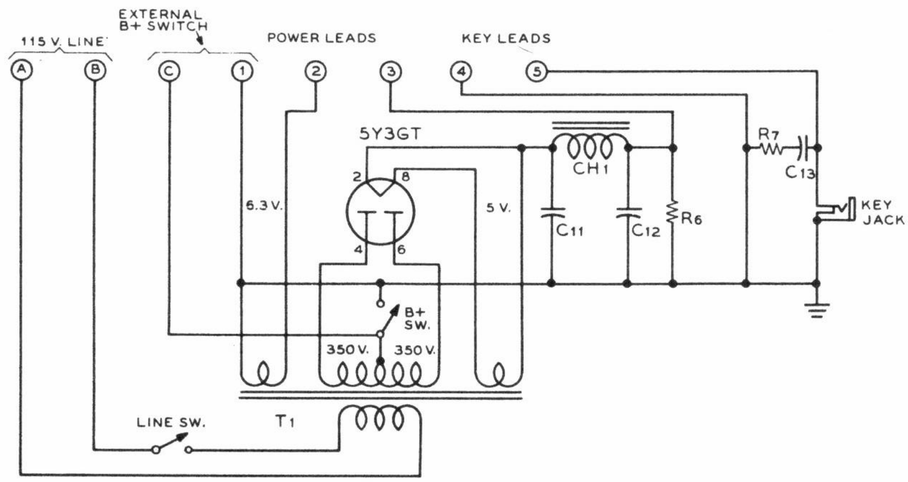


Figure 25.
SCHEMATIC OF THE 350-VOLT SUPPLY.

C_{11}, C_{12}—8-μfd. 500-volt electrolytics
C_{13}—0.5-μfd. 400-volt tubular
R_6—30,000-ohm 25-watt fixed bleeder
R_7—100-ohm 2-watt resistor
CH_1—10.5-hy. 110-ma. choke (Merit C-2993)
T_1—700 v. c.t. 110 ma., 5 v. 3 a., 6.3 v. 4.5 a. (Merit P-3153)
Switches—S.p.s.t. toggle switches

Variable Voltage Power Supply

A pair of 2050 grid-controlled gas thyratrons are used as rectifiers in the variable-voltage power supply. These rectifier tubes have an inverse peak rating of 1300 volts and can deliver an average output current of 100 ma. each or 200 ma. for the pair. A 1300-volt inverse-peak rating on the tubes limits the maximum secondary voltage of the power transformer to about 460 each side of center. The particular transformer used in the unit illustrated furnishes 400 volts each side of center tap and is rated to carry an output current of 200 ma. A capacitor input filter is used so that the full load voltage with the control at maximum is about 400. Due to the peak current limitation of 1 ampere on the rectifier tubes, it is necessary to insert resistors in series with the plate leads. In the unit shown it was found convenient to combine the function of peak current limiting and hash suppression by placing a resistor in series with the plate lead of each tube. In addition a buffer capacitor is placed across each half of the primary of the plate transformer. Resistors R_3 and R_4 in conjunction with capacitors C_1 and C_2 serve the dual function of peak current limitation and hash suppression.

A unique feature of this power supply is the fact that the rectifier tubes are grid-controlled gas thyratrons. Hence it is possible to vary the output voltage of the power supply by varying the phase angle of the a-c voltage applied to the grids of the thyratrons. The use of thyratron tubes in this manner as controlled rectifiers is quite common in industrial practice but is seldom found in amateur equipment.

The mechanism of the action of the grids of the thyratron tubes in controlling the output voltage of the power supply is diagrammed in figure 26. The phase angle of the a-c line feeding the plates of the rectifiers, $\phi 1$, remains constant, as the reference phase, throughout this discussion. However, the phase angle of the voltage applied to the grids of the thyratrons, $\phi 2$, is varied by means of the phase-shifting network with its control R_5 in figure 28. When the phase of the voltage applied to the grids is essentially the same as that applied to the plates, the tube conducts over substantially the entire cycle as is the case with any mercury-vapor or gas-type rectifier tube. This condition is illustrated by figure 26(1). However, when the phase angle of the voltage applied to the grids is retarded, as in (2), the tube will not conduct until the actual negative grid voltage becomes more positive than the critical value for the applied plate voltage. When the critical value is reached, the tube ionizes and current flows through the remain-

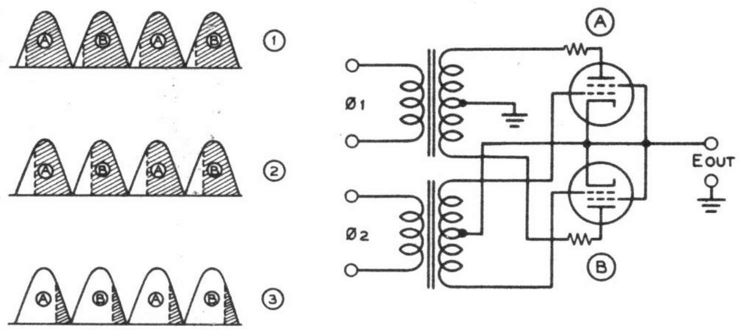


Figure 26.

