USING 2 3-500ZS IN GROUNDED GRID

This linear amplifier operates in a grounded-grid circuit and uses two Eimac 3-500Z zero-bias triodes. It is capable of the maximum legal power input level, 1000 watts dc, and can develop up to 2000 watts peak input during ssb operation. The amplifier is intended for use on cw and ssb, and is not recommended for a-m service. The amplifier requires a driver that can deliver at least 65 wats PEP. Actually, it is best to use a driver that is capable of 100 watts PEP, to assure that sufficient driving power is available on 21 and 28 MHz, the frequencies at which the efficiency of coupling circuits is often poor in comparison to that of the lower bands.

In the circuit of Fig. 6-66, a pi-network input circuit (C_1, C_2, and L_1) is used to aid linearity and to lessen the driving power requirements. Only one tuned circuit is shown in the diagram for reasons of clarity. The remaining tuned circuits (described in the coil table) are connected to the rest of the contacts shown for S_1. Relay K_1 routes the input (J_1) around the amplifier to J_2, thus enabling the operator to keep the amplifier in standby while transmitting around it with his exciter or transceiver when low-power operation desired. Also, this switching arrangement connects the antenna to the transceiver during receive periods, bypassing the amplifier. The changeover relay, K_1, and the bias control relay, K_2, are controlled by external means; J_4 connects to the VOX or push-to-talk circuit of the driver. The input tuned circuit is connected to the filament rf choke, a bifilar-wound inductor consisting of 28 turns (double) of No. 10 Formvar-insulated wire. The turns are close-wound on a ½-inch diameter ferrite rod, 7½ inches long.

A homemade tank coil is used in the plate circuit of the amplifier. Capacitor C_3 is a 300-pF Jennings vacuum variable, and provides the proper capacitance for all of the bands.

An rf sampling circuit is connected to the output of the amplifier (CR_2). Rectified rf is fed to M_3 through the sensitivity control, R_1, for tuning adjustments. There is no reason why this circuit could not be replaced by an SWR bridge so that reflected-power readings could be used for Transmatch adjustments.

Bias resistor R_2 is used to cut the amplifier off during standby periods. During transmit it is shorted out by the contacts on K_2. Forced-air cooling is provided by B_1, a 100-c.f.m. blower. S_4 turns on the filaments supply and blower fan. S_3 turns on the relay supply and activates the plate power supply control relay.

Construction Notes

This equipment is built on a standard 13 × 17 × 4-inch aluminum chassis. The panel and cabinet are home made. A standard rack panel can be used, if desired. The assembly is enclosed in a cover made of sections of aluminum sheeting and perforated aluminum material (Reynolds).

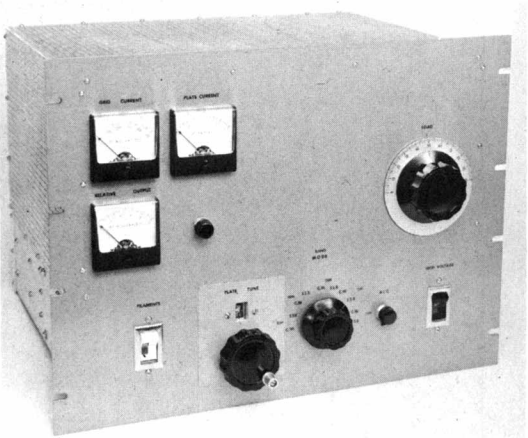

Fig. 6-65—Front view of the amplifier using two 3-500Zs. The grid-current meter is at the center left, with the plate meter to the right and the rf-output meter below. The entire assembly is well shielded to lessen the chances for TVI. The dial counter used on the vacuum-variable capacitor is from a surplus BC-610 antenna tuner. (*Built by Carl E. Smith, W1ETU*)

This was done for TVI reasons, and to prevent accidental contact with rf and dc voltages within. The bottom of the assembly is enclosed by means of an aluminum plate. Forced-air cooling is effected by mounting B_1, the blower, on the rear deck of the chassis, under the Eimac SK-410 tube sockets. The corners of the chassis are plugged with epoxy cement to prevent air from escaping through paths other than the intended one. Each tube has an Eimac SK-406 chimney, assuring that the air stream is directed along the sides of the tubes. Heat-dissipating plate caps are used as anode connectors.

