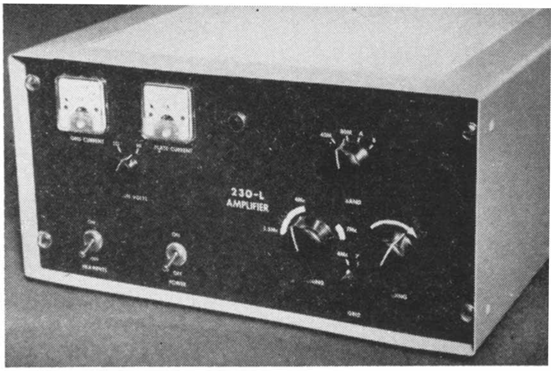


The rotary switch between the two meters is for changing screen voltage. The toggles below control filament and plate power. To the right are the plate tank-tuning and loading controls, with the plate band switch above, and the grid switch below.

The homemade 7 × 14½ × 14½-inch wrap-around cabinet [1] is made of steel with similar cutouts in both top and bottom covered with expanded metal. Both front and back of the cabinet are open. The sides of the front are fitted with sections of angle stock against which the panel is fastened.

The RCC 230-L Amplifier

807s in a 230-Watt Linear for 80 and 40

BY J. L. COPELAND,* W5SQT

By heavily loading the grid circuit of this amplifier, the author achieves both the stability and broad-band input characteristics of a grounded-grid amplifier, but with a much lower driving-power requirement.

The cost of an amplifier (in which the power supply is an important factor) runs approximately in proportion to the power level. In cases where economy is essential, it is well to remember that, other things being equal, the signal from a 250-watt transmitter will be down only one S point (6 db.) from the signal level of an amplifier operating at the maximum legal input of 1 kw. While the single S point may sometimes spell the difference between copy and no copy when working DX at low signal levels, it may serve merely to cause the receiving operator to turn his gain control down a bit in rag-chew operating over moderate distances where the average signal level is ordinarily relatively high. At the same time, the kilowatt job will cost about four times as much and will be approximately four times as large and heavy. With s.s.b. and c.w. rag-chew operating in mind, and minimum cost being essential, these considerations led to the 250-watt two-band unit shown in the photographs. The 80- and 40-meter bands were chosen as most appropriate for the purpose.

Within the last few years, the grounded-grid mode of operation has become popular because an amplifier of this type is s mple to bui'd and stabilize, and also because commercial s.s.b. transmitters in the 50- to 100-watt range required to drive the grounded-grid brutes have become widely distributed. Possibly for this reason, not as many articles on high-gain tetrode and pentode linears have appeared in the amateur journals. Although the amplifier described here is of the grounded cathode-type, it is also simple to build, is extremely stable, and has no tuning controls for the input circuit. It uses cheap tubes and can be driven to 230 watts input in Class AB_1 mode of operation. It uses two 807W beam power tubes (but 1625s and regular 807s can be used equally well) with 1100 volts on the plate and 408 volts on the screens. L networks are used in the grid circuit, and 2½ watts will drive the amplifier to 230 watts or more. The input presents a constant load of 50 ohms to the exciter. This amplifier was designed as a companion unit to an s.s.b. exciter delivering from 10 watts p.e.p. output down to one watt or less. The circuit of the amplifier is shown in Fig. 1.

Circuit

The grid circuit consists of an L network for each of the two bands. This network is designed to look like 50 ohms from the exciter input side when the grid side is loaded with a resistance of 500 ohms. These circuits have a Q of 3.[2] The fixed-tuned networks are switched into the grid of the amplifier by a band switch. Once the value of L is set for the band in use, no further adjustment is required. The networks are easily set up by adjusting for a minimum s.w.r., using an s.w.r. bridge in the coaxial line between the exciter and the transmitter input, with the exciter set at a frequency in the middle of the desired band. All power to the amplifier, including filament supply, is turned off while making this adjustment. This arrangement for feeding grids makes it almost impossible for the amplifier to become unstable. No neutralization is required, and no tuning controls are necessary. The elimination of neutralization and tuning makes the amplifier as simple as a grounded-grid stage, but with the advantage that the power gain is several times greater, and the input impedance as seen by the exciter is constant. The latter is a very desirable feature.

