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Custom Design and Construction Techniques for Linear Amplifiers Using the 8877

BY MERLE B. PARTEN,* K6DC

Test results at 50, 144, and 220 MHz using the new 8877 tube were so gratifying that I decided to try it in a 3.5- to 28-MHz grounded-grid amplifier. Since so many articles about construction have been written in the past, I decided to compile into one text enough data and design variations to allow a home constructor to build an 8877 amplifier without having to bolt-for-bolt copy this design.

Design Advantages

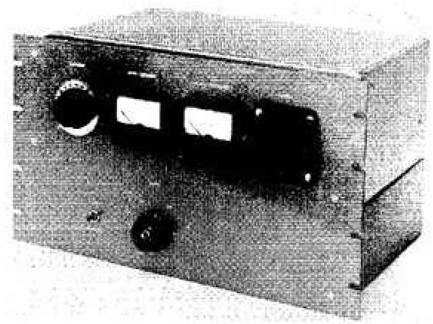
The 8877 is a big brother to the new 8873 series of ceramic/metal power tubes. It is a zero-biased high-mu triode having an oxide-coated cathode. The plate dissipation is 1500 watts. Heater-to-cathode capacitance is low eliminating the need for filament chokes when operated below 30 MHz. An inexpensive 7-pin socket may be used reducing the overall cost. The grid connection is near the chassis level and permits low-inductance grounding. Average IMD products for the 8877 in linear service run 38 dB below one tone of a two-tone test signal for 3rd order products, and 44.5 dB for 5th order products.

Design Considerations

In building anything, whether it is a new home or an amplifier, there is always something you would like to change after the job is completed. Think the project through before picking up the hammer!

Professional designers are not immune to mistakes. Some manufacturers have chosen a symmetrical knob placement and size pleasing to the eye. The band switch and multimeter-switch may be located side-by-side, using identical knobs. Even the knowledgeable operator may close the key, look at the meter, reach for the meter switch (he thinks), and grab the band switch instead. (It only happens once per band!) Different knob sizes or placement could prevent a catastrophic error such as this. Don't worry about beauty in a front-panel layout where performance might suffer.

* EIMAC Division of Varian, San Carlos, CA.



One simple design error can cause several more severe errors to show up as building progresses. A mock-up assembly was made to determine the space required for the coils and capacitors. This rough layout allowed positioning the tube and loading capacitor. A point overlooked was where the loading capacitor shaft terminated on the front panel. It was too close to the left edge. The mistake was solved by using a set of gears from the junk box. An alternate layout would have been to mount the coil and switch assembly on the front shield surface with the switch shaft passing through the front panel. This would eliminate the right angle drive.

Any cost-conscious builder will first review his on-hand supplies. A suitable plate-tuning capacitor, mounted vertically, might free enough space on top of the chassis to mount a plate transformer. The rectifier diodes, capacitors, and bleeder resistors could be located below the chassis, cooled by the airflow from the blower. Suitable power-supply parts may be purchased as replacement items from some amateur equipment manufacturers at a reasonable price.

Convenient location of controls should be a factor in the layout design. A right-handed person

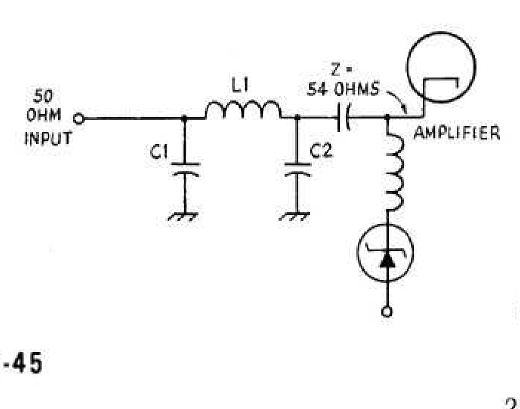


Fig. 1 — Simplified diagram of the input circuit. Component values are given in Table 1.

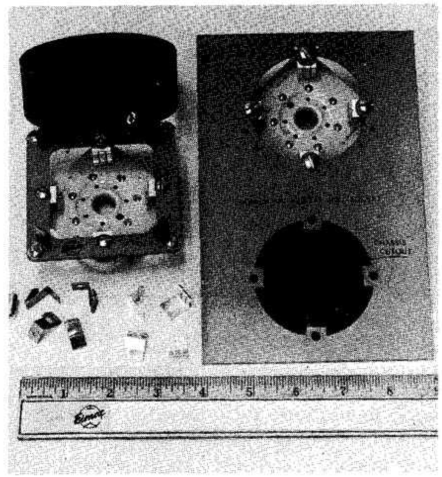


Fig. 2 — The builder may construct his own socket from a combination of components. This is one area in which the amateur can reduce the overall cost of the project.

usually finds it easy to adjust the loading control with his left hand as he adjusts the plate tuning control with his right hand.