SHOWING THE OPERATION OF THE THYRATRON RECTIFIER CIRCUIT.

Tubes (A) and (B) are type 2050 tetrode thyratrons. Phase 1 is the reference phase of the 115-volt line fed to the primary of the plate transformer. Phase 2 is controlled and varies the angle of the plate-supply voltage over which the thyratron tubes will conduct. The output voltage from the supply is taken from the cathodes of the tubes as in the case of any rectifier circuit. The cross-hatched area in (1), (2), and (3) represents the portion of the plate-voltage cycle during which tubes (A) and (B) are conducting. Condition (1) takes place when the grid voltage is substantially in phase with the plate voltage, so that conduction takes place over nearly the whole cycle. In (2) the phase of the grid voltage lags somewhat, while in (3) the phase of the grid voltage lags almost one-half cycle behind the plate voltage. (1) represents nearly full output voltage, (2) will give about half-voltage output, while (3) will give about the lower limit of stable output from the supply.

ing portion of the half-cycle. The portion of each half cycle during which conduction occurs is indicated by the cross-hatch lines in figure 26.

It is important to remember that a thyratron tube continues to conduct, after once having been fired, so long as the plate is positive with respect to the cathode; the grid loses control completely over the flow of current once its peak potential has exceeded the critical value and ionization has taken place. Hence thyratrons must be used in a type of circuit where voltages are periodically applied, with a short resting period between operating cycles. The power supply circuit of figure 28 is an example of such an arrangement since the plate voltage on each tube becomes negative after each period of conduction.

When the phase angle of the voltage on the grid is made to lag far behind that applied to the plate, the tube conducts over only a small portion of the half cycle during which the plate is positive with respect to the cathode. (See figure 26(3).) In a power supply such as that illustrated, this type of operation results in the lowest value of output voltage which may be obtained from the power supply.

The phase-shifting network in the power

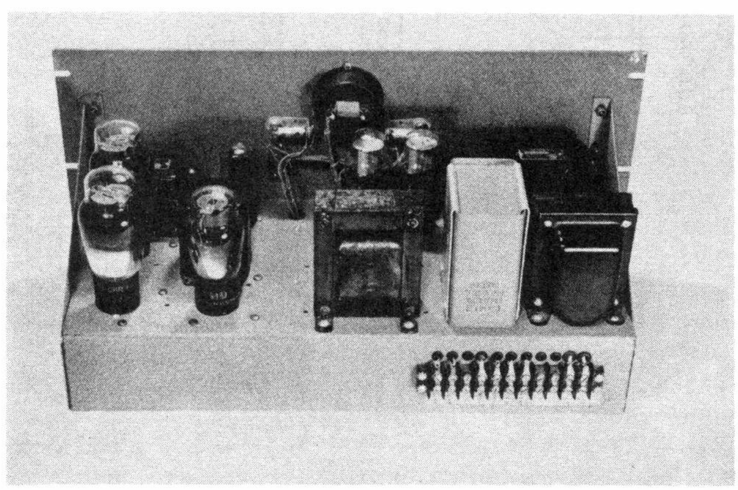


Figure 27.

REAR OF THE VARIABLE-VOLTAGE THYRATRON POWER SUPPLY.