The output circuit is the conventional pi network designed to operate into a 50- to 70-ohm

* Box 7, Wolfe City, Texas.

[1] See Peck, "Homebrew Custom Designing," *QST*, April, 1961.

[2] See Grammer, "Simplified Design of Impedance-Matching Networks," *QST*, March, April, May, 1957.

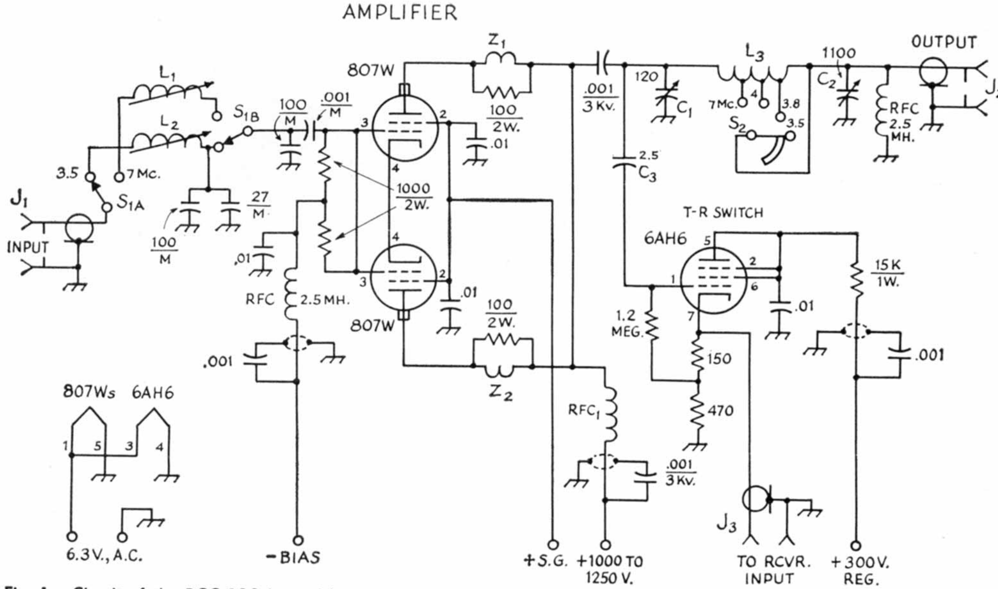


Fig. 1—Circuit of the RCC 230-L amplifier, including t.r. switch. Fixed capacitors are disk ceramic, except those marked M indicating mica. Resistances are in ohms and resistors are ½ watt unless indicated otherwise. Decimal values of capacitance are in uf.; others are in pf. (μμf.) unless indicated otherwise.

C_1—120- to 150-pf. 1500-volt air variable (Johnson 150F20/155–5 or equivalent).

C_2—Three-section variable, 365-pf. per section, sections in parallel (broadcast-replacement type).

C_3—See text.

J_1, J_2, J_3—Chassis-mounting coaxial receptacle (SO-239).

L_1—14 turns No. 24 enam. close-wound on ½-inch iron-core form (National XR-50 form).

L_2—30 turns No. 24 enam. close-wound on form similar to L_1.

L_3—30 turns No. 14, 1¾-inch diam., 2⅝ inches long (Pi Dux 1411A).

S_1—D.p.d.t. ceramic rotary.

S_2—Single-pole four-position progressively-shorting ceramic rotary switch (CRL P-270 index, one type PISD switch section).

RFC_1—2³⁄₁₆-inch winding length No. 26 cotton-enamel wire on 1-inch ceramic insulator (Raypar RL-102 may be used).

Z_1, Z_2—5 turns No. 26 enam. wound on associated resistor.

line. A single tap on the coil is sufficient for the 40-meter band, but two tap positions, in addition to the full coil, are provided to permit maintaining a more or less constant Q across the wider 80-meter band.