When building uncomplicated equipment such as a linear amplifier, the home constructor has a cost advantage over the manufacturer. Labor and engineering amount to nearly 60 percent of the cost of a commercially-made unit. Think of what that saving would buy in new or surplus parts! A home-built unit may not match one commercially made in appearance, because of differences in shop tools, but it should be as reliable electrically.

A word of caution about buying used vacuum-variable capacitors. When there are no apparent cracks or flaws, a "leaker" or defective unit is hard to detect. If the lead screw moves the bellows too easily, the capacitor *could* be a dud. Have it "high-potted" at the rated voltage, or make sure you have a return guarantee so you can check the unit yourself.

Metal Fabrication

Quality workmanship does not depend entirely on the use of a metal brake and shear. Avoid use of tin snips when cutting materials. Sawing along a line causes less mechanical distortion. If you *must* use the snips, cut outside of the mark on the first slice, then approach the line with several thin slices.

Neat and accurate bending can be accomplished with two pieces of 1 1/2-inch angle iron about two feet long. The material to be bent is clamped between the angle irons, using C-clamps and a vise. Use a piece of flat wood or phenolic as a buffer between the hammer and the material to be bent, to avoid hammer marks. A test bend using a scrap piece of aluminum is sometimes helpful where a critical fit is needed. Use common sense to figure whether the bend will add or subtract metal thickness to marked length.

Tips on Shielding and Isolation

Shielding between input and output circuits of a grounded-grid amplifier reduces the possibility of parasitic oscillations, even when fundamental oscillation is not a problem. Generally, either type of oscillation can be detected by observing the grid and plate meter readings as the plate tuning control is rotated through resonance. If the system is free of parasitic oscillations, maximum grid current and minimum plate current will occur at approximately the same dial setting.

Long plate leads usually encourage the vhf parasitic type of oscillation. In this particular amplifier, however, there was no evidence of this.

Fundamental oscillation in a high-mu triode will not occur unless there is a feedback path between the input and output circuits. A path could be established, either by a control shaft not properly grounded, or through a wire not sufficiently bypassed. A metal shaft should be grounded where it passes through an open hole. Shaft bushings of the C-clamp variety do an adequate grounding job. If mechanical strength is not a factor, a nonmetallic shaft will do a good job of preventing undesired coupling. When using shaft couplings, replace the slotted screws with Allen screws. Nothing is more frustrating than a slipping shaft. This applies to knobs, too.

Wires passing through shields require the usual decoupling precautions, using ceramic bypass capacitors and perhaps small rf chokes or ferrite beads. This is especially important in treating the point of exit of the high-voltage lead.

If the high-voltage wire is kept in the plate compartment and not passed into the input area of the amplifier chassis, it will require less decoupling and be less prone to feed back. Shielded wire such as RG-8A/U cable, may be used between the plate choke and the exit point.

Regarding TVI and RFI leakage through an opening in a shielding surface, I recall a demonstration by Phil Rand, W1DBM, and Lew McCoy, W1ICP, at a radio club in Cleveland, just after WW2. A TV set was placed a few feet from a shielded box containing a 29-MHz transmitter. The top of the box had a four-inch row of 1/4-inch holes. Near the row of holes was a 1/4 x 4-inch slot. One or both openings could be closed with a shield plate. When the 4-inch slot was exposed, the TV set displayed severe interference. With only the row of holes exposed, no TVI was evident.

From this we may conclude that the mating surfaces of an rf enclosure should be free of wrinkles and slots. Securing clean surfaces every 2 inches seems to do the job. Some aluminum material is anodized, making it non-conductive. To avoid slots due to the insulation, check the surface with an ohmmeter. If the surface appears to be nonconductive, it must be cleaned.

