# AIR-GROUND RADIO
# PRIVATE SYSTEMS
# ERCO 361-TB TRANSMITTER
# DESCRIPTION

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## 1. GENERAL

**1.01** This section covers the description and operating principles for the Erco Radio Laboratories type 361-TB UHF AM transmitter.

**1.02** This section is reissued to change certain specifications. Marginal arrows have not been used to indicate changes.

**1.03** The 361-TB transmitter is comprised of the following units: RF Unit, Modulator Unit, Control Unit, Power Supply and Cabinet.

**1.04** The 361-TB transmitter is designed to deliver 100 watts of amplitude-modulated radio frequency power into a 50-ohm coaxial transmission line and associated radiating system having a standing wave ratio of 2 to 1 or less. Output frequency is crystal-controlled in the frequency range of 225 to 400 megacycles with 0.005% stability for transmitters manufactured prior to April 1963. Crystal ovens have been furnished in transmitters manufactured after April 1963, providing 0.002% stability.

**1.05** Relay K1 and resistors R-23 and R-24 are provided on the RF chassis to lower the filament voltages to tubes V5, V6 and V7 during stand-by, on transmitters manufactured prior to November 1961. They are not provided on transmitters with serial numbers over No. 7666.

**1.06** The primary power required from a 115-volt 50/60-cycle single-phase source is 1400 watts when operating with rated modulated output and 350 watts during stand-by.

**1.07** The transmitter may be controlled locally or from a remote location. An optional "time-out" relay can be provided to prevent radiation of carrier caused by a defective line facility.

**1.08** The entrance door is equipped with an interlock switch which disconnects the high-voltage supply when the door is open.

**1.09** Cabinet dimensions:

67-1/2 in. high
22 in. wide
18 in. deep

**1.10** Panel space is available in the cabinet to accommodate an Erco type 362-R UHF radio receiver.

**1.11** Net weight of complete transmitter is 350 pounds.

## 2. CIRCUIT DESCRIPTION

**2.01** A block diagram of the transmitter is shown in Fig. 1.

**2.02** The RF unit schematic which contains the oscillator, multipliers, driver, power amplifier, filament transformer, protective relays, blower, and metering circuits is shown in Figs. 2 and 3.

**2.03** The high-voltage power supply schematic is shown in Fig. 4.

**2.04** The modulator and compressor amplifier schematic is shown in Fig. 5.

**2.05** The control unit schematic which contains control switches, control relays, bias, and low-voltage supplies is shown in Fig. 6.

**2.06** The cabling diagram is shown in Fig. 7.

**(A) RF Unit**

**2.07** ***Crystal Oscillator:*** V-1 uses a type 5763 tube in hot-cathode Pierce oscillator circuit. The circuit uses a military-type CR-18/U crystal between 4687.5 and 8333.3 kc. The crystal frequency is 1/48th of the carrier frequency. Capacitor C-1 provides a fine adjustment of the oscillator frequency. The plate circuit of the oscillator is tuned to twice the crystal frequency by L-1 and C-4.

**2.08** ***First Multiplier:*** V-2 uses a type 5763 tube as a frequency doubler. The plate circuit is tuned by L-2 and C-11 to twice the drive frequency. The output covers a nominal frequency range of 18.7 to 33.4 megacycles.

**2.09** ***Second Multiplier:*** V-3 uses a type 5763 tube. The plate circuit is tuned by L-3 and C-18 to twice the drive frequency. The output covers a nominal frequency range of 37.5 to 66.7 megacycles.

**2.10** ***Third Multiplier:*** V-4 uses a type 5894 tube. The plate circuit is a capacity-tuned quarter-wave line tuned by L-5 and C-26 to three times the drive frequency. The output covers a nominal frequency range of 113.5 to 200 megacycles.

**2.11** Tubes V1, V2, V3, and V4 have protective cathode bias so that under normal tuning and operating conditions, tube ratings will not be exceeded.

**2.12** ***Fourth Multiplier/Driver:*** V-5 uses a type 6979/4X250B tube as a doubler and driver. The plate circuit is a capacity-tuned quarter-wave line tuned by L-7 and C-33 to twice the drive frequency. The output covers a nominal range of 225 to 400 mc. The inductance of L-7 is varied by an adjustable shorting bar with C-33 providing the fine frequency adjustment. A fixed-negative 65-volt bias is provided to protect the tube should the drive fail.

**2.13** ***Power Amplifier:*** V-6 and V-7 use a pair of type 6979/4X250B tubes in push-pull, operating straight through as a class C modulated amplifier. The grid circuit utilizes a half-wave line L-9 link-coupled to the driver by L-8. The plate circuit is a capacity-tuned quarter-wave line tuned by L-10 and C-36 to the drive frequency. The output covers a nominal range of 225 to 400 mc. The inductance of L-10 is varied by an adjustable shorting bar with C-36 providing the fine frequency adjustment. Relay K-2 protects V-6 and V-7 by connecting R-43 to ground which reduces the screen voltage. K-2 is normally held operated by the grid current. When the grid current falls below the safe value or when the TUNE-OPERATE switch is in the TUNE position, K-2 releases, reducing the screen voltage. RF output is obtained from each of the tubes by capacity-coupling to each plate by C-37A and C-37B which are connected together with a half-wave balun E-2 made from RG-8/U coaxial cable. A "T" connector E-4 is provided for the output with one end for the antenna and the other end connected to E-5 which is an RF monitor consisting of a capacitor divider and a shunt silicon diode assembled in a fitting which attaches to E-4. An eight-position METER SWITCH connects the EXCITER METER to each multiplier stage and to the RF monitor E-5. Individual meters for the MODULATOR PLATE, IPA PLATE, and PA PLATE are permanently connected to their respective circuits. A single-pole double-throw coaxial-type relay is provided to transfer the antenna from transmitter to receiver and is energized with negative 35-volts dc from the control unit.

**2.14** A motor equipped with sealed ball bearings drives a centrifugal blower which circulates air around the type 4X250B tubes. An air vane attached to a Micro Switch connected in series with the high-voltage control circuit opens the circuit when the air flow is insufficient to hold the vane operated. The final amplifier should be replaced only with glass-type 6979/4X250B tubes.

