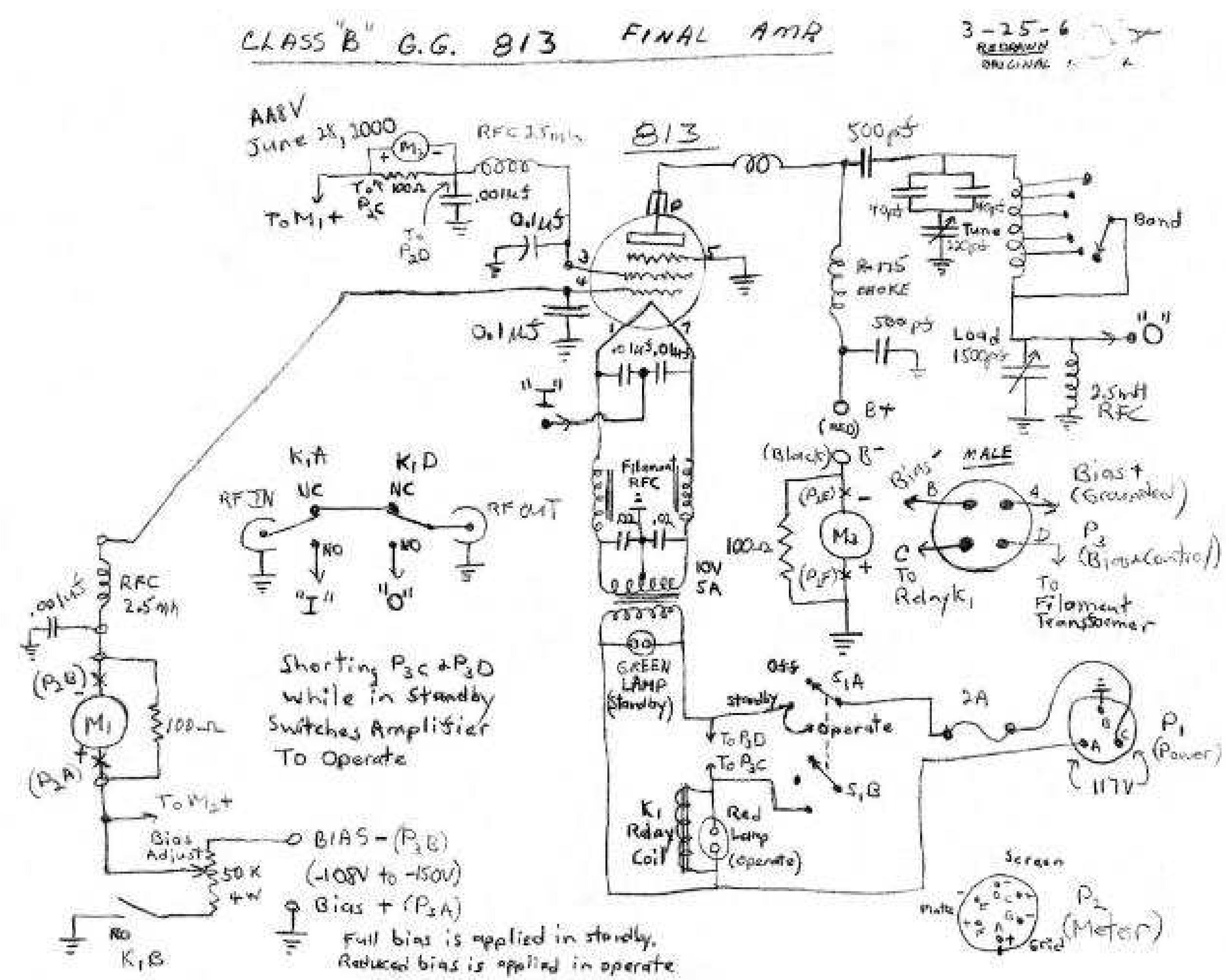
The AA8V Wingfoot 813 Amplifier
High Technology Of The 1950's In The 2000's
by Greg Latta, AA8V

Circuit Description and Schematic Diagram

Click On A Section of the Schematic Below for Information on That Part of the Circuit:



[Click here for a high resolution schematic.]

