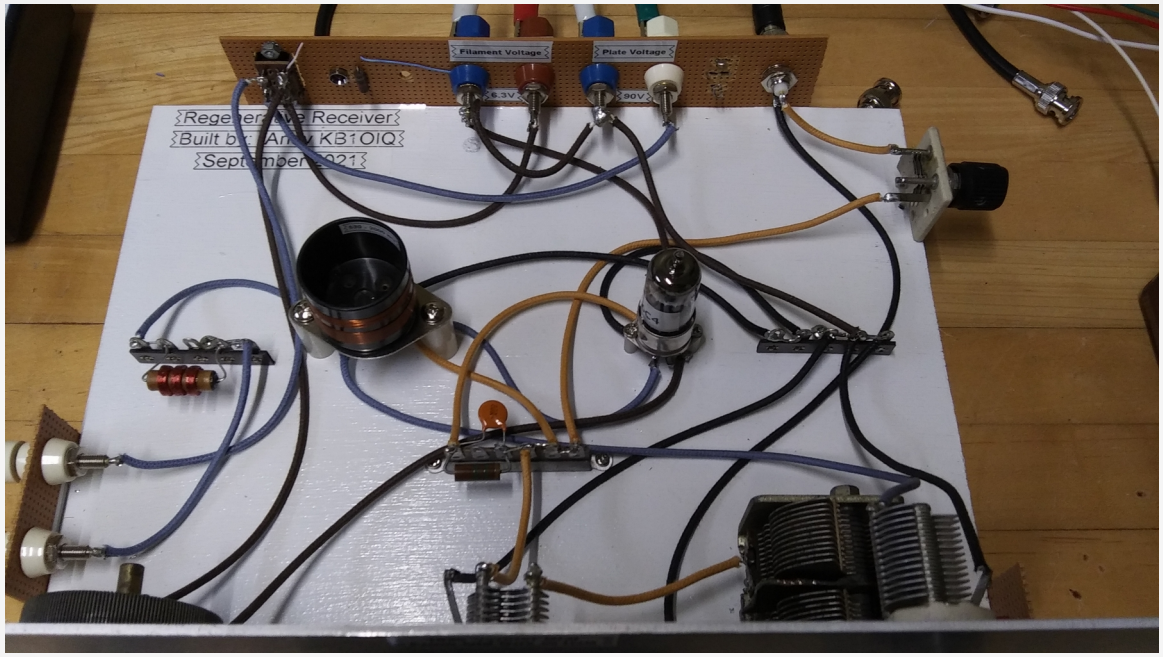


- The tuning coil and the tickler coil are coupled (on the same form).
- Use math to compute an approximate value for the tuning coil.
- Experimentation was used to “dial in” the actual values.
- Each band has its own coil.
- The coil is in a socket for easy replacement.
- Building this correctly is critical for proper tuning and regeneration.

Aluminum Front Panel

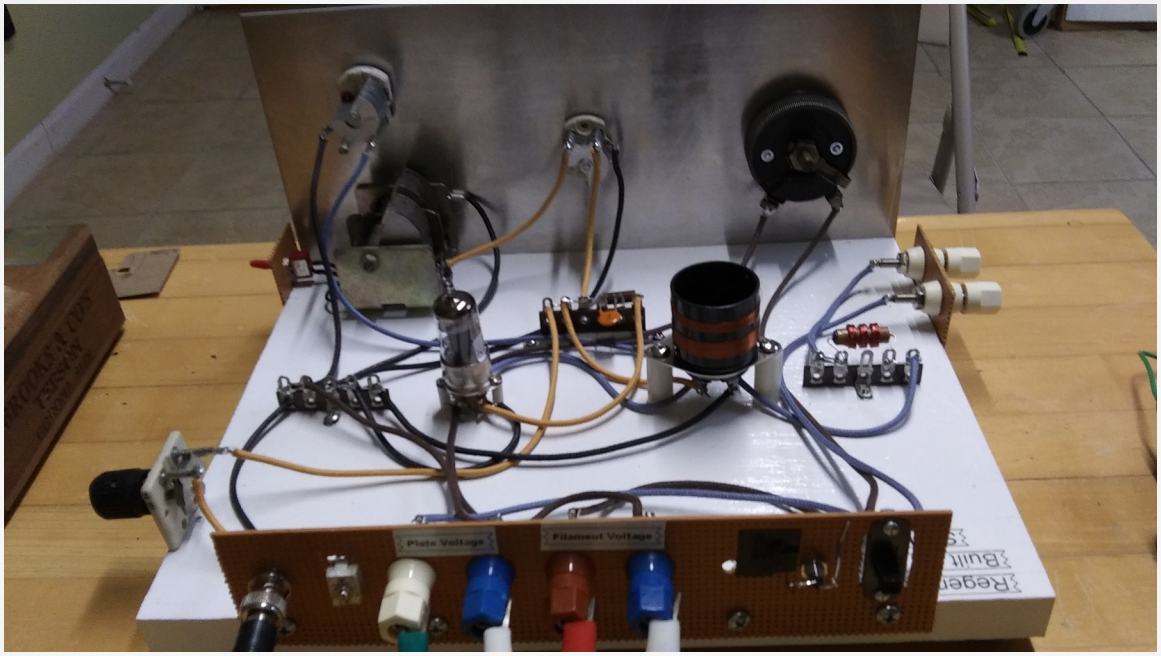
- Filament voltage rheostat (1920s)
- Coils for different bands (160m – 40m, 6MHz - 10MHz)
- Fine tuning vernier (1925!) from Old Gus (W1OG)
- Regeneration control
- Coarse tuning
- Cardboard tuning guide, one for each band