**(B) Modulator Unit**

**2.15** The modulator is designed to provide 100% amplitude modulation for the power amplifier. Audio input may be from either a local carbon microphone or a remote 500- to 600-

ohm telephone line. Either source can be selected by the INPUT switch S-2. When the local microphone source is selected, dual primary windings on the input transformer T-1 are connected in parallel, producing an input impedance of 125 to 150 ohms. The ring connection of the microphone jack is connected to one side of the windings, with negative dc from the control unit power supply connected to the other side of the windings. The microphone jack tip connection is used for push-to-talk operation and the sleeve is connected to ground. When the remote telephone line is selected, the dual primary windings of T1 are connected in series, producing an input impedance of 500 to 600 ohms, and are terminated at terminals 14, 15, and 16 of TS-2. Terminal 14 is the winding centertap. The secondary windings of T-1 are terminated with R-8 and R-9 and drives V-3 and V-4 through the GAIN control R-10. V-3 and V-4 are connected in push-pull and provide a gain of approximately 25 db. A negative voltage from the rectified audio appearing across the plates of V-3 and V-4 is applied to the control grids of V-3 and V-4. As the audio input level is increased the negative voltage applied to the grids of V-3 and V-4 increases, reducing the over-all gain. This reduction of the dynamic range of the audio input is called compression.

**2.16** The audio level at which compression starts is set by the voltage on the cathode of V-2. The output of V-3 and V-4 increases linearly with the input voltage until the voltage across the secondary of T-2 causes the negative voltage applied to the grids of V-3 and V-4 to increase. Compression starts when approximately 50% modulation has been reached. Beyond the level at which compression starts, an additional input of 25 db will provide an output of approximately 6 db (Fig. 8). Tube V-1 is used to indicate the relative compression voltage and % modulation. GAIN control R-10 adjusts the input level, and the % MOD control R-18 adjusts the point of compression. R-10 and R-18 permit adjusting the amplifier to insure a high average modulation level without exceeding 100% modulation during peak audio inputs.

**2.17** V-6 is a transformer-coupled audio amplifier which drives the modulator tubes V-8, 9, 10, and 11 operating in class AB1 push-pull parallel. V-7, 12, and 13 are voltage regulators to maintain screen voltage of the modulator tubes. BIAS control R-22 and SCREEN control R-35 are used to set the bias and screen voltages to the modulator tubes.

**2.18** T-3 provides filament voltage for all tubes in the modulator unit.

**2.19** Modulation transformer T-5 matches the modulator plate load to the RF amplifier.

**(C) Control Unit**

**2.20** Two switches that control application of all power to the complete transmitter are located on the control unit panel. A LOCAL-REMOTE switch changes the control function from the transmitter to a remote location. Power supplies for protective bias, local microphone dc and control relays are contained in the unit.

**2.21** With 115-volt 50/60 cps power connected to terminals 1 and 2, operating the POWER switch to ON applies power to the FILAMENT pilot lamp I-2, the relay and bias supply transformers T-1 and T-2, time delay relay K-3, and to terminals 3 and 4 which supply 115-V ac power to the filament transformers located on the RF unit, modulator unit, high-voltage power supply, and the blower motor.

**2.22** The contacts of relay K-3 are in series with the high-voltage control relay K-1 and the rear door interlock switch. 30 to 45 seconds are required for K-3 to operate after power is applied.

**2.23** After K-3 has operated and with the LOCAL-REMOTE switch in the LOCAL position, operating PLATE switch S-2 to ON applies —35 volts dc to keying relay K-2 which applies 115 volts ac to relay K-1 which connects 115 volts ac to terminal 5 supplying power to the high-voltage transformers on the high-voltage power supply unit and lights the PLATE pilot lamp on the control unit.

**2.24** Two identical dc power supplies furnish protective bias, relay, and microphone dc voltages. They are connected in series and furnish —35 volts dc at terminal 7 and —70 volts dc at terminal 14 with —17 volts dc for local microphone at terminal 15.

**2.25** Selenium bridge rectifiers SR-1 and SR-2 are used with each supply filtered by 150 ufd capacitors C-1 and C-2. Additional filtering is provided by CH-1 and C-3 to provide —65 volts dc for bias at terminal 13.

**(D) Power Supply**

**2.26** The power supply provides 400 volts dc for the exciter and speech amplifier, 600 volts dc for the Multiplier/Driver and power amplifier, and 600 volts dc for the modulator. The voltages are supplied by two separate power supplies.

**2.27** The 400 volts dc is obtained from transformers T-3, T-4, V-3, V-4, CH-3, C-3, and R-1 with the output connected to terminal 5.

**2.28** Two 600-volt dc voltages are obtained from transformers T-1, T-2, V-1, V-2 with the output from filters CH-1 and C-1 connected to terminal 7 which supply high voltage to the modulator tubes. The output from filters CH-2 and C-2 is connected to terminal 6 and supply high voltage to the Multiplier/Driver and power amplifier stages.

**2.29** The rectifier tubes are Xenon-filled type 3B28.

## 3. EQUIPMENT CHARACTERISTICS

**3.01** Characteristics of the 361-TB transmitter are as follows:

***Power Output:*** 100 watts nominal.

***Modulation:*** Amplitude, high level, plate modulated.

***Load:*** Nominal 50-ohm unbalanced with standing wave ratio of 2 to 1 or less.

***Frequency Range:*** 225 to 400 megacycles.

***Frequency Stability:*** 0.005% with unheated crystals or 0.002% with heated crystals.

***Control:*** Local or remote.

***Audio Input Impedance:*** Carbon microphone or 500/600-ohm line.

***Audio Input Level:*** —20 to 0 dbm from 500/600-ohm line.

***Distortion:*** Less than 6% at 1000 cps for 95% modulation.

***Frequency Response:*** ±3 db between 200 and 3000 cycles.

***Carrier Noise:*** 40 db below 95% modulation.

## 4. DRAWINGS AND PHOTOGRAPHS

**4.01** The following drawings and photographs form a part of this section.

Fig. 1 – Block Diagram Erco Type 361-TB Transmitter

Fig. 2 – Type 361-TB Transmitter — RF Unit Schematic (after serial No. 7666 and with heated crystal)

