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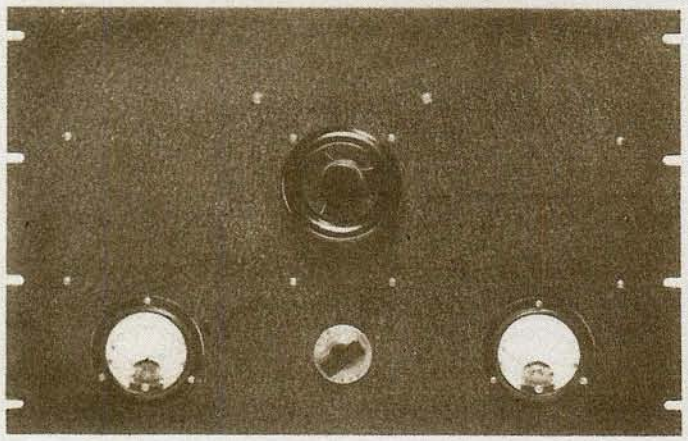
FINAL AMPLIFIER USING PAIR OF RCA-813's IS A DX DEMON

"SUPER-SLUGGER" HIGH POWERED FINAL



Panel view of the unit which uses a pair of RCA-813's, has low drive requirements and automatic correction of L/C ratio for all bands.

NOVEL RIG COVERS 10-80 BAND FOR PHONE OR CW APPLICATION

By M. L. "Doc" REDMAN
W2PBX (Ex-W9ENK/2)
Manager, Electron Microscope Section, RCA Service Co., Inc.

Four months ago this station put a pair of RCA-813's in a new final amplifier, and shoved a full kilowatt into them. They took the soup without blushing, and the recent announcement of new tube ratings has proved our point. The new post-war RCA-813's are bigger and better than ever, and the reduced price of $14.50 makes them the logical choice for that high-powered final.

A casual inspection of the pictures will show no parasitic chokes, or other electrical or mechanical corrective gadgets. Instead, observation reveals symmetry, and complete band coverage from 10 to 80. The thing we like best of all is the feature that the plug-in coils can be changed from either side, top, or rear, whichever is most convenient.

What more do you want in a unit of this kind? Quick band change without neutralization? Low drive requirements? Provisions for both phone and CW operation? Automatic correction of L/C ratio for all bands? No bugs, parasitics, or other forms of electronic vermin? Ease of construction with ordinary hand tools? You get all these and "heavenly reports too" with the 813 "Super Slugger".

As can be seen, the transmitter is built around a pair of National TMA-100-DA split-stator variable condensers, a Millen 10,000 worm gear drive unit, a set of B & W type TVH plate tank coils, a set of National AR-16 grid coils, and of course, a pair of those big beam "bottles".

The two variable condensers are mounted end-to-end into the worm

(Continued on Page 2, Column 1)

COMPACT OSCILLATOR A GIANT PERFORMER FOR 2 METER WORK

By J. H. OWENS
W3ASZ/2
Amateur Sales. RCA Tube Department

Try this one for size! And if you are one of those Hams who agree that good things comes in small packages, you will like the "Ninety-Ninety" oscillator.

The "Ninety-Ninety", or "90+90", if you prefer, is exceptionally small and compact. But the components are not overly crowded. In fact, as can be seen from the photographs, there is space enough for the modulation transformer in a cabinet only 3" x 4" x 5"—just in case you want to use plate-and-screen modulation.

Starting at the beginning, the 90+90 is a push-pull oscillator, having a tuned plate tank and a tuned grid tank. Intermediate between the two, and coupled to both of them is a third tank circuit, also tuned. That makes three tank circuits, all tuned to the same frequency, and all doing their utmost to hold the transmitter on frequency.

Ninety-Ninety, you see, is not just the name of the oscillator, it is also a significant expression for the principle of operation.

Electromagnetically speaking, two loosely-coupled tank circuits are 90 degrees apart in phase, and if a third one is loosely coupled to the second (and properly polarized), there will be a total phase shift of "90 plus 90" or 180 degrees.

The meaning of all this is that a tube will oscillate at the resonant frequency of its grid and plate tank circuits only when they are both tuned to the same frequency, and are exactly 180 degrees out of phase. Under any other condition, the frequency will have to deviate from resonance to provide the reactance necessary for this phase difference.