[Click here for a rotated schematic more suitable for printing.]

The Wingfoot 813 amplifier was designed and built by me to match the W8EXI Wingfoot VFO Exciter. At the time I received the exciter from Jim Trutko, W8EXI, I also received an amplifier that Jim had been working on years earlier. Designed around the popular (in the 1950's) 813 beam power tetrode, the amplifier was unfinished and incomplete. There was also a power supply for the amplifier on a separate chassis, but the power supply had design problems, defective parts (particularly the filter capacitors), and was not operational.

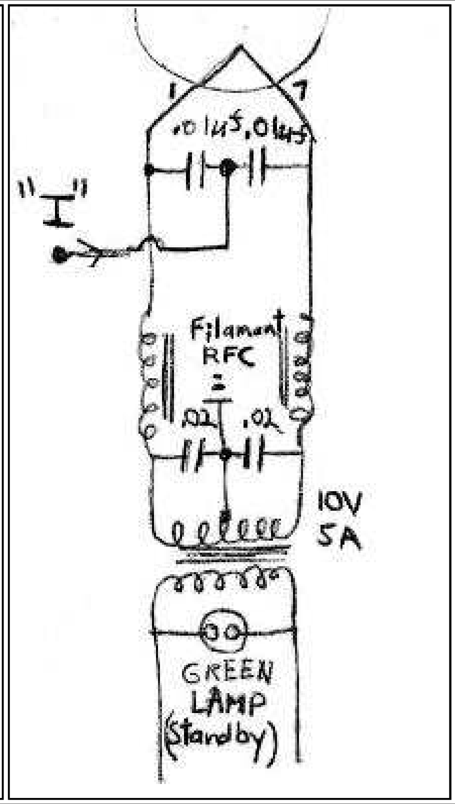
Since the amplifier would make a beautiful companion to the exciter, I decided to repair and redesign the power supply, and then to completely disassemble the amplifier into a pile of parts and start completely over. The result is an amplifier of exceptional performance and beauty.

Circuit Design Considerations:
The design of the amplifier was largely determined by the parts on hand: it would be designed around the 813 beam power tetrode and would hopefully utilize the tank components on hand. A grounded grid (cathode driven) configuration was selected, since plenty of drive was available, and the circuit would be simpler. It was decided to run the 813 "triode connected", with the screen in parallel with the control grid. This would eliminated the need for a screen supply, and during operation the tube could be run with zero

bias. A bias supply would thus only be needed to cut off the tube during standby/receive, and a simple, unregulated bias supply would suffice. Though in input matching circuit would have given better linearity and a better impedance match to some exciters, one was not used since the exciter could match a wide range of impedances and the amplifier would be used for CW, where linearity was not a major concern. Finally, since the amplifier might be used with a transceiver, a relay transmit/receive circuit was included to bypass the amplifier and apply cutoff bypass to the 813 during receive.

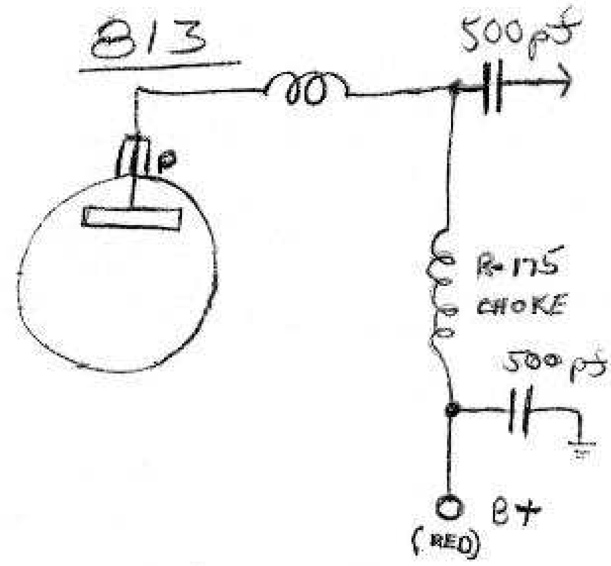
Click here for pictures and information on the matching Wingfoot VFO 2E26 Exciter