Fig. 3 – Type 361-TB Transmitter — RF Unit Schematic (before serial No. 7666 and without heated crystal)

Fig. 4 – Type 361-TB Transmitter — H. V. Power Supply Schematic

Fig. 5 – Type 361-TB Transmitter — Modulator Unit Schematic

Fig. 6 – Type 361-TB Transmitter — Control Panel Schematic Diagram

Fig. 7 – Type 361-TB Transmitter — Cabling Diagram

Fig. 8 – Type 361-TB Transmitter — Typical Compressor Action

Fig. 9 – Type 361-TB Transmitter — Front View (crystal oven indicator on RF unit not shown)

Fig. 10 – Type 361-TB Transmitter — Rear View

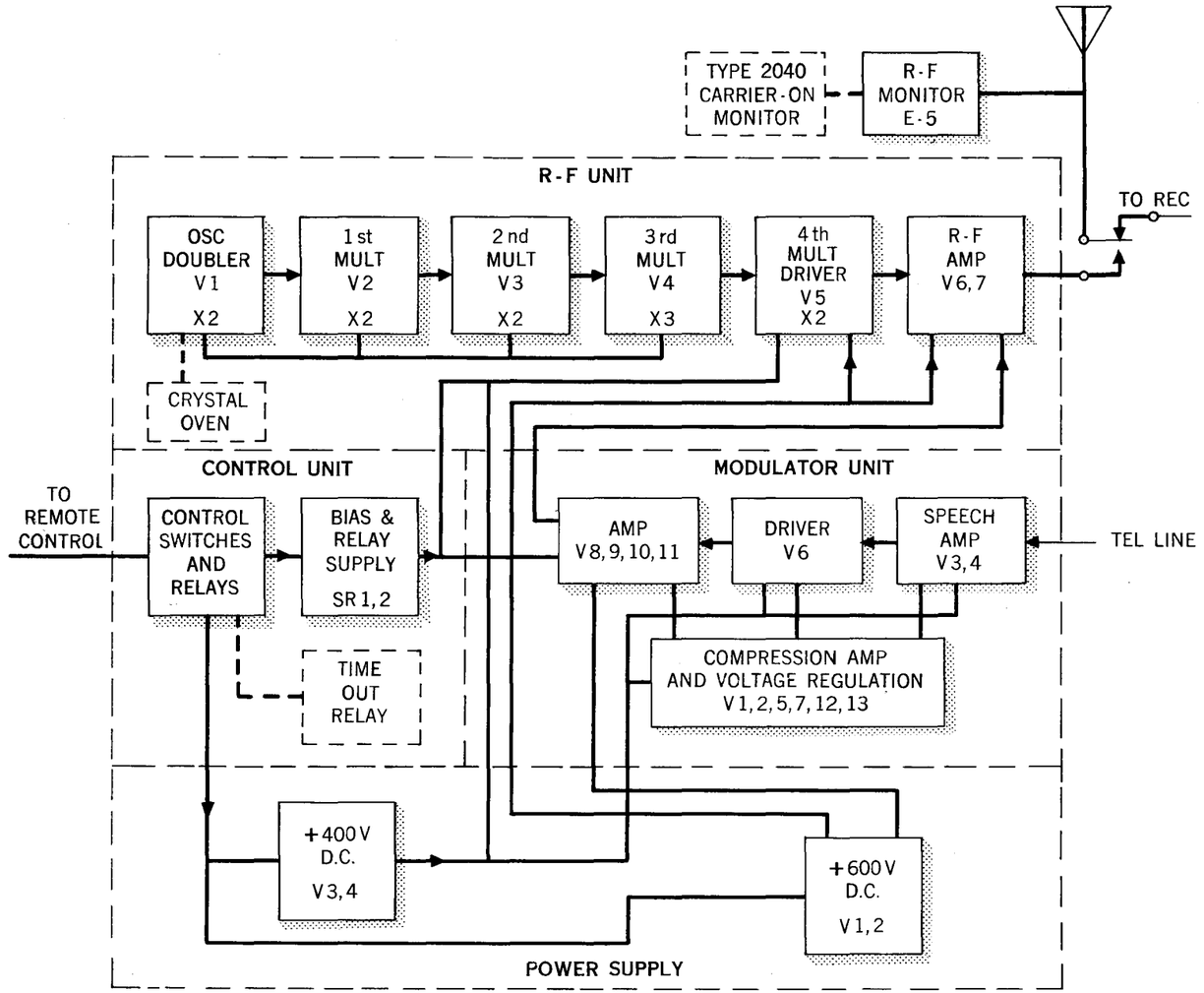


Fig. 1 — Block Diagram Erco Type 361-TB Transmitter

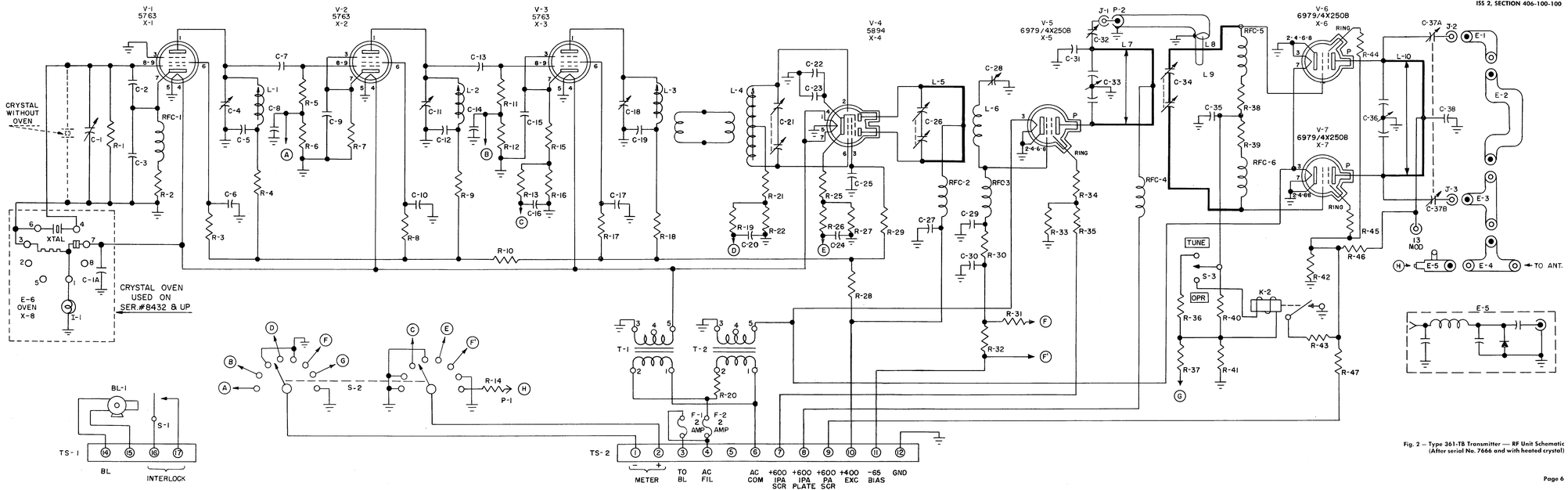


Fig. 2 — Type 361-TB Transmitter — RF Unit Schematic (After serial No. 7666 and with heated crystal)

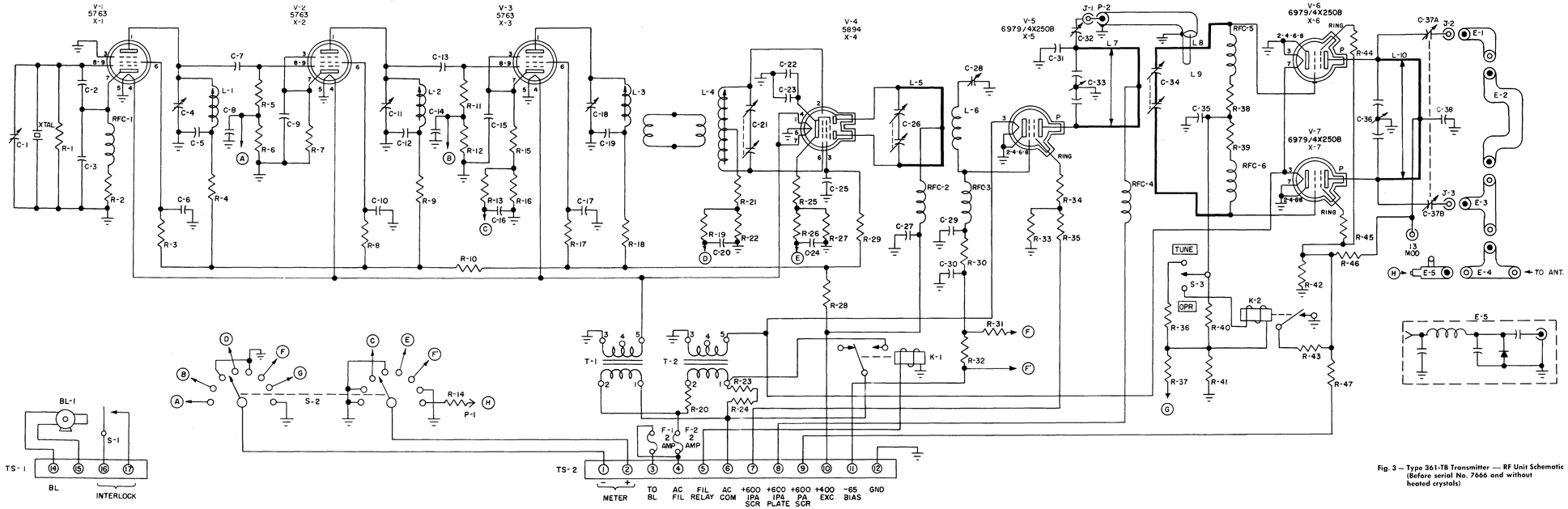


Fig. 3 — Type 361-TB Transmitter — RF Unit Schematic (Before serial No. 7666 and without heated crystals)