The surprising characteristic of the Ninety-Ninety is the way it "tracks" in tuning. When it is properly adjusted, the points of

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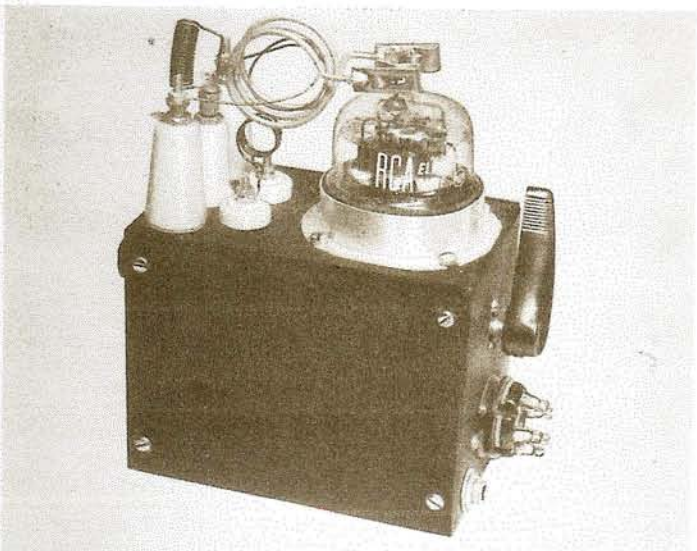
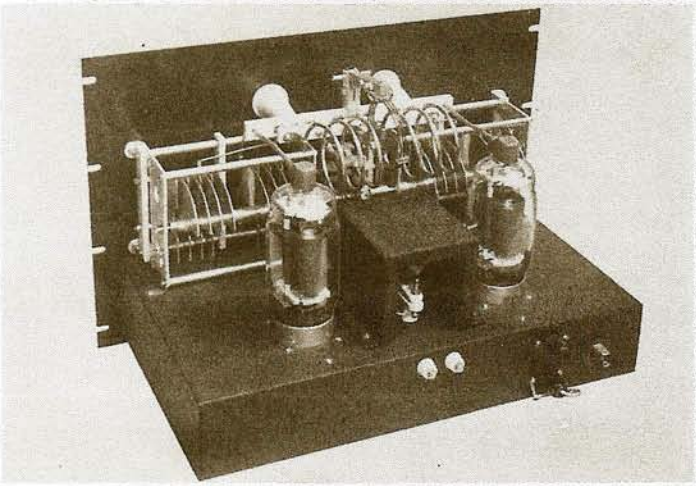
"NINETY-NINETY" RARIN' FOR THE AIR



This diminutive oscillator develops remarkable power output even though it is housed in a 3" x 4" x 5" cabinet.

DESIGNED FOR SYMMETRY AND EFFICIENCY



Rear view of "Super-Slugger" reveals clever removable shield which permits coils to be changed with maximum convenience.

NOVEL RIG

(Continued from Page 1, Column 4)

drive unit. In this arrangement, they serve as chassis mounting brackets as well as the source of capacitive reactance. The frame bases are bolted to the panel, and the frame sides are bolted to the chassis by means of ½" angle brackets. A very substantial mechanical linkage is the result.

All four sections of the condensers are used for 80 and 40, and only one section of each condenser for 20 and 10 meters. Adequate capacitance is supplied on all bands by this arrangement. Two turns were removed from the 80-meter coil, as well as from the 40, 20, and 10-meter coils. This was done to keep harmonics to a minimum, and to keep the signal extra sharp so as to prevent BCL interference. (We are apartment house dwellers.)

Circuits Isolated

The final tank-coil swinging-link assembly is suspended from the panel with two 1¾" insulators, which almost places the soldering lugs of the unit directly above the connecting points on the condensers. It is not possible to see the plate rf choke which is mounted on a feed-through insulator located between the panel and gear drive. This placement aids in further isolating the grid and plate circuits. The screen circuit is conventional with a possible exception that each tube is individually by-passed to ground and that the plate by-pass capacitor is connected to the screen circuit. This is done for best phone performance, as it serves to prevent loss of high-frequency audio response. It will be noticed by referring to the bottom view of the chassis that all by-pass capacitors from the screen and filament leads are connected directly to ground in the region of each socket through socket mounting bolts. One mica filament capacitor is located at each socket, by-passing one and the other side of the filaments. The beam-forming plates are placed at ground potential through connection to socket mounting bolts.