Amplifier Input and Filament Supply Circuit:
In a directly heated cathode grounded-grid circuit it is necessary to allow both the input RF ("I") and the filament power to reach the filament/cathode without interfering with each other. In the circuit shown at right the two 0.01 uf capacitors permit the input RF to reach the filament, while preventing the much lower frequency filament AC from flowing back through the input circuit. At the same time, it is important to keep the input RF from flowing into the filament power transformer. This is accomplished with a pair of heavy duty RF chokes that are actually wound on the same core. These allow the low frequency heater AC to pass through while blocking the much higher frequency RF. Any residual RF that might have passed through the RF chokes is shorted to ground through the two 0.02 uf capacitors. The filament transformer provides 10 volts AC at 5 amperes to heat the 813 filament.

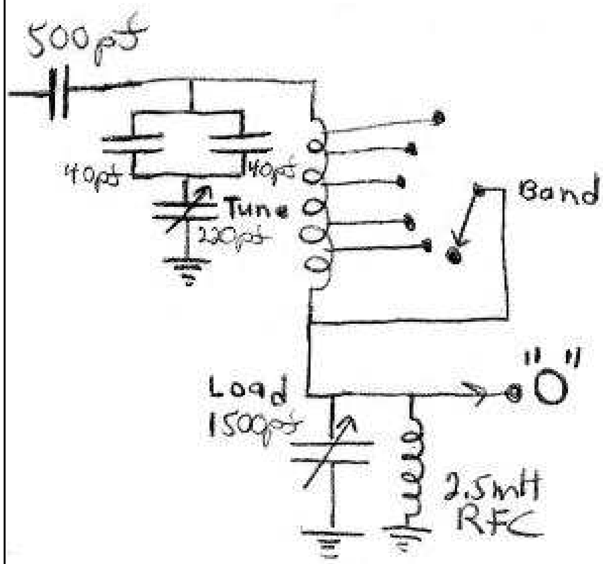


Amplifier Plate Feed Circuit:

In an RF amplifier it is necessary to supply DC plate voltage to the tube (about 2000 volts in this case) and at the same time extract the amplified RF that appears at the plate of the tube. In the circuit at right, the R-175 plate RF choke allows the direct current from the plate supply (B+) to pass through it, while preventing the RF on the plate of the tube from flowing back through the plate supply. At the same time, the 500 pf plate coupling capacitor (at the top in the schematic) permits the RF on the plate to flow though to the output tank circuit while blocking the plate voltage. The 500 pf capacitor at bottom short circuits any residual RF that might have gotten through the plate choke and prevents it from reaching the plate supply. The small coil in series with the plate lead is a parasitic suppressor, which helps prevent unwanted oscillations.