All non-signal leads, except the high-voltage bus, are bypassed where they enter the chassis in the interest of TVI prevention. In actual service, the panel meters are enclosed in a shielded compartment.

To obtain the maximum power output, the LC ratio of the tank circuit must be optimum for the voltage and current used. One feature of this amplifier is that a separate tank tap is provided for 1- or 2-kW operation on each band. Operators planning only cw or ssb service can leave out the taps for the unwanted mode.

When winding RFC_1 it is suggested that a piece of 7/16-inch diameter wooden dowel be used as a form. After the coil has been wound, slip it off the dowel and mount it on the ferrite rod. Because of the stress needed when winding the No. 10 wire, the ferrite might break if used as a former.

Adjustment and Performance

Although any voltage between 2000 and 3000 can be used with this amplifier, the latter is recommended for best efficiency with this circuit;

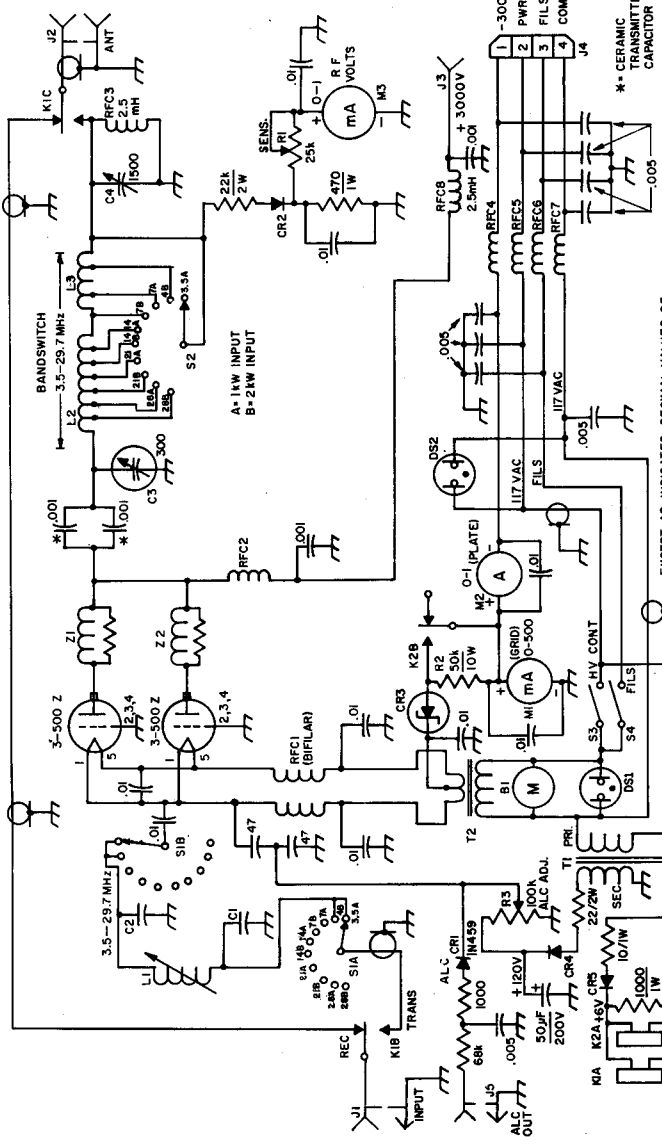

Fig. 6-66—Schematic diagram of the 2-kW amplifier. Fixed value capacitors are 1000-volt disk ceramic unless otherwise indicated. Capacitors with polarity marked are electrolytic.