One method of supplying the screen voltage, consists of a voltage divider circuit which automatically prevents the screen voltage from rising to the plate potential if the space current is reduced to zero. Details for determining values for the voltage divider circuit will be found in an article "Fool Proof Screen Feed" by W. E. Roberts, Radio Corporation of America, Page 38, October 1940 QST.

The screen grids can also be fed from the plate supply through a series resistor, or they can be fed from a separate supply. If either of these methods is employed and the amplifier is used for CW work, precautions must be taken to prevent excessive screen dissipation or voltage during key-up conditions.

All grid components are completely isolated from the plate circuit. This is imperative to prevent self-oscillation of the tubes. The plug-in grid coil is housed in a removable shield above the chassis which plugs in like a coil assembly, facilitating quick coil changing.

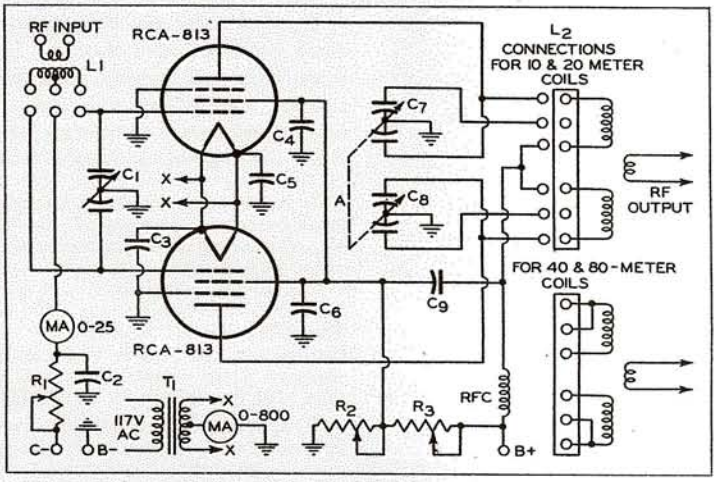
Short direct connections from the grid coil to the grid condenser and then to the grid proper is made possible by placing the grid condenser between the two sockets. It will be noted that the grid bias terminal at the back of the chassis is grounded externally. This is not an innovation but rather was done for convenience at this station. Fixed bias is placed in the grid circuit by removing the grounded plug and substituting one from the bias supply. Grid-leak bias has been used entirely for phone operation. However, it is good practice to combine fixed bias with grid-leak bias for purposes of tube protection, during periods of no excitation, whether caused by key-up periods or by failure of a preceding stage.

More than sufficient excitation was supplied to the amplifier from 80 through 10 meters from a conservatively operated 807 doubler. The needle of the 25 milliampere meter in the 813 grid circuit can be pushed to the pin with only 30 to 50 plate mils at 450 volts to the 807.

Meter Functions

The plate and grid meters are conventionally located in the circuit. The plate meter is in the cathode circuit, and therefore reads the total of screen, plate, and grid currents. All circuits, screen, grid, and plate, have been checked individually and this probably should be considered recommended procedure because too high screen current and voltage will result in excessive dissipation while too low screen voltage will reduce the output. If the grid-leak resistor is returned to the top side of the plate current meter instead of to ground the plate meter will not read grid current.

The unit is entirely free of parasitics and remains stable during periods of 100% modulation. Many compliments have been received commenting on the sharp powerful signal and fine 'phone quality. Probably the nicest one comes from W2PLF who admired the amplifier's efficiency and performance to the point of constructing an identical unit.



"Super-Slugger" Schematic

PARTS LIST

L1 National AR-16 center-link coils.
L2 B & W type TVH (see text).
A Millen 10,000 worm drive gear.
C1 100 μμf per section, split-stator, variable.
C2 0.006 μf, 500 volt, mica.
C3, C5 0.002 μf, 500 volt, mica.
C4, C6 0.003 μf, 2500 volt, mica.
C7, C8 50 μμf per section, split-stator, variable, 0.171" spacing.
C9 0.002 μf, 5000 volt, mica.
R1 25,000 ohm, adjustable, 25 watt, WW.
R2 25,000 ohm, adjustable, 25 watt, WW.
R3 50,000 ohm, adjustable, 75 watt, WW.
T1 10 volt, 10 ampere, filament transformer.
RFC National R-175 or R-154U.