TABLE 1

VALUES OF CIRCUIT Q OF 1					
MHz	C1 Opt.	pF (USE)	C2 Opt.	pF (USE)	L µH
3.5	839	(820)	842	(820)	2.36
4.0	734	(750)	737	(750)	2.07
7.0	420	(430)	421	(430)	1.18
14.0	210	(220)	211	(220)	0.59
21.0	140	(150)	140	(150)	0.39
28.0	105	(100)	105	(100)	0.30

Practical capacitor values in parentheses

TABLE 2

L1 COIL WINDING DATA				
BAND MHz	NO. TURNS	WIRE SIZE	INDUCTANCE RANGE IN µH	F* MHz
3/8-inch Diameter Forms				
3.5	14	24	1.64 - 4.58	5.05
4.0	14	24	1.64 - 4.58	5.8
7.0	10	24	0.96 - 2.32	10.1
14.0	7	16	0.44 - .74	19.5
21.0	5	16	0.28 - 0.52	29.2
28.0	4	16	0.17 - 0.34	40
1/2-inch Diameter Forms				
3.5	15	20	1.975 - 3.67	5.05
4.0	13	20	1.584 - 3.045	5.8
7.0	10	16	0.76 - 1.21	10.1
14.0	6	16	0.43 - 0.736	19.5
21.0	5	16	0.35 - 0.55	29.2
28.0	4	16	0.26 - 0.39	40

Coil winding data is given to allow a choice of either 3/8-inch or 1/2-inch slug-tuned forms. The winding should be close spaced and start at the top of the form.

* A grid dip meter should be used to assure that the inductor resonates at the indicated frequency. These adjustments should be made with capacitors C1 and C2 out of the circuit.

Air Cooling

The opening in a shield surface where blower air enters the chassis may be a source of rf leakage. In this amplifier, brass-wire screen is mounted in the air stream to minimize this leakage. Tiny globs of solder at several crossover points assure positive connection on the screen. The disadvantage of this method is the eventual collection of dust, restricting air flow. It requires periodic cleaning.

The question so often asked is, "Do I actually need this much air?" Remember, heat is what destroys a tube! If the blower noise is too great, place the fan elsewhere and duct the air to the amplifier. Only a slight hiss will remain as the air passes through the anode cooler.

The Input Circuit

The cathode impedance of an 8877/3CX1500A7 is about 54 ohms. Direct coupling from the exciter to the cathode without the use of a cathode-tuned circuit *will* work, but performance will be degraded. The reduced-drive requirements and improved distortion products make the small effort of putting a "flywheel" in the input circuit worthwhile.

The input pi-network circuit for each band is set and forgotten. Final adjustment of the slug-tuned coils is made with the amplifier operating and will be discussed later.

Fig. 1 shows the basic input circuit. A computer program for 50 to 54 ohms and a selection of three input circuit Q figures produced the most practical values of capacitance. Q values of 3, 2, and 1 in the computer run indicated that at 3.5 MHz the required network capacitors would be 2500, 1700, and 850 pF, respectively (values rounded out for illustration). A circuit Q of 1 was chosen based on price, physical size, and nearness to stock values. I accurately measured the value of more than 50 5-percent mica capacitors and found that about 90 percent of them were on the low side of the marked value. Keep this in mind when making a selection!

The Q of the input circuit is so low that any of the polyiron or ferrite-core materials are satisfactory. The slugs used in this amplifier were coded red (1-20 MHz).

Miller No. 4400 ceramic forms are one source of 3/8-inch cores. Cambion and Millen are other sources. The Millen No. 69046 is a good choice for 1/2-inch forms.

The Socket

For grounded-grid application, a reasonably priced socket is available from Eimac. The socket is part number SK-2206. If you prefer to build one yourself, a 7-pin septar socket, made by E. F. Johnson (part number 122-247-202) may be used. Fig. 2 shows construction details. Proper standoff spacing is obtained with 3/8-inch metal spacers, plus two metal washers. The finger-stock clips may be ordered from Eimac (part number 149-842).

Output Circuit Considerations

In any amplifier, the plate-to-grid capacitance of the tube adds to the stray capacitance, making it difficult to achieve the desired values of capacitance in a pi-network circuit at 28 MHz. A high value of input capacitance results in a high plate-circuit Q, and high circulating current. The higher Q is an advantage in attenuating harmonics, but the efficiency will be reduced because of high circulating current and heat loss. Since some compromise in circuit Q between 3.5 and 28 MHz is necessary, the best place to "cheat" is at the 10-meter end of the operating range. The 28-MHz coil can be wound with tubing or flat strap which aids in dissipating the heat.

If the 10-meter trade-off is chosen, then consider using an air-spaced capacitor for plate tuning. For contest operating or fast band changing it allows retuning quickly. If a capacitor such as the Johnson 152-1 is used, it will require extra capacitance to be switched in for 3.5 MHz.