B_1—115-V ac, 100-cfm blower (Burstein-Applebee 41A4003).
C_1, C_2—See table.
C_3—Vacuum variable, 300 pF (Jennings-ITT).
C_4—1500-pF transmitting variable (104-12 from LaPointe Industries, Rockville, CN06066).
CR_1—High-frequency type (1N458 or 1N459).
CR_2—Germanium (1N34A or 1N67).
CR_3—Zener, 6.8 V, 50 W (International Rectifier Z3305-C).
CR_4—600-PRV, 1-A silicon.
CR_5—100-PRV, 1-A silicon.
DS_1, DS_2—Part of S_3 and S_4.
J_1, J_5, J_6—Phono jack, panel mount.
J_2—SO-239-style chassis connector.
J_3—Millen 37001 high-voltage chassis-mount connector.
J_4—Male 4-pin chassis-mount connector (Cinch-Jones P-304-AB).
K_1—Dpdt 6-volt dc relay (Potter & Brumfield KT-11D).
K_2—Spdt 6-volt dc relay, one contact not used (Potter & Brumfield KM5D).
L_1—See coil table.
L_2—11½ turns of ¼-inch copper tubing, 2¼-inches inside diameter, approx. ⅛-inch spacing between turns. Tap at 1¼ turns in from the amplifier tube end for 28B, 3¼ turns for 28A, 3½ turns for 21B, 5½ turns for 21A, 5¾ turns for 14B, 8½ turns for 14A, and full coil for 7B.
L_3—15 turns, No. 12 wire, 6 tpi, 2½-inch diameter, tapped at 6 turns in from the junction with L_1 for 7A, 8 turns for 4B, and full coil used for 3.5A (Polycoil type 1774).
M_1—0 to 500-mA dc meter (Simpson type 06290).
M_2—0 to 1-A dc meter (Simpson type 02440).
M_3—0 to 1-mA dc meter (Simpson type 06175).
R_1—25,000-ohm, linear-taper carbon control.
R_2—See text.
R_3—100,000-ohm, linear-taper carbon control.
RFC_1—Bifilar filament choke wound on ½-inch dia. ferrite rod (Newark Electronics 59F1521), see text for winding details.
RFC_2—Transmitting-tube rf choke (National Radio R-175A or B&W 800).
RFC_3—2.5-mH, 150-mA rf choke.
RFC_4-RFC_8, incl.—22 turns, No. 14 enam. wire, ½-inch dia.
S_1—Ceramic rotary switch, 2-pole, 17 position (10 used), 2 section, non-shorting contacts (Centralab PA-3003).
S_2—Ceramic rotary power switch, 1 pole, 17 position (10 used), 1 section, non-shorting contacts (Centralab JV-9001).
S_3, S_4—Spst lighted rocker switch (Carling LT1LA65).
T_1—125-V, 15-mA and 6.3-V, 0.6-A power transformer (Stancor PS-8415).
T_2—5-V, 30-A filament transformer (Stancor P-6468).
Z_1, Z_2—Homemade parasitic choke consisting of 2 turns of ⅜-inch flat copper or brass strap around a Workman FRT-1 thermistor.

L_1 COIL TABLE

Band	C_1, C_2	L_1
80	1600 pF (Arco VCM-35B162K)	16 t., closewound
40	910 pF (Arco VCM-20B911K)	8 t., closewound
20	430 pF (Arco VCM-20B431K)	6 t., closewound
15	300 pF (Arco VCM-20B301K)	4 t., closewound
10	220 pF (Arco VCM-20B221K)	4 t., spaced to fill form.

Capacitors are 1000-V silver mica. Inductors wound with No. 16 Formvar or Nylclad on ½-inch diam. slug-tuned form (No. 69046—James Millen Co., 150 Exchange St., Malden, Mass.)

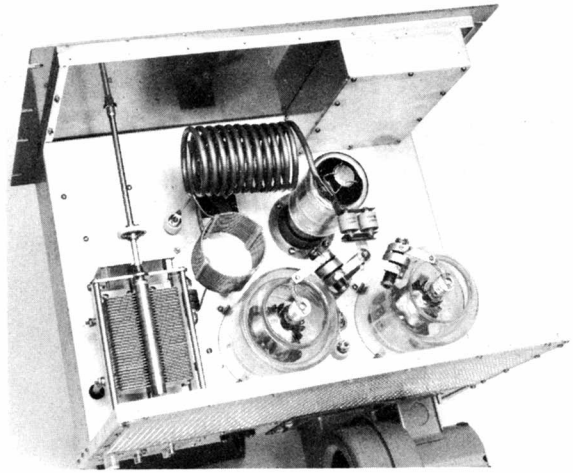

Fig. 6-67—Looking into the top of the amplifier, the vacuum variable is mounted at the center, in front of the two 3-500Zs. The loading capacitor is at the far-left side of the chassis. Hidden behind the homemade tank coil is the plate band switch. Eimac sockets and chimneys are used with the tubes, and air is forced into the pressurized chassis by the 100-cfm blower on the rear deck. A box encloses the panel meters (on the right-hand side of the front panel). Full shielding of the meters is required to prevent stray radiation that could cause TVI.