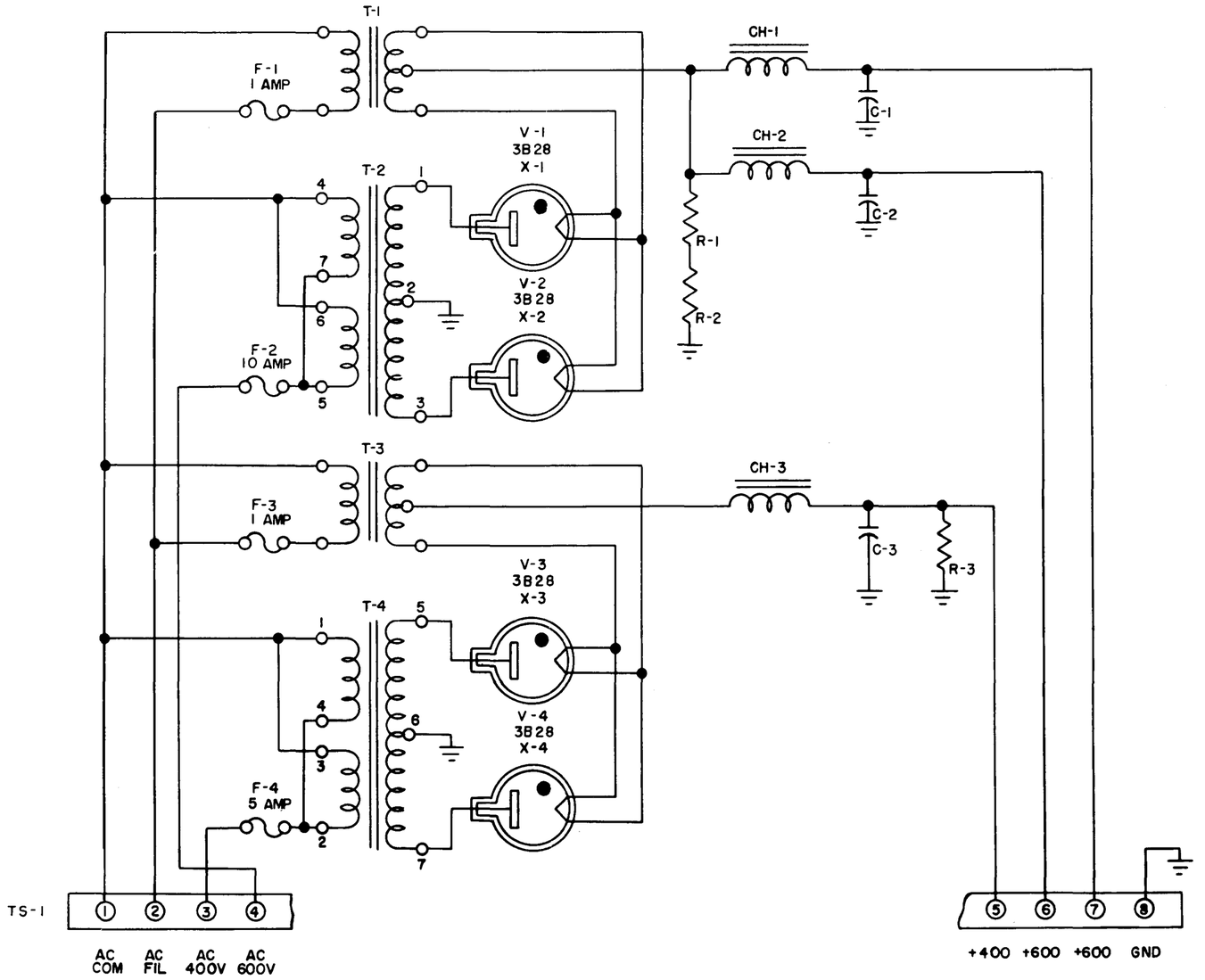


Fig. 4 — Type 361-TB Transmitter — H.V. Power Supply Schematic

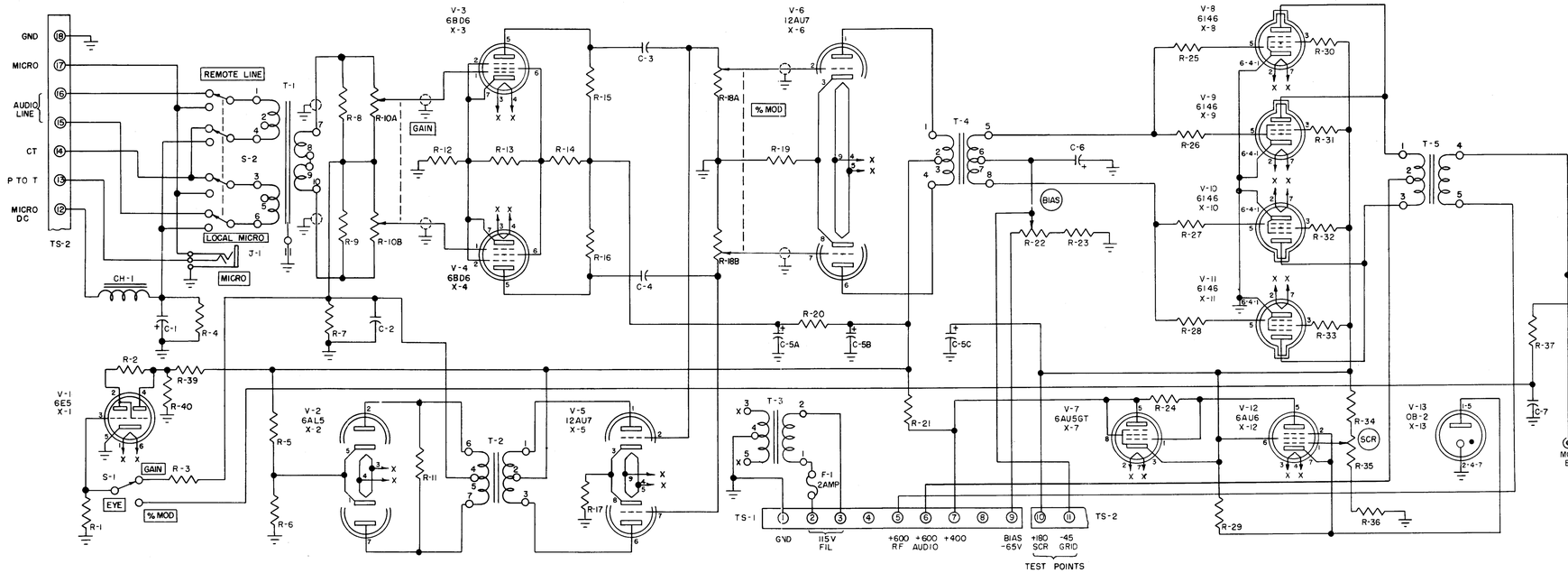


Fig. 5 — Type 361-TB Transmitter — Modulator Unit Schematic