Wooden Base and Components



- Painted wooden base: 9”x12”
- Back Panel: on/off power switch and LED, plate voltage (90Vdc), filament voltage (6.3Vac), and BNC antenna input
- RFC, coil and socket, tube (6C4)
- White headphone connectors (bottom left)

Wooden Base and Components



- Bottom left: antenna trimmer capacitor
- Middle left red switch: coarse tuning cap 440pF or 880pF
- Front panel: throttle cap, coarse tuning, fine tuning, and filament rheostat
- Headphone connector (white) on right

Headphones

- 1920s headphones are about 1kΩ – 2kΩ and not hard to obtain
  - Modern 8Ω headphones will NOT work
- They are somewhat uncomfortable to wear
- There is PLENTY of volume for listening

AM Operation

- Any AM signal (broadcast band or shortwave)
  - Adjust regen control to a point just before oscillation
    - Oscillation sounds like a LOUD “squeal” or contant tone
    - Highest gain occurs just before oscillation starts
    - Oscillation is NOT desirable in this case
  - Adjust coarse and fine tuning to find a desired station
  - Readjust regen control to maintain high gain without oscillation.
  - Repeat all steps until desired station is tuned in.

CW Operation

- In this case, oscillation is a desired feature(!)
- Adjust the regen control to the point of oscillation, and perhaps a hair beyond that point.
- Adjust coarse/fine tuning to find a desired station.
- Continuously adjust all controls until CW is heard.
- This takes some patience and skill.

SSB Operation

- Oscillation is a desired feature in this mode.
- Perhaps the most challenging to tune
- Tune the regen control until oscillation is heard.
- Proceed in the same manner as tuning CW.
- When you hear “Donald Duck”, tune the fine tuning VERY SLOWLY until the voice is properly audible, perhaps SLIGHTLY readjusting the regen control as well.
- This requires a steady hand and the most patience.

Recommendations

- DON’T wear the headphones directly on your ears!
  - Wear them on your cheek bones in front of your ears.
  - Loud squeals are expected and often startling and WILL HURT your ears!
- Use a big outdoor antenna – the larger the better.
  - I use my 80m delta loop (270 feet long).
- Have patience and it will be rewarded.

Challenges

- Building the coils was the toughest part
  - Each coil was rebuilt perhaps 6 times to get it exact
  - Tickler coil was most challenging
  - Physical distance between coils matters A LOT!
- Ground: don’t daisy chain, use point to point wiring
  - I did this and avoided a lot of potentially strange problems
- To reduce hand/body effects:
  - Ground the aluminum front panel
  - Ground the capacitor frame

Epilogue

- I learned an awful lot from this project.
- I had a lot of fun!
- I now have a very usable radio receiver!
- Later, I built a power supply so I could save money on batteries.
- It does not work above 10MHz
  - Wires are too long, next time make it more compact
  - Smaller capacitors are needed at higher frequencies
- Old Gus' 1925 Martin Copeland vernier works quite well!
- The "Rockey" book was invaluable, especially describing "gotchas" so I could avoid them.

The End

- Thank you for attending this presentation.
- Email: kb1oiq@arrl.net

References

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  C. F. “Rock” Rockey
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- Simple Regen Circuit diagram
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  Figure 3.1, page 49