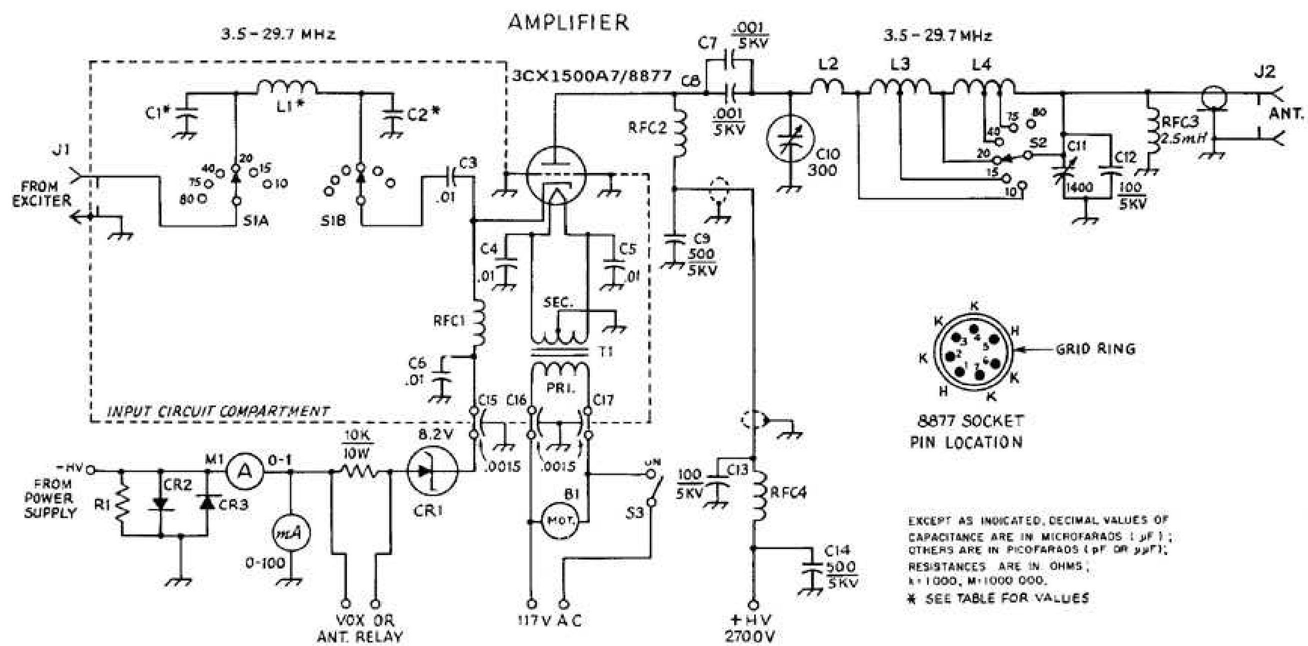
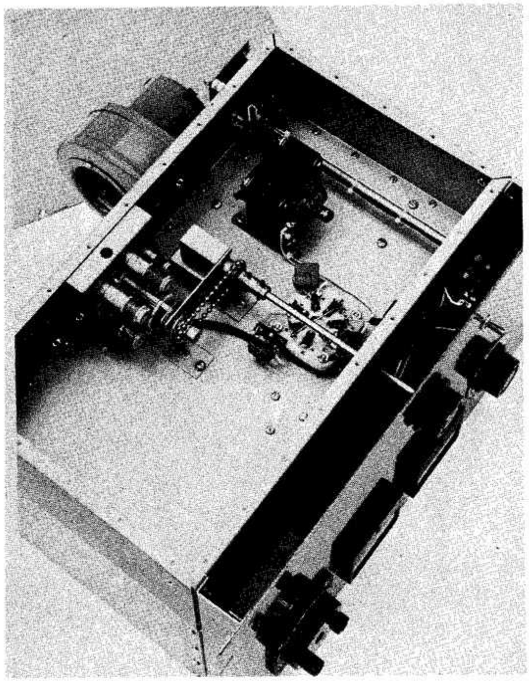


Fig. 3 — Circuit diagram of the 2-kW amplifier. Component designations not listed below are for text reference. The values for C1, C2, and L1 are given in Table 1.