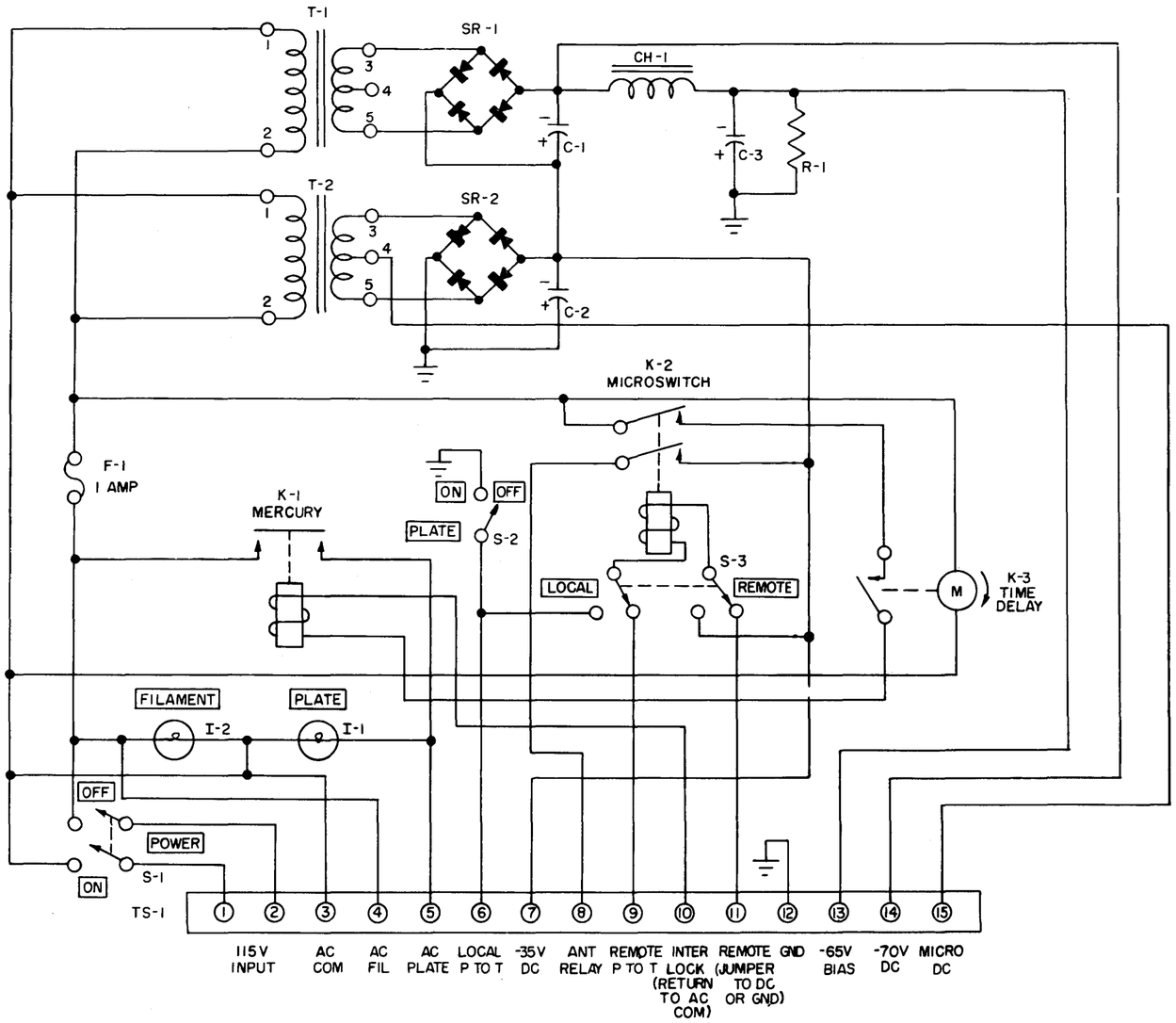


Fig. 6 — Type 361-TB Transmitter — Control Panel Schematic Diagram

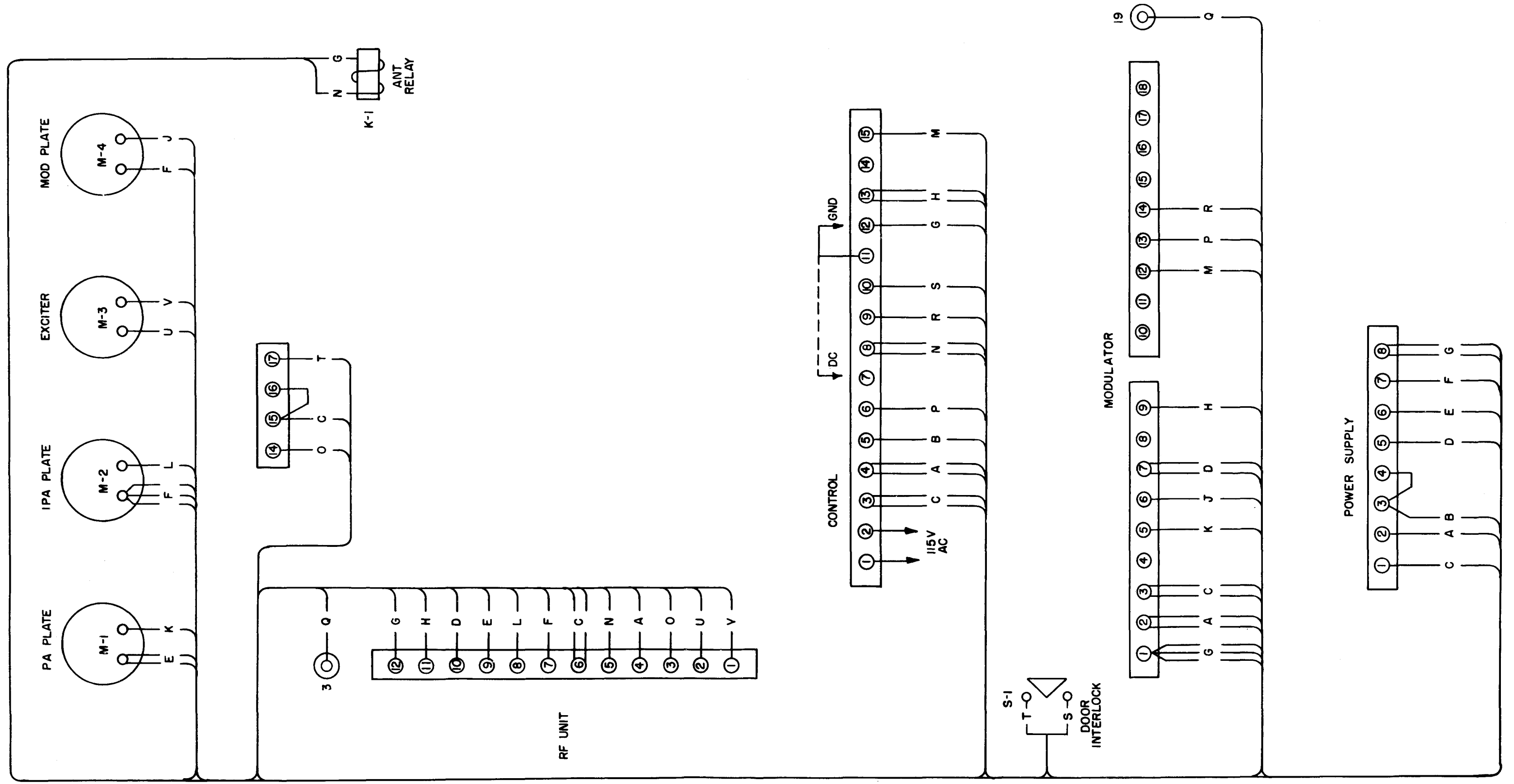