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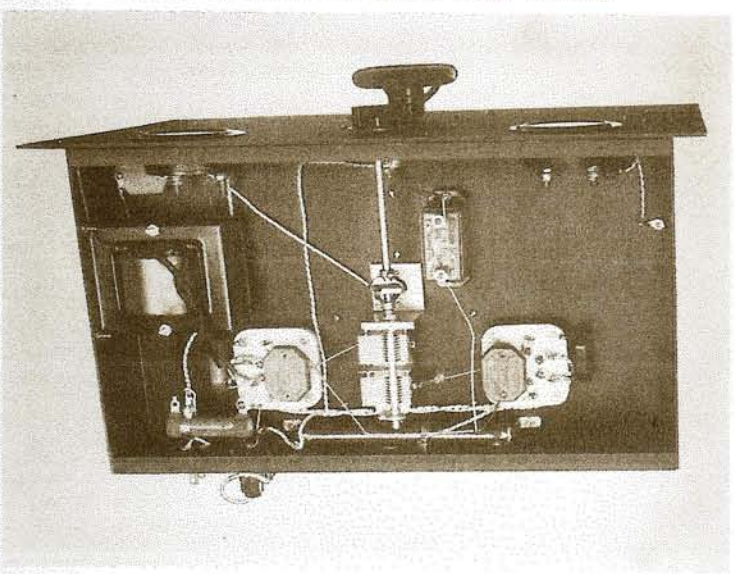
SIMPLE MECHANICAL WORK AND WIRING



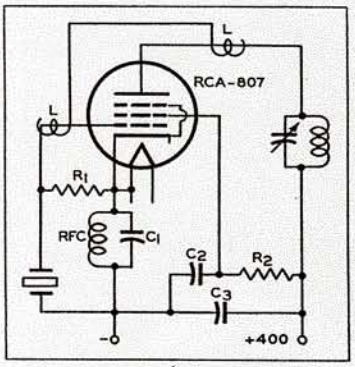
Bottom view of the final amplifier shows how all grid components are completely isolated from plate circuit to prevent self-oscillation of tubes.

807 XTAL. OSCILLATOR CONVERTS THIS RIG FROM 40 TO 15 METERS

By J. L. REINARTZ
Power Tube Group, RCA Lancaster Engineering Section

I was asked the other day what I would do to my transmitter to be able to operate in the 15-meter band. My solution would be to use a suitable 40-meter crystal, which I have, and triple to the 15-meter band in the plate circuit of an 807 crystal oscillator.

A laboratory set-up proved the point. The 807 crystal oscillator operated well at the fundamental, the second and the third harmonic, and proved capable of driving an 813 at 21 Mc. The following circuit arrangement was used and can readily be duplicated.



PARTS LIST

C1 100 $\mu\mu$f midget, mica.
C2 0.005 μf midget, mica.
C3 0.005 μf midget, mica.
L, L Piece of insulated wire looped one or two turns around plate and grid leads.
R1 25,000 to 50,000 ohms, 2 watt carbon.
R2 25,000 ohms, 5 watt WW (50,000 ohms if plate supply exceeds 500 volts).
RFC Single layer coil, #24 enameled wire, coil 1½ inches long, ⅜ inch diameter.

COMPACT OSCILLATOR

(Continued from Page 1, Column 2)

minimum plate current, maximum grid current, and maximum rf output will all fall at the same points of tuning. This is a good indication that the grid and plate tanks are separated by two 90-degree phase shifts.

The plate tank is on top of the chassis, and is supported by the Fahnstock plate clips and the rf feed choke. It is tuned by the expedient of squeezing or spreading the turns.

Loose Coupling

Mounted on two feed-through insulators, and very loosely coupled to the plate tank, is the pick-up coil that feeds the intermediate coupling tank. This tank is tuned by a variable condenser, and is in turn very loosely coupled to the grid tank, which is also condenser tuned. The desired result is accomplished. (A lot of tanks, eh, what?)

The accompanying photographs, the circuit diagram, and the parts legend, illustrate the oscillator well enough to make it easily duplicated. That leaves little else to put in writing except some pointers derived from experience in the building of three models.