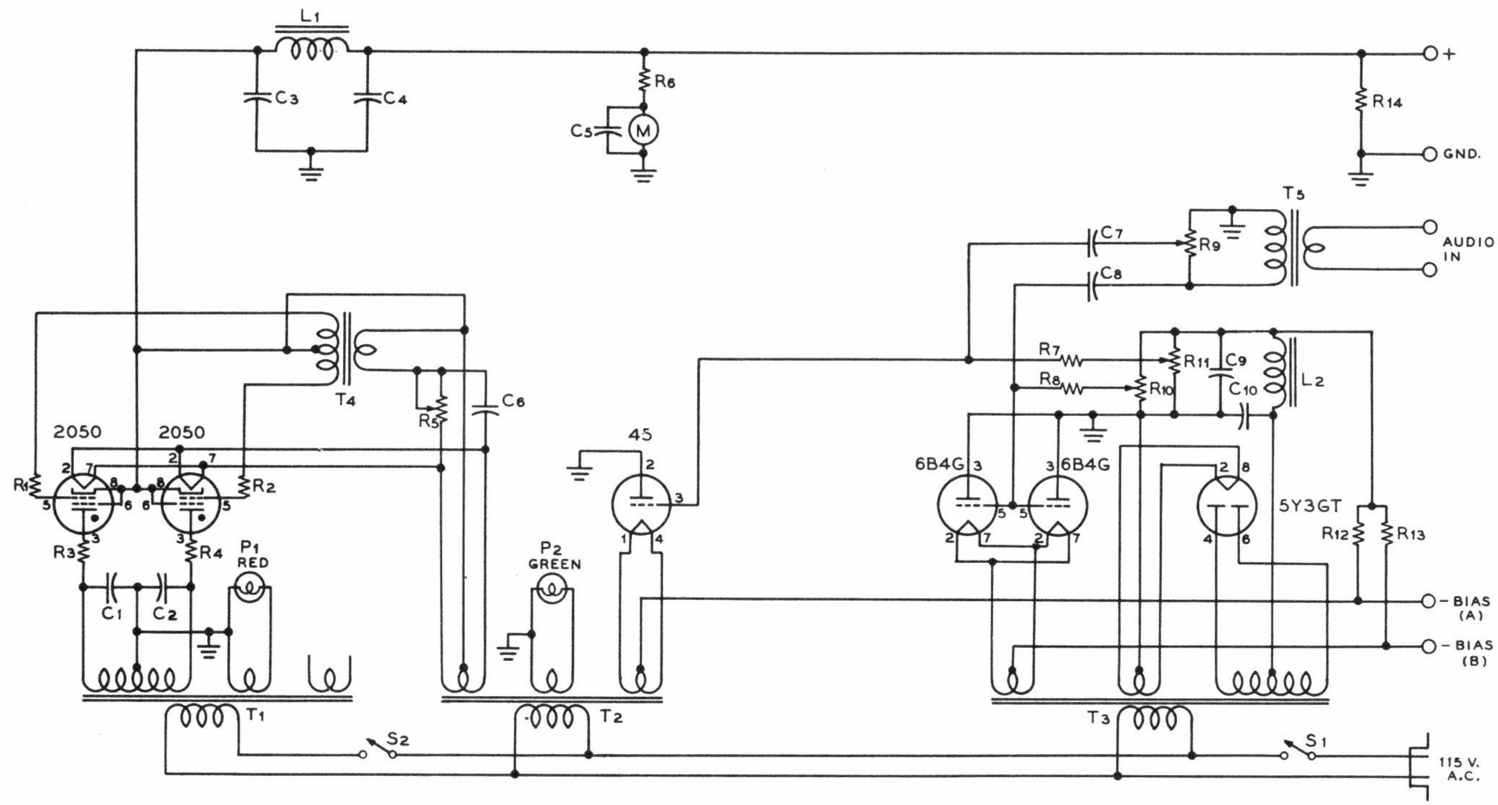


Figure 28.

SCHEMATIC OF THE VARIABLE-VOLTAGE DUAL POWER SUPPLY.

C_1, C_2—0.002-μfd. 1250-volt mica
C_3—4-μfd. 600-volt oil filled
C_4—8-μfd. 600-volt oil filled
C_5—0.003-μfd. mica
C_6—8-μfd. 150-volt elect.
C_7, C_8—0.05-μfd. 400-volt
C_9, C_{10}—8-μfd. 450-volt elect.
L_1—8.5-hy. 200-ma. choke (Stancor C-1721)
L_2—16-hy. 50-ma. choke (Stancor C-1003)
M—0-5 d-c milliammeter (Marion HM-2)

R_1, R_2—100,000 ohms ½ watt (Ohmite Little Devil)
R_3, R_4—200 ohms 10 watts (Ohmite Brown Devil)
R_5—10,000-ohm wire-wound potentiometer
R_6—Group of 2-watt resistors in series to make 100,000 ohms
R_7, R_8—100,000 ohms ½ watt (Ohmite Little Devil)
R_9—50,000-ohm potentiometer
R_{10}, R_{11}—70,000-ohm wire-wound potentiometers (Mallory 470MP)
R_{12}, R_{13}—25,000 ohms 10 watts (Ohmite Brown Devil)