B1 — Blower. (Dayton 4C012).
C3-C6, incl. — .01-μF, 600-volt disk ceramic.
C7,C8 — .001-μF, 5-kV (Centralab 858S).
C9 — 1500-pF, 5-kV (3 parallel 500-pF Centralab 858S).
C10 — Vacuum variable, 5-300 pF.
C11 — 4-section broadcast variable, 365 pF per section. All sections parallel-connected. (J.W. Miller 2104).
C12,C13 — 100-pF, 5-kV (Centralab 850S).
C14 — 500-pF, 5-kV (Centralab 850S).
C15,C16,C17 — Feedthrough, .0015-pF, 400-V.
CR1 — Zener diode, 8.2 V, 50 W (Motorola 1N3307).
J1 — BNC, chassis mount (Amphenol UG-1094/U).
J2 — SO-239 chassis connector.
L2 — 10-meter coil (see text).
L3 — 15- and 20-meter coil (see text).
L4 — 80- and 40-meter coil (see text).
M1 — 0-1 A dc meter.
M2 — 0-100 mA dc meter.
RFC1 — 15-μH, 1-A choke (Miller 4624).
RFC2 — 160 turns, No. 24 Formvar, wound on a 3/4-inch dia ceramic insulator, 4 inches long.
RFC3 — 2.5 mH, 300 mA.
RFC4 — 10 turns, No. 14 wire, 1/4-inch ID, 1-inch long.
S1 — Ceramic rotary switch, 2 pole, 6 position (Centralab PA-2045).
S2 — 1 pole, 6 position (Millen 51001).
T1 — 5-V, 10-A filament transformer.



The input circuit is mounted on a small bracket to keep the adjustments inside the chassis. S1 and S2 are coupled with a chain drive. A separate shaft arrangement with a knob could have been used for the input circuit eliminating the need for the chain drive.

The above points are illustrated in Fig. 4. The values given for a Q of 12 are the ones used in the amplifier described. All are for an input resistance of 2000 ohms.

A construction detail sometimes overlooked is the junction marked (A) in Fig. 4. If the amplifier is to operate properly at 28 MHz, the connection between capacitor C2 and the 50-ohm output terminal should be very short. A 5-inch lead, for example, represents quite an inductance. If a long lead is necessary, use RG-8A/U cable from the 50-ohm connector to the junction of L and C2.

Coil and Switch Mock-up

The actual inductance of the plate coil must be close to the design value. This is simple if the author's data and layout are duplicated. A drastic change of layout might be desired, so the following mock-up procedure for the coil and switch assembly will assure optimum operation. Fig. 5 shows the points referenced below.

1) Cut a piece of sheet metal or aluminum slightly larger than the space selected for mounting the coil and switch assembly.

2) Mount the band switch on the sheet in the position it will occupy in the final setup.

3) Measure the distance from the switch arm to the capacitor (C2, if it were mounted) and along the chassis to the tube (if it were mounted). See item M, Fig. 5.

Cut a 3/8-inch-wide copper strap to the length measured. Attach one end to the switch arm and add a jumper to the 80-meter switch position. The free end will be connected to Cx, at (M), later.

4) Measure and cut a strap for the path between the tube position (A) and the 28-MHz coil (D). This path is via the chassis at (A), through the position of C1, then to a point near the connection of the 28-MHz coil, blocking capacitor and rf choke (B) (C) to (K).

Don't let the length of the leads scare you. They actually represent circuit inductance not wound into the coils. Each strap will be about a foot or so long. Now we must find the added amount of inductance needed for each band in the form of a coil.

A pi network is a resonant circuit using a coil and two capacitors in series. For this mock-up, a fixed value of capacitance is used to represent the *effective* value of capacitors C1 and C2 in Fig. 4. The value changes with each band and can be made with stock values or parallel combinations.

Assuming the use of design values in Fig. 4(A) for a Q of 12, the effective series capacitance of C1 and C2 used for Cx is:

MHz	*Cx*
3.5	230 pF
4.0	202 pF
7.0	115 pF
14.0	57 pF
21.0	38 pF
28.0	28.7 pF[1]

5) Place the band switch in the 10-meter position. Connect Cx (10-meter value) to the two strap ends (K) and (M). Wind a coil (D) of 1/4-inch copper tubing having 5 to 8 turns about 2 inches in diameter. Space the turns about 1/8 inch apart.

Cone-and-pillar insulators (E) (F) (H) (J) are used to make stable mountings for the coils. Connect the (10) and (20) taps to the proper insulators and install straps (G) between (F) and (H). Securely mount one end of the 10-meter coil to insulator (E). Position the free end as shown for connection to the junction of the blocking capacitor, rf choke and C1 (B) (C). The insulator at (C) represents the height and location of the plate rf choke.