The first point to be kept in mind is that the three tanks must be loosely coupled. If they are closely coupled, the tuning will be broad, and the setting for maximum grid current and rf output will not track with the plate current dip.

The second point for attention is the adjustment for optimum grid drive. The tendency may be toward too little grid drive with loose coupling. If this happens, it can be corrected by using more inductance and less capacitance in the grid tank. The use of more wire in the intermediate tank pickup coil also helps to provide more drive with a given degree of coupling to the plate tank. Use of the smallest amount of grid current that will provide upward modulation is recommended.

Final Adjustment

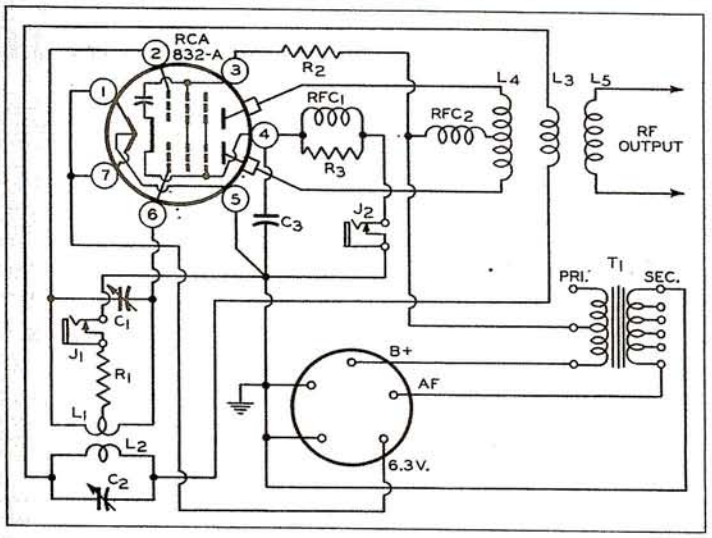
The third and last point, is to make sure that the intermediate tank pickup loop is properly polarized. If it is wound in the wrong direction, the oscillator will not function when all circuits are tuned to resonance. Instead, oscillations will occur when the intermediate tank is tuned to either side of resonance! Reversing the winding will correct this in a jiffy.

Either the 832-A or the 829-B will give good performance at 1¼ as well as 2 meters. The 829-B has higher input and output capacitance, therefore will require less inductance and capacitance in the tank circuits. The 815 performs nicely at 2 meters, but should not be expected to work the higher frequency band. A pair of 2E26's can also be used with good results. As illustrated, the oscillator will work only the 2-meter band.

The initial tune-up should be done with reduced power on the tube. A milliammeter should be connected in series with the plate and screen voltage supply. Also, a milliammeter should be connected in series with the grid-bias resistor, or a voltmeter should be connected across it. A 15-watt incandescent lamp should next be connected across the antenna pickup loop.

The grid tank condenser and the intermediate tank condenser should be tuned for maximum rf output. Then the plate tank coil should be squeezed or spread to get the oscillator on frequency, and the variable condensers should be tuned again. Preliminary adjustments should be made for lowest plate current.

In the final adjustment, the point of minimum plate current will track with the point of maximum grid current to develop the greatest power output, and then the Ninety-Ninety will prove deserving of its name.