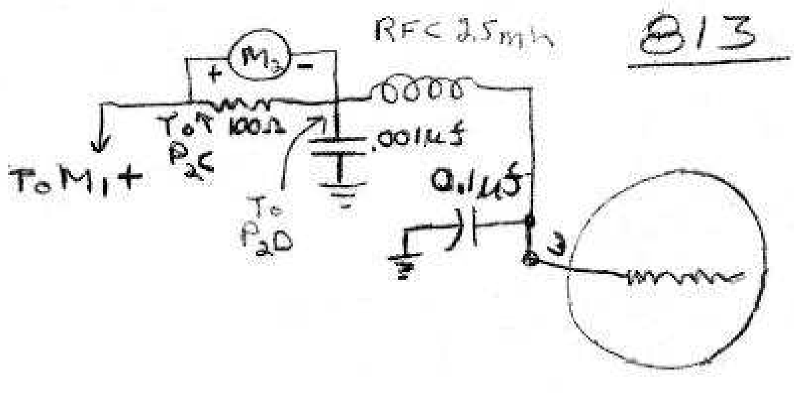


Amplifier Plate Tank Circuit:
The plate tank circuit is a pi-network that matches the high impedance of the plate to the low impedance of the antenna. At the same time the circuit filters out undesired harmonics from the output signal. The signal from the plate enters through the 500 pf plate coupling capacitor at the upper left in the schematic. The two 40 pf capacitors and the 220 pf variable capacitor, in combination with the plate tank coil, tune the plate to resonance. The two 40 pf capacitors are placed in parallel to produce an 80 pf capacitor. This is then placed in series with the 220 pf variable capacitor. The result is effectively a variable capacitor with a maximum capacitance of about 59 pf. This slows the plate tuning rate and makes the amplifier much easier to tune. The band switch varies the inductance of the tank coil, and the 1500 pf load capacitor adjusts the network for the best impedance match. The 2.5 mH RF choke performs two important functions: If the plate coupling capacitor should fail and short, the RF choke will short circuit the plate supply, hopefully blowing the fuse. This will prevent the plate voltage from appearing on the antenna, a very dangerous situation. The choke also prevents any DC voltage from appearing across the load capacitor, lowering the voltage it is required to handle.

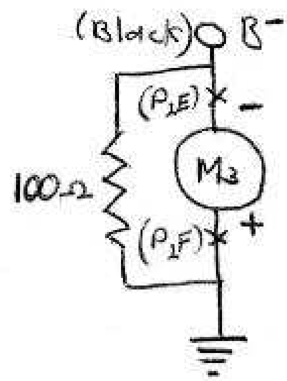


Amplifier Grid Metering Circuits:
Metering the DC grid currents of an RF amplifier is an important method of monitoring amplifier operation. In this

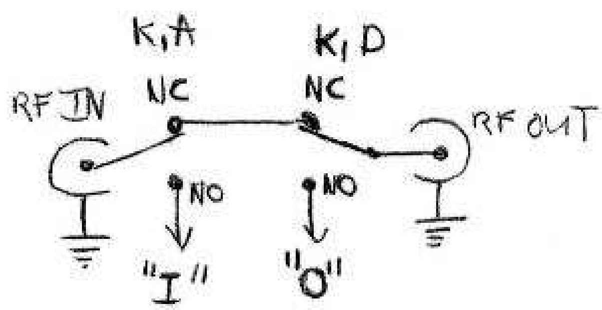
amplifier, the control grid and screen grid are connected in parallel for RF, effectively creating a "super" control grid. (So called "triode connection".) Though they are in parallel for RF, the DC current of each is measured separately. The screen grid and control grid metering circuits are identical and for clarity only the screen grid metering circuit is shown here. Each meter is shunted with a 100 ohm resistor. This permits the amplifier to operate without the meter panel connected. The 0.1 uf capacitor grounds the grid for RF right at the tube socket, and the 2.5 mH RF choke and 0.001 uf capacitor make sure that no residual RF finds it way to the meter.



Amplifier Plate Metering Circuit:
Metering the plate current of an RF amplifier is even more important than metering the grid current. In this amplifier, the plate current meter is placed in the negative lead of the plate supply. This keeps the meter near ground potential and keeps high voltages off of the meter. The 100 ohm resistor grounds the negative lead of the plate supply (B-) if the meter is disconnected, which is a safety feature, but the amplifier cannot be operated without the plate meter connected, as the resistor alone cannot handle the necessary current and would burn out. It is also important for the grid return to be connected to the amplifier chassis ground and not the B- lead, as connecting the grid return to B- would cause the plate meter to indicate both plate and grid current.