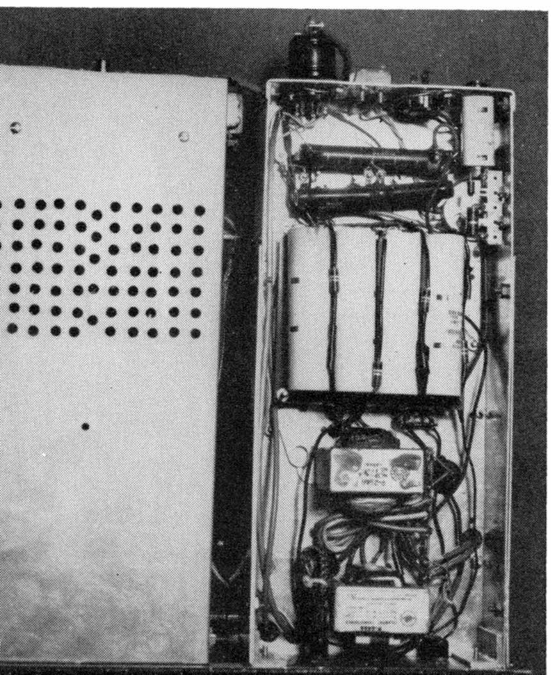
T.R. Switch

The t.r. switch uses a 6AH6 tube connected as a triode cathode follower to couple the receiver to the plate end of the final tank circuit of the amplifier. In this way, "suck-out" of the signal is avoided. The t.r. switch is built into the final, and all outlets for the filament and plate voltages are well bypassed. As a result of these precautions, no TVI has been observed. The coupling capacitor (C_3) to the grid of the t.r. switch tube is made of one inch of RG-59/U. The braid acts as one capacitor plate and the inner conductor acts as the other. The approximate capacitance is 2.5 pf.

The amplifier is metered by a grid-current meter, the full scale of which is 10 ma., and a plate meter of 300 ma., full scale. The grid meter is useful in tuning up and also acts as a modulation monitor.

The Power Supply

The circuit of the power supply is shown in Fig. 2. The cost factor indicates the use of bridge rectification so as to keep the cost of the power transformer down. After a look through current catalogs for transformers in the 1200- to 1500-volt class at 200 to 300 ma., a Merit P-3157 was



Bottom view showing the filter capacitors and two additional filament transformers in the power-supply chassis. The bottom of the amplifier chassis is perforated in the area of the 807Ws for ventilation.

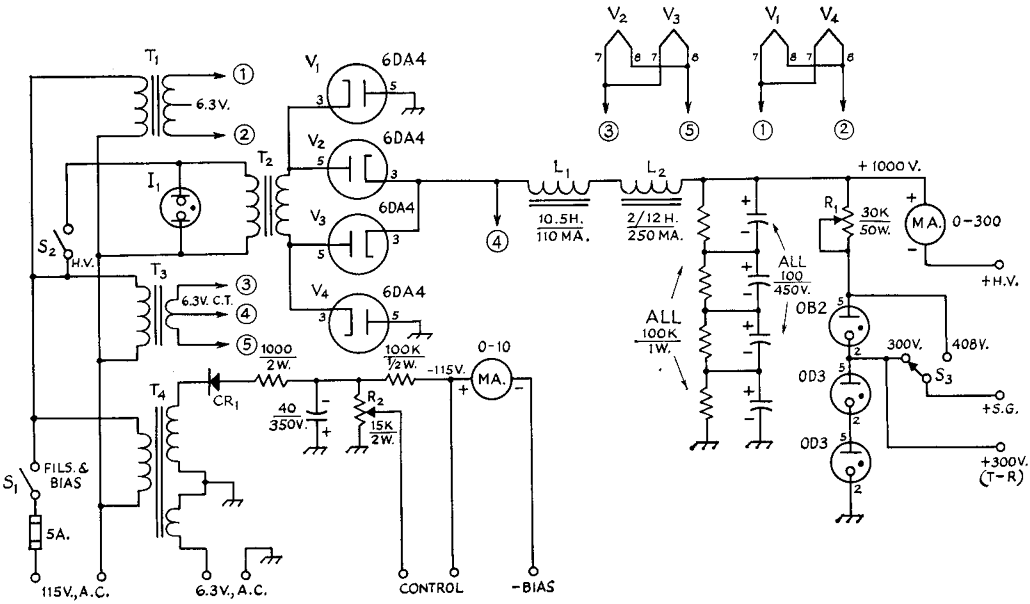


Fig. 2—Power and metering circuits. Capacitances are in μf. and capacitors are electrolytic. Resistances are in ohms.

CR1—Silicon diode, 400 p.i.v. (Texas Inst. 1N2070 or equiv.).