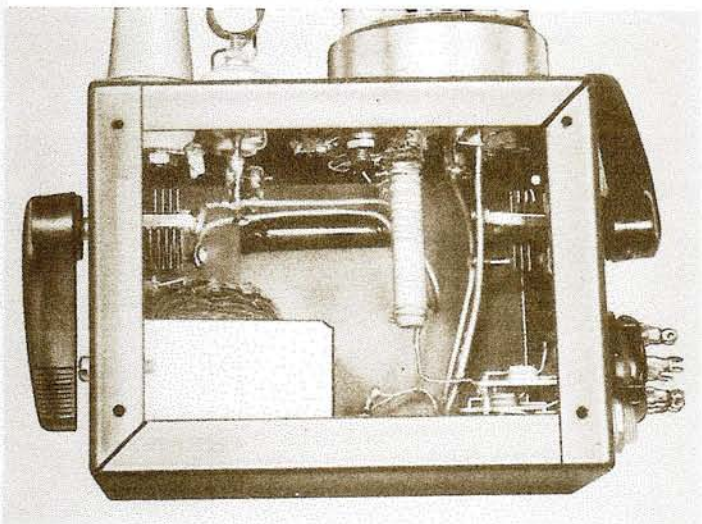


Compact Oscillator Schematic

PARTS LIST

L1 Grid tank, 7 inches #12 wire in hairpin loop.
L2 Intermediate coupling tank, 7 inches #12 wire in hairpin loop.
L3 Pickup coil, 4 turns #18 wire, ½ inch diameter coil.
L4 Plate tank, 3 turns #10 wire, 1½ inches diameter coil.
L5 Antenna coil, 1 inch diameter, 2 turns #18 wire.
C1 6 plate midget variable, ceramic frame.
C2 9 plate midget variable, ceramic frame.
C3 500 $\mu\mu$f midget mica, 500 volt.
R1 30,000 ohm, 5 watt, WW (2 watt carbon Okay).
R2 15,000 ohm, 5 watt, WW.
R3 100,000 ohm, 2 watt, carbon.
RFC1 38 inches #26 DSC wound on R3.
RFC2 20 inches #18 enameled wire wound on ¼ inch mandrel, coil 1 inch long.
J1 & J2 Closed circuit phone jack.
T1 Universal output transformer, 10 watt size, with air-gap in core.

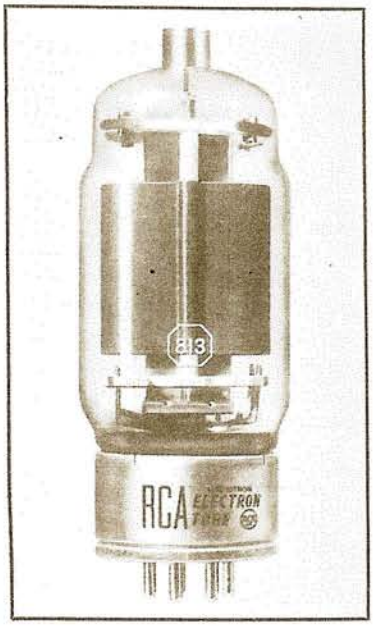
SMALL, COMPACT, BUT NOT CROWDED



Well planned placing of components in the 3" x 4" x 5" cabinet leaves sufficient space to work with soldering iron and tools.

RCA-813 TRANSMITTING BEAM POWER AMPLIFIER

500 WATTS INPUT TO 30 MEGACYCLES *Amateur Net* **$14.50**



RCA 813

Features

- *No Neutralization.* QUICK BAND CHANGE FROM "EIGHTY" TO "TEN".
- *High Power Gain.* ABOUT 4½ WATTS OF DRIVING POWER IS REQUIRED.
- *Real Ham Value.* THIRTY-FOUR-PLUS WATTS-PER-DOLLAR.
- *High Efficiency.* FULL PLATE-CIRCUIT EFFICIENCY AS HIGH AS 30 MC.
- *Low Screen Current.* MORE EFFICIENT USE OF DC AND AF POWER.

Behind the superb performance features of the RCA-813 are the following important electrical and mechanical design features:

1. Element supporting dome-top bulb.
2. Low-resistance, dual-ribbon plate leads.
3. Pure, gas-free, alumina insulators.
4. Electron-confining capacitance shield.
5. 50-watt thoriated-tungsten filament.
6. 125-watt non-warping graphite anode.
7. Nonex hard-glass straight-side bulb.
8. Unobstructed guarded getter.
9. Low-loss glass-dish stem.
10. Drawn tungsten metal-to-glass seals.
11. Short-leads for low internal inductance.

Application

Driving Power. A small crystal oscillator will provide adequate drive at frequencies of 3 to 7 Mc. At 30 Mc., an 807 doubler will drive a pair of 813's, with power to spare.

Shielding. The high power gain of the 813 necessitates complete shielding of the grid circuit from the plate circuit. Neutralization is not required.

Plate Modulation. The screen grid must be modulated simultaneously with the plate. The screen grid voltage can be taken from a fixed supply, fed through a modulation transformer winding. A less efficient but equally satisfactory method is to feed the screen grid through a dropping resistor connected to the modulated plate supply.

Class C Telegraphy. Under key-up conditions, the screen grid potential should not exceed 800 volts. If a preceding stage is keyed, a fixed bias of about 45 volts should be used to limit the plate current to a safe value.