The free end of the lead (B) attached to (C) is then moved from turn to turn until the circuit resonates at 28 MHz. Remove excess turns. This coil stays in the circuit on all bands. Its position affects the inductance of the remaining coils, so mount it securely and connect the lead (B) from (C).

6) The 20-meter coil can be determined next. It is mounted between (E) and (F). Wind the coil in the same direction as the 10-meter coil (D). Normally 1/4- or 3/16-inch copper tubing is used for the 15- and 20-meter coils. This is because of the larger surface and better heat-handling capability.

[1] If the plate-tuning capacitor has a high minimum capacitance, use 35 to 40 pF for this band.

Change the band switch and Cx to 20 meters. The coil diameter and turns are juggled along with the turn spacing to arrive at 14-MHz resonance. The coil must fit the space between insulators (E) and (F). Five turns about 3 inches in diameter should work. The turns may be squeezed or spread to adjust the inductance.

7) Connect a lead to the 15-meter tap on band switch (15). Change band switch and Cx to 15 meters. The 10-meter coil plus 2 turns of the 20-meter coil should be about the correct tap point for 15 meters. If it is, solder the lead to the coil. The 20-meter position should be rechecked. Don't forget to change Cx.

8) For 80 meters, inductance is added to the 10- and 20-meter coil previously wound. Air-Dux 2404T coil stock may be used. It is 3 inches in diameter, has 4 turns per inch, and is of No. 10 wire. This coil is connected between (H) and (J). Leads for the 40- and 75-meter taps are attached to the appropriate band-switch lugs. The 80-meter band must be adjusted first. Place the proper value for Cx in position, rotate the band switch to 80 meters, and trim the coil to resonance. The 40- and 75-meter taps are determined in the same manner as the 15-meter tap was found. Be sure to recheck each band when all of the taps are in place.

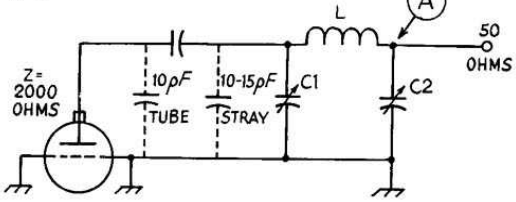
9) The switch, coil, and insulators are removed from the test plate *as a unit*. The test plate serves as a template to lay out the holes on the amplifier chassis. The tank circuit then is installed in the amplifier in one piece and the leads are attached to the variable capacitors. All leads and straps should be made as short as possible.

Proving the Mock-up Procedure

I used two methods to determine that the value of inductance was correct on each band. The amplifier tube was placed in its socket and connected to the tank circuit. Then, with a 2000-ohm load resistor shunted across the plate circuit, an Rx meter was used to check the impedance at the output connector. When the tuning capacitors were adjusted to the calculated value, the Rx meter indicated 50 ohms.

The second method of testing the amplifier was under full-power operating conditions into a

(A)



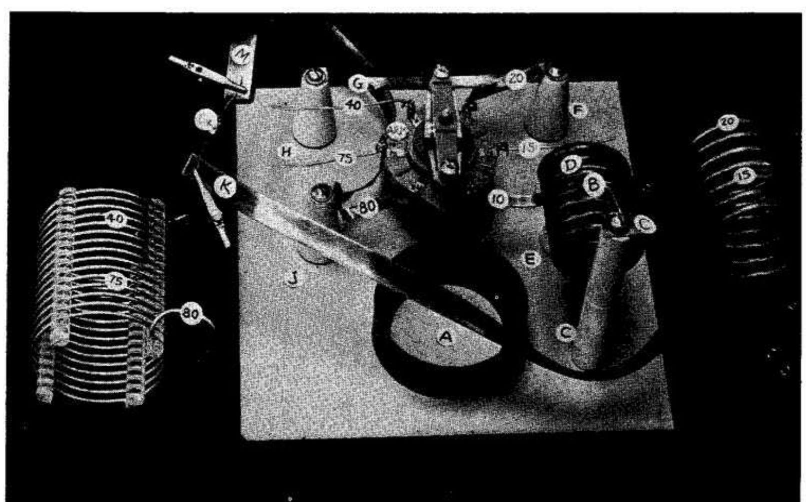
(B)