I1—NE-57 neon lamp.

L1—Filter choke (Stancor C-1001).

L2—Swinging filter choke (Stancor C-1402).

R1—Slider adjustable.

R2—Wire-wound control.

S1, S2—S.p.s.t. toggle switch.

S3—S.p.d.t. rotary.

T1, T3—6.3-volt 3-amp. filament transformer (Stancor P-6466).

T2—Plate transformer, 1320 volts, 250 ma. (Merit P-3157, center tap not used).

T4—Power transformer, 120 volts, 50 ma.; 6.3 volts, 2 amp. (Merit P-3045).

selected. The transformer delivers 660 volts each side of the center tap, and is rated at 250 ma. By dropping the center tap and using bridge rectification and a choke-input filter, about 1100 volts at 250 ma. can be obtained for s.s.b. operation.[3] Past experience with this transformer has shown it to hold up well under these conditions, and it fits within the limited available space. By using heater-type rectifier tubes that have been developed for high-voltage service in TV work, we can build a bridge rectifier using only two filament transformers instead of the three usually required. Four 6DA4s were used here as they are small in size and have ample current and voltage ratings.[4]

Regulated screen voltage is obtained from VR tubes across the power supply, and a switch is used to change the screen voltage from 300 to 408 volts. Don't be afraid to operate with screens at 408 volts on s.s.b., because, when the amplifier is properly loaded, the screens are within their rated dissipation.

A separate supply provides operating and stand-by blocking bias, and also filament power for the amplifier. With the control terminals open, full supply voltage is applied to the grids of the 807s, which reduces the plate current to a negligible value. When the terminals are closed for transmission, the operating bias may be set by adjustment of the potentiometer.

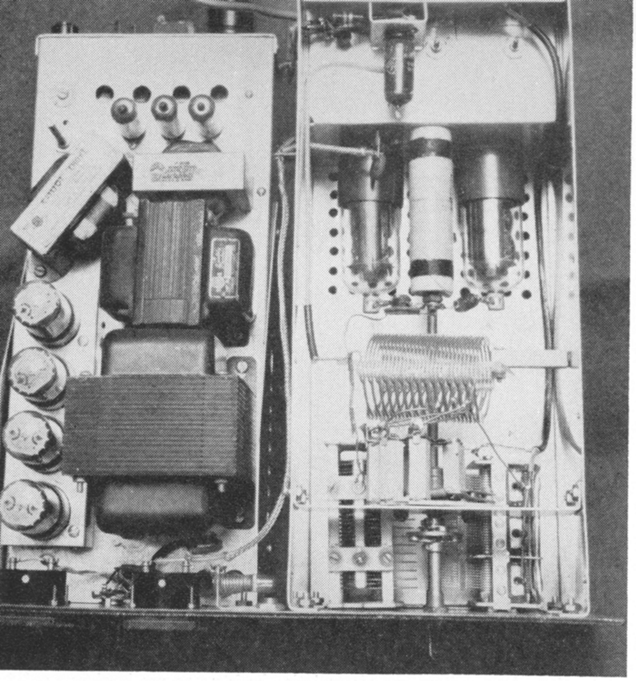
Putting the Amplifier into Operation

With all voltages, including filament, removed from the amplifier and the band switch in the 80-meter position, feed a 3.8-Mc. signal from an exciter capable of supplying about 3 watts of output to the input of the amplifier through an s.w.r. bridge. Adjust the slug in L_2 for minimum s.w.r. With the band switch in the 40-meter position, repeat the process with a signal at 7.15 Mc. Adjust the slug of L_1 for the same indication. The grid circuit is now adjusted and can be forgotten.

Remove excitation and turn on the filament and plate supplies with the screen-voltage switch set for 300 volts. Close the bias-control terminals and adjust the grid bias with the potentiometer until the plate current is just zero. Now switch the

[3] On the same basis as used by the manufacturer, the current rating would be reduced to 125 ma. when a bridge rectifier is used. However, because of the short duty cycle in c.w. and s.s.b. operation, a rating of 250 ma. for these services appears to be reasonable. The basic limiting factor is transformer temperature rise. — *Editor.*