Frequency Multiplication. Use Class C telegraphy ratings, but increase grid bias and grid current to point that produces optimum efficiency. Proper values will be approximately twice those given.

RF Bypassing. In plate-modulated telephony service, where the screen grid is fed through a series resistor from the modulated plate supply, the plate-circuit should be by-passed to the screen grid, and the screen grid should be by-passed to cathode. The screen by-pass capacitor should be about three times as large in value as the plate capacitor.

NEW RATINGS — RCA-813

Plate-Modulated R-F Power Amplifier—Class C Telephony

Maximum Ratings, Absolute Values

	CCS	ICAS
D-C Plate Voltage	1600 max.	2000 max. volts
D-C Screen Voltage (Grid No. 2)	400 max.	400 max. volts
D-C Grid Voltage (Grid No. 1)	—300 max.	—300 max. volts
D-C Plate Current	150 max.	200 max. ma.
D-C Grid Current	25 max.	30 max. ma.
Plate Input	240 max.	400 max. watts
Screen Input	15 max.	20 max. watts
Plate Dissipation	67 max.	100 max. watts

Typical Operation

D-C Plate Voltage	1250	1600	2000 volts
D-C Screen Voltage*	400	400	350 volts
From a series screen resistor of	53,000	60,000	41,250 ohms 11K
D-C Grid voltage**	—120	—130	—175 volts
From a grid resistor of	30,000	21,600	41,000 ohms
Peak R-F Grid Voltage	195	210	300 volts

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HAM TIPS is published by the RCA Tube Department, Harrison, N. J., and is made available to Amateurs and Radio Experimenters through RCA tube and parts distributors.

H. S. STAMM ..... *Editor*
J. H. OWENS ..... *Technical Editor*

D-C Suppressor Voltage (Grid No. 3)	0	0	0 volts
D-C Plate Current	150	150	200 ma.
D-C Screen Current	16	20	40 ma.
D-C Grid Current (Approx.)	4	6	10 ma.
Driving Power (Approx.)	0.7	1.2	4.3 watts
Power Output (Approx.)	135	175	300 watts

*Obtained preferably from a fixed supply modulated simultaneously with plate voltage, or from modulated plate supply through series resistor of value shown.

**Obtained from a grid resistor of value shown or from a combination of grid resistor with either fixed supply or cathode resistor. Total effective grid circuit resistance should not exceed 30,000 ohms.

R-F Power Amplifier and Oscillator—Class C Telegraphy

Maximum Ratings, Absolute Values

	CCS	ICAS
D-C Plate Voltage	2000 max.	2250 max. volts
D-C Screen Voltage (Grid No. 2)	400 max.	400 max. volts
D-C Grid Voltage (Grid No. 1)	—300 max.	—300 max. volts
D-C Plate Current	180 max.	225 max. ma.
D-C Grid Current	25 max.	30 max. ma.
Plate Input	360 max.	500 max. watts
Screen Input	22 max.	22 max. watts
Plate Dissipation	100 max.	125 max. watts

Typical Operation

D-C Plate Voltage	1250	1500	2000	2250 volts
D-C Screen Voltage†	300	300	400	400 volts
From a series resistor of	27,000	40,000	36,000	46,000 ohms
D-C Grid Voltage‡				
From a fixed supply of	—75	—90	—120	—155 volts
From a grid resistor of	6000	7500	12,000	10,000 ohms
From a cathode resistor of	330	400	520	565 ohms
Peak R-F Grid Voltage	160	175	205	275 volts
D-C Suppressor Voltage (Grid No. 3)	0	0	0	0 volts
D-C Plate Current	180	180	180	220 ma.
D-C Screen Current	35	30	45	40 ma.
D-C Grid Current (Approx.)	12	12	10	15 ma.
Driving Power (Approx.)	1.7	1.9	1.9	4 watts
Power Output (Approx.)	170	210	275	375 watts

†Obtained from a separate source, from the plate-voltage supply with a voltage divider, or through a series resistor of value shown. Series screen resistor should be used only where the 813 is employed as a buffer amplifier and is not keyed. The screen voltage must not exceed 800 volts under key-up conditions.

‡If preceding stage is keyed, partial fixed bias is required.