	Freq. MHz	*Input* C1 pF*	*L μH*	*Output C2 pF*	*Notes*
For *Q* of 12	3.5	273	8.54	1473	
	4.0	239	7.47	1289	
	7.0	136	4.27	737	A good set of
	14.0	68	2.14	368	compromise
	21.0	45	1.42	246	values.
	28.0	34	1.07	184	
For *Q* of 15	3.5	341	6.90	1961	Note high input
	4.0	298	6.04	1716	C at 28 MHz, and
	7.0	171	3.45	918	high output C at
	14.0	85	1.73	490	3.5 MHz.
	21.0	57	1.15	327	
	28.0	43	0.86	245	
For *Q* of 10	3.5	227	10.12	1123	
	4.0	199	8.85	983	All practical
	7.0	114	5.06	562	values except
	14.0	57	2.53	281	for 28 MHz input
	21.0	38	1.69	187	C. Large coils
	28.0	28	1.26	140	would be required.

*Value indicated is total of stray, tube, and tuning capacitor capacitance.

Fig. 4 — Simplified diagram of the output circuit. (B) lists the values for C1, C2, and *L*.

Fig. 5 — The mock-up used by the author for determining the correct tap points for the output circuit. The letters and numbers are for text reference. ▼



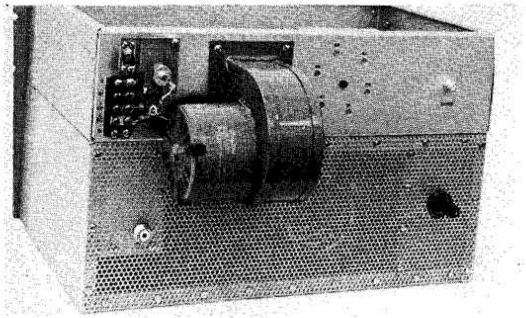


Fig. 6 — Rear view (inverted) of the amplifier. The diodes are mounted on a piece of circuit board.

dummy load. The settings of C1 and C2 were the same as determined earlier.

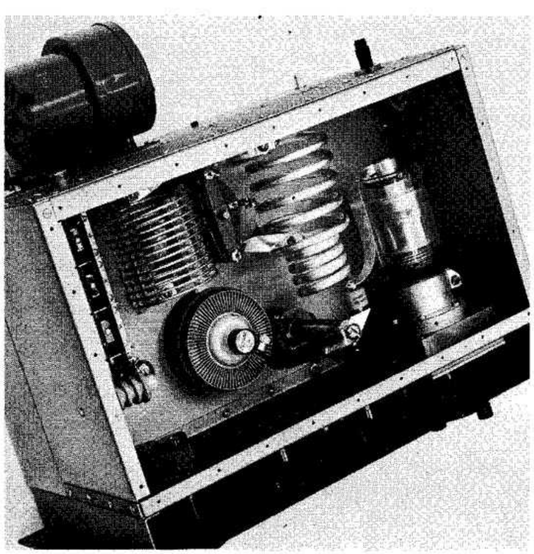
Control Circuits

There are two choices of methods for controlling standby-transmit conditions. First, the plate voltage may be turned off during standby, in which case no added grid bias is required. The second method allows the plate voltage to be left on at all times, but calls for additional bias during standby. The extra bias is required to cut the tube off completely during this period.

The second method is perhaps more commonly used, and only requires a fixed value of resistance to be placed in series with the biasing Zener diode during standby. Exciter or antenna relay contacts can be used to short out the resistor during transmit periods. This method is preferred when using solid-state rectifiers and high-capacitance filters in a power supply.

For cw operation, an additional resistor may be used to bias the tube close to cutoff, and can be switched out for ssb. A fuse in series with the Zener diode is a feature to be considered. It may save a tube, Zener, or meter from damage if an arc occurs, causing a high current surge. Use a 1-ampere fuse.

A piece of printed-circuit board may be used to mount the meter-protecting diodes. The Zener diode is also mounted on this board. Fig. 6 shows the meter diodes on the left side of the board. Space was allowed to mount a second Zener diode for added bias, switchable from the front panel.



Mechanical Assembly

Wires from the front panel to the rear of the chassis are routed through a duct made of 3/8-inch tubing, threaded at each end to accept nuts. The small blower in the photograph (Fig. 6) provides sufficient air for a 2-kW PEP operation.

To the left of the blower are the six access holes for tuning the input coils. A round disk with matching holes is mounted inside the chassis, held by a center screw. Once the adjustments are made, the disk is rotated enough to cover the holes. Then the screw is tightened to hold the disk in place. Metal buttons will work just as well.