Fig. 7 — Type 361-TB Transmitter — Cabling Diagram

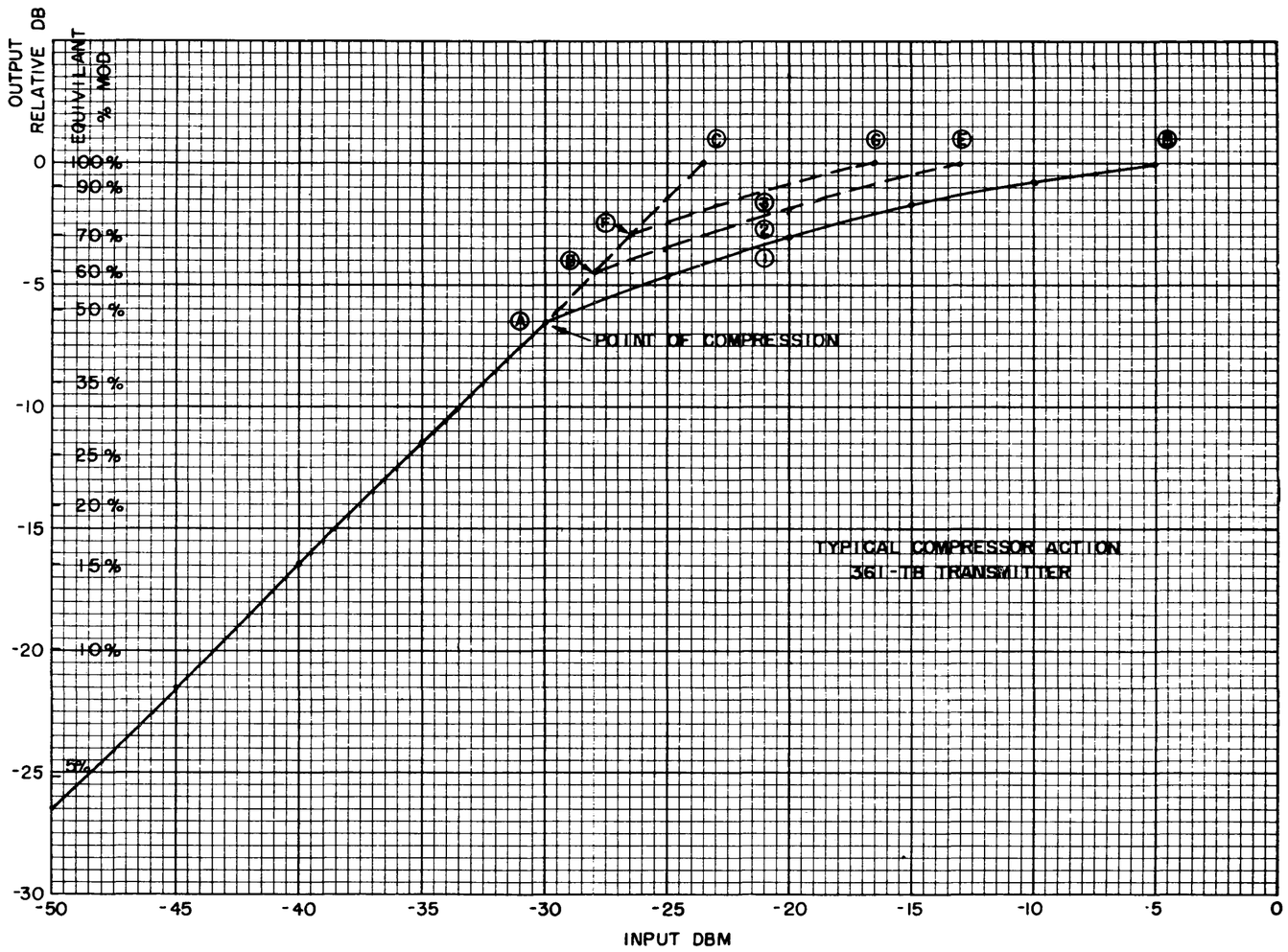


Fig. 8 — Type 361-TB Transmitter —Typical Compressor Action

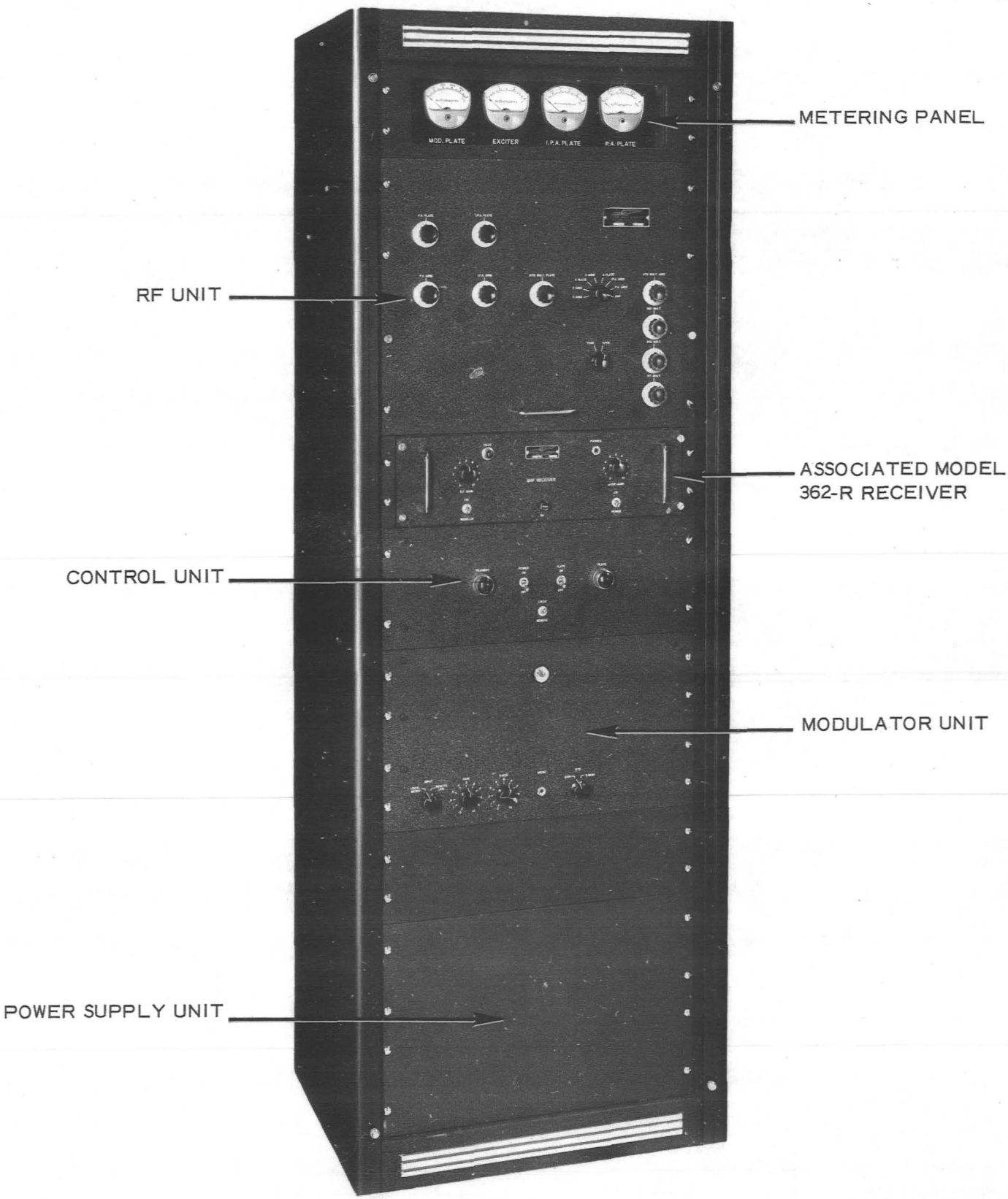