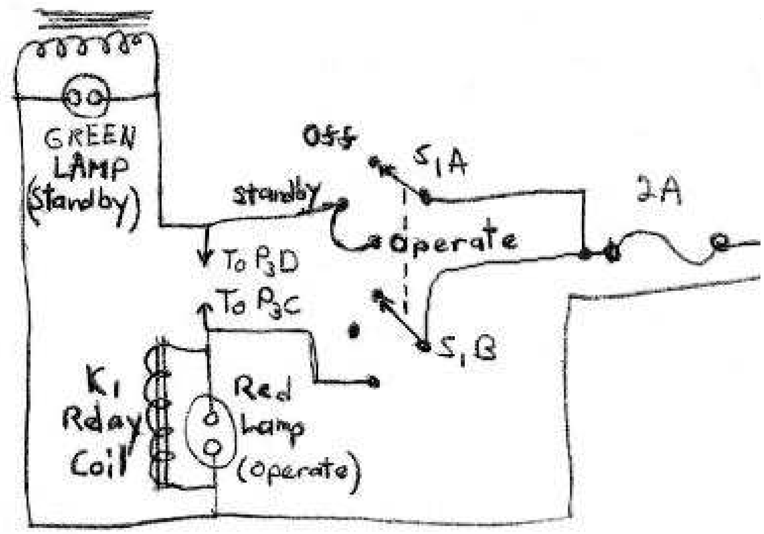


Amplifier Transmit/Receive Switching Circuit:
When an RF amplifier is used with a transceiver, it is necessary to bypass the amplifier during receive periods. In this amplifier sections "A" and "D" of relay K1 handle the transmit/receive switching. (Section "B" is used for bias switching.) When the coil of K1 is not activated (amplifier "Off" or in "Standby") the normally closed (NC) contacts of relay sections "A" and "D" connect the amplifier input jack directly to the output jack, bypassing the amplifier. When the relay coil is activated (amplifier in "Operate") the input jack is connected to the input of the amplifier "I" via the normally open (NO) contact of section "A" and the output jack is connected to the output of the amplifier "O" via the normally open contact of section "D".

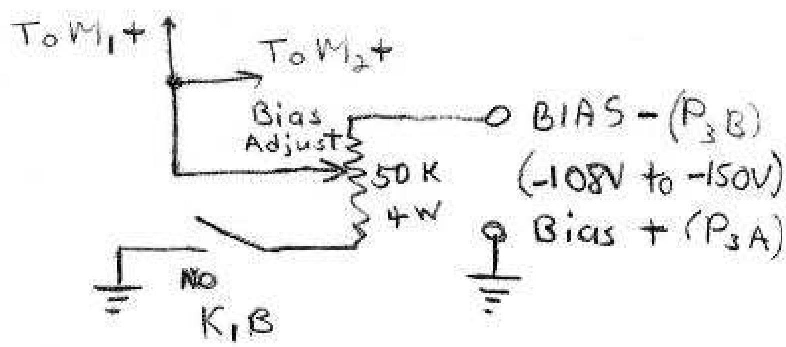


Amplifier Mode Switch and Relay

Activation Circuit :
One side of the 117 volt AC line (from power jack P1 on the rear of the amplifier) is routed through a 2 Amp fuse to the rotors of sections "A" and "B" of mode switch S1. The other side of the AC line is routed to one side of the filament transformer and relay K1. When mode switch S1 is in the "Off" position, the AC is disconnected from the filament transformer and relay and the amplifier is turned off. When S1 is set to the "Standby" position, the filament transformer and green standby light are turned on and the amplifier is in "Standby" mode. When the mode switch is placed in the "Operate" position, relay K1 is also activated, placing the amplifier in "Operate" mode. The amplifier can also be remotely switched from "Standby" to "Operate" by shorting pins "C" and "D" of bias and control jack P3 on the back of the amplifier.



Amplifier Bias Circuit:
The amplifier bias circuit applies adjustable bias to the 813control and screen grids, which are run in parallel. (So called "triode connection".) In "Standby" mode the coil of relay K1 is not activated, and one end of the 50k potentiometer is left unconnected. This applies the full output of the bias supply to the 813 grids to cut the tube off. During "Operate" mode, the coil of relay K1 is activated, and the end of the 50k potentiometer is grounded, reducing the bias to the value selected by the bias adjust potentiometer. In actual operation the tube is operated with zero bias so the wiper is set at the bottom end of the potentiometer.




Click here for pictures and information on the matching Wingfoot VFO 2E26 Exciter

Back to Dr. Greg Latta's Electrical Engineering and Amateur Radio Pages

Visit Greg Latta's Personal Web Page

Questions, Comments, and E-Mail

If you have any questions or comments, you can send E-Mail to Dr. Greg Latta at glatta@frostburg.edu

Thanks for stopping by!