[4] The 6DA4 has a maximum cathode-voltage rating of 300 volts negative in respect to heater. In the bridge circuit, the cathode-heater capacitances of V_1 and V_4 are in series across the transformer-secondary voltage (approximately 1850 volts peak in this case). This voltage divides equally across the two capacitances if the capacitances are equal; if they are not equal, a higher voltage appears across the smaller of the two capacitances. In this instance, the minimum peak cathode voltage, negative in respect to heater, will be 925 volts. Although the author has experienced no failures, it would seem advisable to operate V_1 and V_4 from separate heater transformers. — *Editor.*



Amplifier components are mounted inside an inverted 6 × 6 × 14½-inch homemade chassis of 0.051-inch aluminum sheet. The 807Ws and homemade plate r.f. choke are mounted on a standard 3 × 4 × 6-inch chassis which houses the grid-circuit components. The adjusting screws of the two grid coils may be seen to the right of the t.r. switch tube mounted on a bracket. The plate switch is mounted on an aluminum strip spanning the chassis below the plate coil. The grid band-switch shaft runs between the output and tuning capacitors and thence between the two amplifier tubes to the switch mounted inside the small chassis. This chassis is fitted with a cover of perforated aluminum.

Power-supply components are mounted on a homemade chassis of the same material, measuring 6 by 14½ by 2 inches. The chassis is fastened to the panel with side brackets. The rectifier tubes are mounted on a narrow inverted-U-shaped subchassis made sufficiently high that the sockets clear the main chassis. The center portion of the chassis is occupied by the high-voltage transformer, filter chokes and one of the filament transformers.

screen voltage to 408 volts and adjust the potentiometer until the plate current is 40 to 45 ma. With no load on the output and no drive, rotate the plate tank and loading capacitors through their ranges. There should be no variation in plate current, and no grid current should show.

Now, with a dummy load such as a 100- to 150-watt lamp or a doublet antenna connected to the output, and the exciter connected to the input, insert carrier and tune for resonance with the plate tank capacitor, and load with the loading capacitor for maximum output as indicated on an output indicator such as the lamp or an r.f. voltmeter. When the input is such that the grid meter begins to show a very slight amount of grid current, the plate current shou'd be in the neighborhood of 220 ma. when the amplifier is properly loaded, and the output should make a 150-watt lamp g'ow brightly. Now balance out the carrier. A sustained "ohhhh" into the microphone should cause a plate current of about 125 ma. when the grid meter shows a very slight flicker. Adjust the audio gain unt l the above conditions exist.

At this point it m'ght be well to reinsert carrier and, with the same plate current as indicated previously (220 ma.) and the loading adjusted for maximum output, the output should fall off instantly as the excitation is lowered. If the fall-off is sluggish, slightly decrease the loading until the output falls instantly as the excitation is decreased. Again remove the carrier, and the amplifier is ready to operate on s.s.b. phone. When the p.e.p. power input is about 230 watts (1050 volts at 220 ma.), the output should be about 150 watts p.e.p. — a very respectable amount of power.

C.W. Operation

Switch the screen to 300 volts. Insert carrier until the grid draws a current of about 4 to 5 ma. when the plate current at resonance is about 150 ma. and the r.f. indicator shows maximum output. Key the exc ter and you're on c.w.

Good results should be obtained with this rig and tube life should be reasonably long with the ventilation afforded in this construction. In a similar rig using 1625s, the first pair of tubes lasted four years when operated about 10 hours a week — a total of more than 2000 hours. Tube cost was 50 cents.

I wish to thank K5BFT (Bob) for the nice decaling of the panels. If you want to hear this amplifier, look for him on the low end of the 75-meter phone band — s.s.b., of course. QST

Strays

The Metropolitan Ragchewers Club of Southeastern Michigan meets the first Sunday afternoon of each month at the Department of Recreation's Lakewood House in Detroit. It was founded three years ago and is dedicated to helping handicapped hams. Of its 100 members, about 10 are handicapped. Code and theory classes are held at the Lakewood House each Tuesday at 1930 EST. On-the-air meetings are held each Wednesday at 2100 EST on 50.250 Mc. A certificate is available through K8PUS (5336 St. Clair Ave., Detroit 13) for working 10 members (25 if you live in Michigan).

If you were ever a KR6 ham on Okinawa, please contact the Okinawa Amateur Radio Club, APO 331, San Francisco, Calif., and supply your current stateside address.