**Fig. 9 — Type 361-TB Transmitter — Front View (Crystal oven indicator on RF unit panel not shown)**

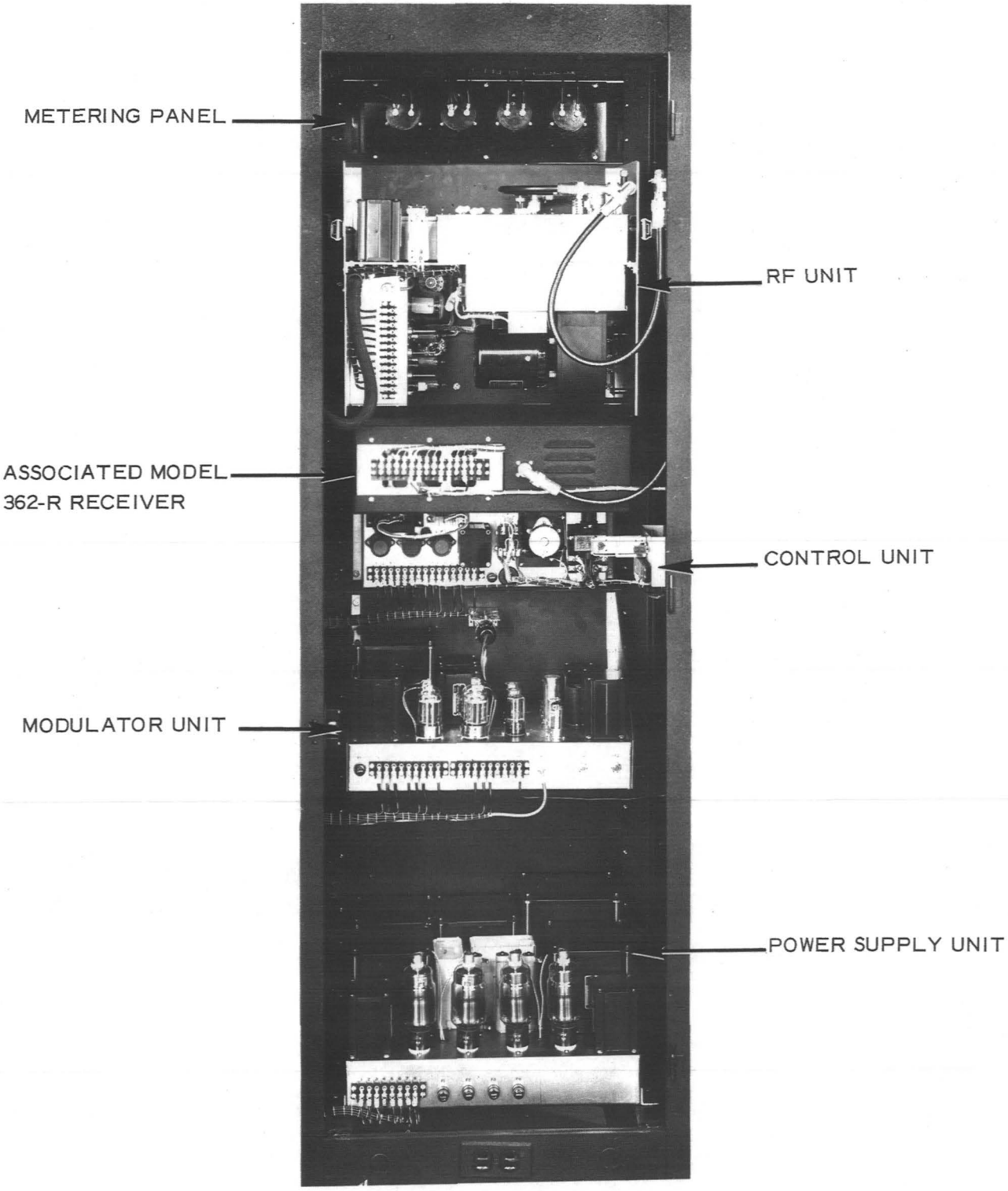


**Fig. 10 — Type 361-TB Transmitter — Rear View**