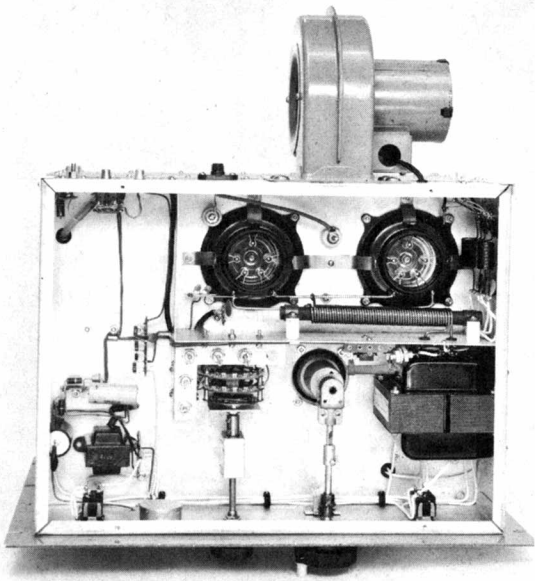

Fig. 6-68—On the under side of the chassis, the filament transformer is at the lower right. The filament choke is inside the shielded partition that closes off the tube-socket compartment. A right-angle drive, Millen 10012, drives S_1 and S_2 (it is visible at the center-front portion of the chassis). The power supply for the relays and alc system is at the front-left side. The blower is mounted on the rear deck, with a piece of foam insulation between the blower housing and the chassis to reduce vibration and noise. A full bottom cover is required.

the L-C ratio in the plate tank is designed for 3000-volt, one- or two-kW input operation. One must always be mindful that *lethal voltage* is being used here. *Never apply the high voltage while the top or bottom covers are removed.* Do not handle the power supply until it is turned off and unplugged from the ac outlet. Allow plenty of time for the filter capacitors to bleed off, using a shorting stick to discharge them as a final safety measure.

Resting plate current (no signal) for this amplifier will be approximately 150 mA with R_2 shorted out. As much as 200 mA of grid current can flow during peak drive periods. In practice, with 3000 volts on the plates, approximately 150 mA of grid current was noted when the full legal power input was being run.

With the amplifier's covers in place, a dummy load connected to the output, and an SWR indicator connected between the driver and the input jack, J_1, apply a small amount of drive (single-tone or cw) and adjust L_1 for minimum SWR. Adjust C_3 and C_5 for maximum output as noted on M_3. Gradually increase the drive until the loaded plate current, at dip, is 330 mA. This will provide 990 watts dc input to the tubes; the output will be approximately 650 watts. For 2-kW PEP input, connect the amplifier to a dummy load and adjust the cw or pulsed-tone drive for 667 mA plate current (3000 volts). Adjusting for 2-kW dc input in this manner should not be done with the antenna connected, in order to comply with FCC regulations. *Stay legal!*

Spectrum-analyzer tests show this amplifier to have an IMD level (intermodulation distortion) that is down in excess of 30 dB at 2-kW peak input. Harmonic output was down some 40 dB from the fundamental.

The power supply for this amplifier is described in Chapter 12, and in December 1969 *QST*.

THE SS-2000 AMPLIFIER

The SS-2000 linear amplifier is designed to handle the legal maximum power input on cw and ssb. Because of the high plate-dissipation rating of the tube there is plenty of safety margin to prevent tube damage in the event of accidental mistuning. This amplifier is carefully shielded and filtered for the reduction of TVI. Though a 3-1000Z tube is used, the popular 4-1000A can be substituted as mentioned later. Both tubes have a maximum plate dissipation of

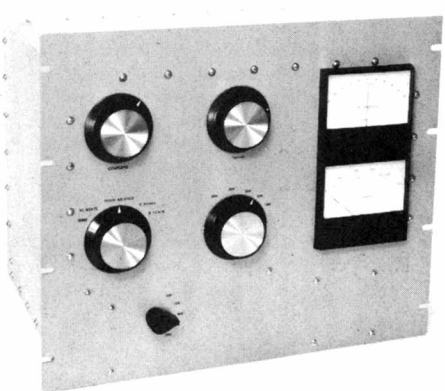

Fig. 6-69—The front panel of the 2-kW PEP amplifier has the controls grouped at the left. The panel has been sprayed with gray enamel, and black decals identify the controls. The hardware visible in this photograph secures the TVI shielding.