Also shown in the photograph is a method of securely mounting the connector to a plate that is independent of the removable perforated screen. On the upper left is the high-voltage connection.

Metering

Be sure to protect the meters from damage with a pair of back-to-back diodes. Any of the inexpensive silicon diodes connected in parallel, but with anodes in opposite directions across the meter terminals, will conduct if the voltage exceeds approximately 0.6 volt. An extreme surge may even short one of the diodes. It is therefore advisable to place them where they may be tested or replaced easily. A shorted diode may shunt the meter sufficiently to give a false meter reading, and calibration should be checked if a surge is ever experienced. Only two diodes are needed in this amplifier to protect both meters.

Negative-lead metering is preferred both for safety and simplicity. This method requires all grounds to be removed from the negative points in the high-voltage power supply. The negative points are then connected to a common negative bus which is grounded through a resistor. A separate wire is used to connect the negative bus to the plate meter and back to the tube cathode through the meter and Zener diode, completing the high-voltage path. Since the tube is connected in the grounded-grid configuration, metering for grid current is placed in series with the grid (ground) and cathode. Thus both meter movements are only a few ohms above ground.

The Power Supply

If a power supply is modified for negative-lead metering it is a good idea to use a grounding resistor in the power supply as well as in the amplifier. This limits any voltage difference between the negative bus and the chassis to a very low value. The resistance must be high enough to prevent shunting the meters, but low enough to provide a low voltage difference between -HV and ground. Any value of *wirewound* resistor between 25 and 500 ohms, rated 10 to 25 watts will suffice.

The top view of the amplifier shows the vacuum-variable capacitor mounted to a subpanel. A small blower mounted on the rear of the cabinet provides sufficient air to cool the tube during full-power operation.

With safety of life as a factor, the writer prefers to use parallel resistor combinations.

Final Testing

Laboratory tests at Eimac indicate best performance to be at an anode potential of 2700 to 3000 volts. The efficiency runs between 60 and 65 percent.

Plate impedance figures are based on a 2 kW PEP input using 2700 volts at 740 milliamperes. The grid current for the 8877 runs about 15 percent of the plate current. At full power input, the grid current should be about 110 mA.

When plate voltage is applied, the zero-signal plate current should be about 95 mA. Drive should be applied through a directional coupler. On each band, after fully loading the amplifier to the above conditions, tune the input coil for minimum reflected power. No further adjustment is required and the directional coupler can be removed.

As the plate tuning control is "rocked" through resonance note the action of the grid and plate current. If maximum grid current and minimum plate current occur at approximately the same point, the amplifier is probably stable.

For maximum efficiency from *any* amplifier at *any* power level, it is important to have proper drive and loading. Changing from high to low power (2 kW to 1 kW, for instance) is *not* just a matter of reducing the driving power. Using the 15-percent ratio of grid-to-plate current, the ratio would be 110 to 740 mA for 2 kW input, and 55 to 370 mA for 1 kW input. If the anode voltage of 2700 is maintained, a change from 2 kW to 1 kW will double the plate load impedance. Therefore, the tuning and loading controls *must* be readjusted. Additionally, the drive must be reduced. If the dummy load survives tune-up logging of dial settings, you are finished.

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[EDITOR'S NOTE: A constructional technique used by the author to eliminate rf leakage through large holes in the chassis will be discussed in a subsequent issue of *QST*. It is called a "wave-guide-beyond-cutoff" and can be used to duct air from a blower to the amplifier chassis. No screens are required in the air path, yet the chassis remains rf tight.]

SOCKET AND CHIMNEY COMBINATIONS FOR THE 3CX1500A7/8877

Two Air System Sockets and Chimneys are available for this tube:

(Grounded Grid operation with grid grounded to chassis)	SK-2210
(Grounded Cathode operation)	SK-2200
Fiberglas Air Chimney (for use up to 30 MHz)	SK-2206
Teflon Air Chimney (for VHF use)	SK-2216

A home made socket for the 3CX1500A7/8877 may be made from a 7-pin septar socket (E.F. Johnson 122-247-202). Proper chassis to socket spacing is obtained with 3/8-inch metal spacers. Four chimney clips are required (EIMAC 115-846), as well as four grounding clips for the screen ring of the tube (EIMAC 149-842). A set of the eight clips may be obtained for Two Dollars ($2.00) from Amateur Service Dept., EIMAC Division of Varian, 301 Industrial Way, San Carlos, Ca. 94070.