R_{14}—50,000 ohms 20 watts (Ohmite Brown Devil)
S_1, S_2—S.p.s.t. toggle switches
T_1—400 volts to 460 volts each side center at 200 ma. (Stancor P-6165 used)
T_2—2.5 v. 3.5 a., 5 v. 3 a., 6.3 v. 3 a. (Stancor P-6144)
T_3—600 v. c.t. 55 ma., 5 v. 2 a., 6.3 v. 2.7 a. (Stancor P-6119)
T_4—Push-pull input, 3:1 ratio (Stancor A-4750)
T_5—Line to grid (Stancor A-4351)

supply illustrated is made up of R_5 and C_6. These two components are connected across the 6.3-volt winding for the 2050 heaters in such a manner that the phase of the voltage across the primary of T_4 may be varied over a wide angle. The phase-shifted voltage then is fed to the grids of the 2050 tubes from the push-pull secondary of transformer T_4. Type 2D21 miniature thyratrons may be used in place of 2050's since their characteristics are similar. The balance of the circuit for the power supply is conventional, with a 0-5 milliammeter connected in series with the bleeder on the output of the power supply in such a manner that the milliammeter acts as a voltmeter. The output voltage is obtained by multiplying the milliammeter reading by 100.

Specifications for the 2050 tube call for a delay of at least 10 seconds after the application of heater voltage before the tube is required to conduct. This requirement is met by isolating the transformer which supplies heater power from the plate transformer. When S_1 is closed, heater power is applied to all tubes, and the bias supply becomes operative. Green pilot lamp P_2 lights whenever the heaters of the tubes are energized. Then when S_2 is closed the red pilot lamp P_1 lights, and plate voltage is applied to the 2050's. The output voltage of the power supply indicated by the milliammeter/voltmeter on the front panel, and the value of the output voltage may be varied by the front-panel control of the potentiometer R_5.

The Regulated Bias Supply The balance of the chassis of the unit is taken up by the regulated bias supply. Two separately controlled bias outputs are provided, either one of which may be varied from a few volts to about −300 volts. Bias output (A), which uses a type 45 tube as the regulator, is capable of handling a maximum grid current into the bias pack of about 50 ma. Bias output (B), using a pair of 6B4-G tubes in parallel, is capable of handling up to 200 ma. of grid current from the tubes to which it feeds bias.

The circuit of the bias supply uses a 5Y3-GT as a rectifier, with the tubes specified in the previous paragraph as reverse-connected bias regulators. Potentiometers R_{10} and R_{11}, which are brought out to the front panel, serve to control separately the output voltage from each of the bias channels. Provision has been included with the components T_5, R_7, R_8, R_9, C_7, and C_8 for modulation of the grid-bias voltage by means of an audio signal from an external speech amplifier. Since potentiometer R_9 permits controlling the ratio of the audio voltage on channel (A) with respect to that on bias channel (B), the bias pack may be used for simultaneous cascade grid-bias modulation of two successive stages in an AM transmitter. Such an arrangement would be particularly convenient when grid-bias modulating a grounded-grid output stage (such as with one or two 304TL's) while simultaneously grid-bias modulating the stage which excites the final amplifier (which might be an 812A, 35TG, or similar type).

Obviously the bias-modulating portion of the regulated grid-bias pack may be omitted if this provision never will be needed. But if a bias supply such as the one described is to be used as a portion of a c-w transmitter, the in-

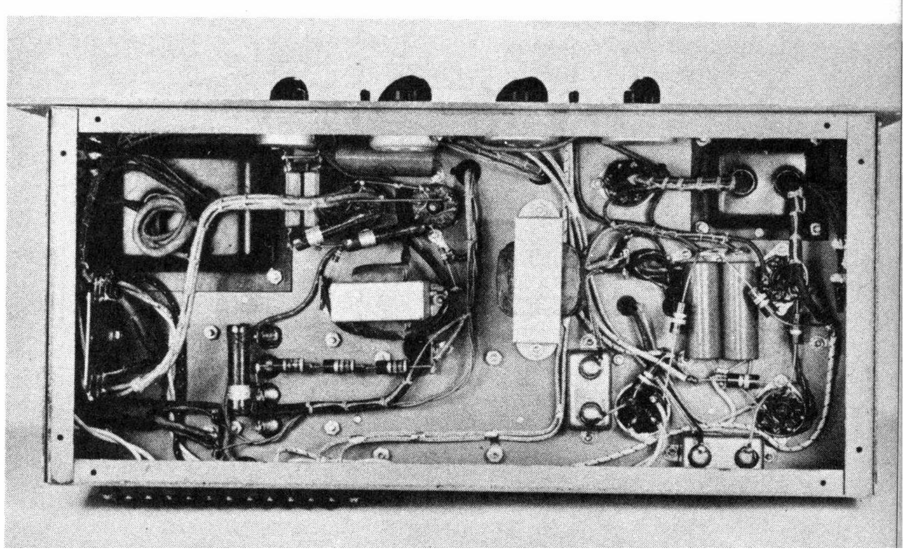


Figure 29. UNDERCHASSIS OF THE THYRATRON POWER SUPPLY.

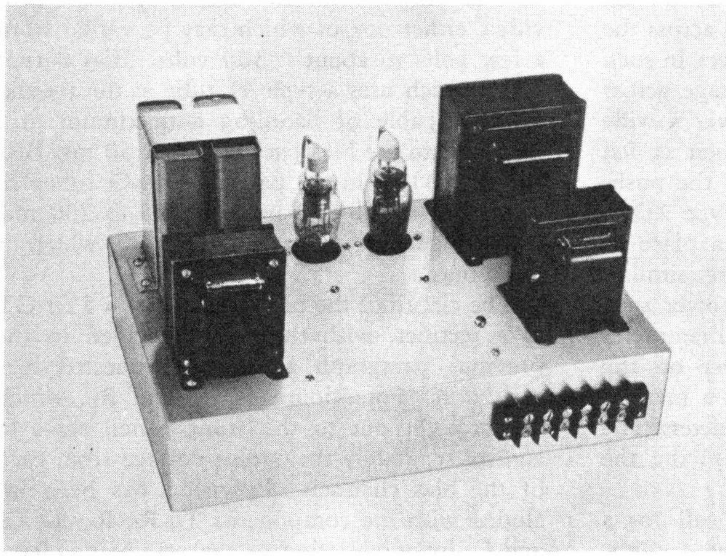
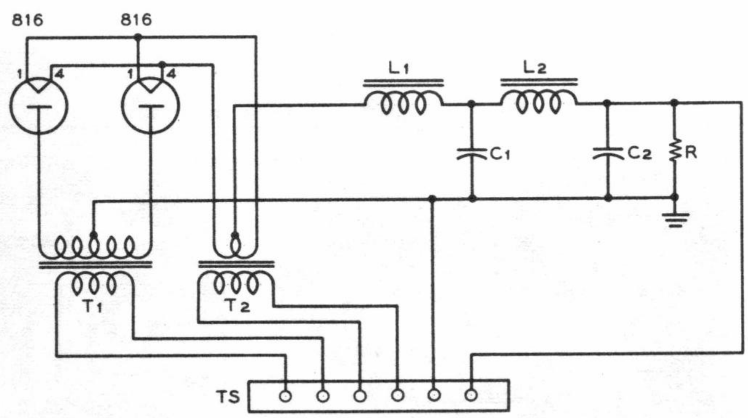


Figure 30.
FRONT OF THE 400-VOLT 250-MA. SUPPLY.

clusion of the few components for grid-bias modulation will allow the transmitter to be used for AM phone with little difficulty, should the occasion demand. Also, the bias supply may be separated from the variable-voltage power supply in the event that only one or the other is required simply by separating the functions of the filament transformer T_2.

400-Volt 250-Ma. Power Supply

Illustrated in figures 30 and 31 is a 400-volt power supply capable of delivering 250 ma. of current to the load. Type 816 tubes are used as rectifiers to feed a two-section choke-input filter. A high degree of filtering is obtained through the use of two 10-μfd. 600-volt oil-filled capacitors in the filter system. Ripple percentage at full output from the power supply is about 0.25 per cent. The regulation from the supply is sufficiently good so that the one power supply may be used to feed both the final amplifier and a class AB_2 or class B modulator for the r-f amplifier. The primary of the plate transformer is brought out to a separate pair of terminals from the primary of the rectifier filament transformer. The separation of the two primary circuits allows a greater degree of flexibility in the control circuits of the transmitter of which the power supply is a unit.



C_1, C_2—10-μfd. 600-volt oil filled
L_1—2-12 hy. 250-ma. swinging choke (Stancor C-1402)
L_2—4-hy. 250-ma. filter choke (Stancor C-1412)
T_1—1000 v. c.t., 300 ma. max. (Stancor P-8040)
T_2—2.5 v. 5 a., 7500 v. insulation (Stancor P-6133)
R—25,000 ohms, 25 watts fixed (Ohmite 0219)

Figure 31.
SCHEMATIC OF THE 400-VOLT 250-MA. SUPPLY.