RCA 1-K TRANSMITTER including BTA-250K EXCITER

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10–10. RCA Type 1–K Broadcast Transmitter—The RCA type 1–K broadcast transmitter equipment is identified by the stock number MI–7186–A and is comprised of the following items:

- 1 type 250–K exciter
- 1 type 1–K power-amplifier unit
- 1 type 1–K power equipment section
- 2 type TMV–129B crystal unit, complete with crystal
- 1 power-change equipment (supplied only if 250/500, 250/1000 or 500/1000 watt operation is desired)
- 2 sets tubes
- 1 set miscellaneous hardware
- 1 r-f output meter

The RCA type 1–K amplifier equipment, for use with a 250–K transmitter already installed, is identified by the stock number MI–7187, which is comprised of the following items.

- 1 type 1–K power-amplifier unit
- 1 type 1–K power equipment section

1 conversion kit (to convert type 250–K transmitter for use as an exciter)
1 power-change equipment (supplied only if 250/500, 250/1000 or 500/1000 watt operation is desired)
2 sets tubes for 1–K power amplifier-modulator and 1–K power equipment section
1 r-f output meter

10–10a. Technical Summary

1. *Electrical Characteristics*

Frequency Range: 550 to 1600 kc
Frequency Stability: ±10 cycles
Carrier Shift: Less than 5% from 0 to 100% modulation (50 to 7500 cycles)
R-f Harmonics: Less than 0.05%
Power Outputs: 250/500, 250/1000, 500/1000, 500, 1000 watts
Output Circuits: Usual antenna, or 70 to 600 ohm transmission line
Type of Modulation: High level, Class B
Audio Input Level—
  At 100% modulation (sine wave): +11 vu
  At average program level: +5 vu
Audio Response: Within ±1.5 db from 30 to 10,000 cycles
Audio Distortion: Less than 3% r-m-s—from 50 to 7500 cycles
Noise Level: 60 db below 100% modulation level
Main Power Supply: 220 to 240 volts, 50/60 cycles, single phase
  Permissible Line Voltage Variation: ±5%
  Power Consumption at 1000 watts r-f output:
    (at 100% modulation) approx. 5700 watts
    (at average program level) approx. 4500 watts
  Power Consumption at 500 watts r-f output:
    (at 100% modulation) approx. 4900 watts
    (at average program level) approx. 3700 watts
  Power Consumption at 250 watts r-f output:
    (at 100% modulation) approx. 4450 watts
    (at average program level) approx. 3350 watts
  Crystal Heater Power Supply: 115 volts, 50/60 cycles, single phase
  Power Consumption: 30 watts

2. *Tube Complement*

Exciter—Amplifier Unit "250-K"—
  Crystal Oscillator: 1 RCA-802
  Buffer: 1 RCA-828
  Intermediate Power-Amplifier: 1 RCA-810
  First Audio: 2 RCA-6J7
  Second Audio: 2 RCA-828
  Main Rectifier: 2 RCA-872
  Bias Rectifier: 1 RCA-80
Power-Amplifier Unit—
  Power-Amplifier: 2 RCA-833-A
  Modulator: 2 RCA-833-A
  Bias Rectifier: 2 RCA-866
  Main Rectifier: 4 RCA-872

3. *Mechanical Specifications*

  Number of Cabinets: 3
  Type of Construction: Vertical Chassis
  Floor Area: 14.5 sq. ft.
Dimensions (overall)—
  Width: 108¾ inches
  Height (including lead-in bushings): 84⅞ inches
  Depth: 20⅛ inches
  Depth (including rear door swing): 38⅞ inches
Weight (net)—
  Exciter-Amplifier Unit: 1360 pounds
  Power Amplifier-Modulator Unit: 1000 pounds
  Power Equipment Unit: 1050 pounds
  Total Floor Load: 3410 pounds

10–10b. Description—This transmitter will provide reliable, high-fidelity operation at any frequency between 550 and 1600 kc with negligible distortion and low carrier noise. It is very easily installed, requiring only the connection of external wiring and the bolting of cabinets together. When the type 1–K amplifier equipment is being added to an existing 250–K installation, several minor alterations are required to convert the 250–K transmitter into an exciter for the type 1–K transmitter. A conversion kit is supplied with the equipment to facilitate the changeover. These changes have been made at the factory on the complete type 1–K transmitter. The equipment requires a single-phase power supply of 230 volts, 50/60 cycles. The transmitter will deliver rated power into a 70- to 600-ohm transmission line or into any type of antenna normally used with broadcast transmitters. Convenient terminals are provided for supplying energy to operate modulation and frequency monitors, and a monitoring amplifier.

The transmitter as normally supplied is wired for operation only at its full-rated power output of 1000 watts or only at a lower output of 500 watts. If it is desired to operate the equipment at 250/500, 250/1000 or 500/1000 watts, this may be accomplished by using the power change equipment kit listed under EQUIPMENT. This kit may be added to the transmitter at any time.

10–10c. Construction—The cabinet enclosures are designed to produce a unified and distinctive appearance as shown by Figure 10–20. All necessary controls are grouped conveniently on illuminated panels. Adjustments are facilitated by the liberal provision of meters, which are mounted at eye level on hinged panels located just above the controls.

Access to the rear of each meter panel is obtained by first operating the release handle, which is reached through a chassis hand-hole from the rear, and then by swinging the panel forward. The panel is held in its raised position by stay joints. The handle which operates the panel-catches operates, in addition, a high voltage interlock switch.

All transmitter components are mounted on vertical type chassis and each is readily accessible from the rear through full-length doors. The opening of these doors operates high-voltage interlock switches. In making repairs and replacements it is necessary to remove the chassis. The edges of all wire holes are rounded, and the holes are of sufficient size to permit wires to be removed or replaced easily should this ever be necessary. Sufficient lengths of wire are provided to permit easy removal of the terminal boards and high voltage terminals. Shields are placed behind the high-voltage terminal bushings to protect them against accidental short circuits. The bushings may be removed and the wires "fished in" if necessary.

Fig. 10–20. RCA 1-k standard broadcast transmitter.

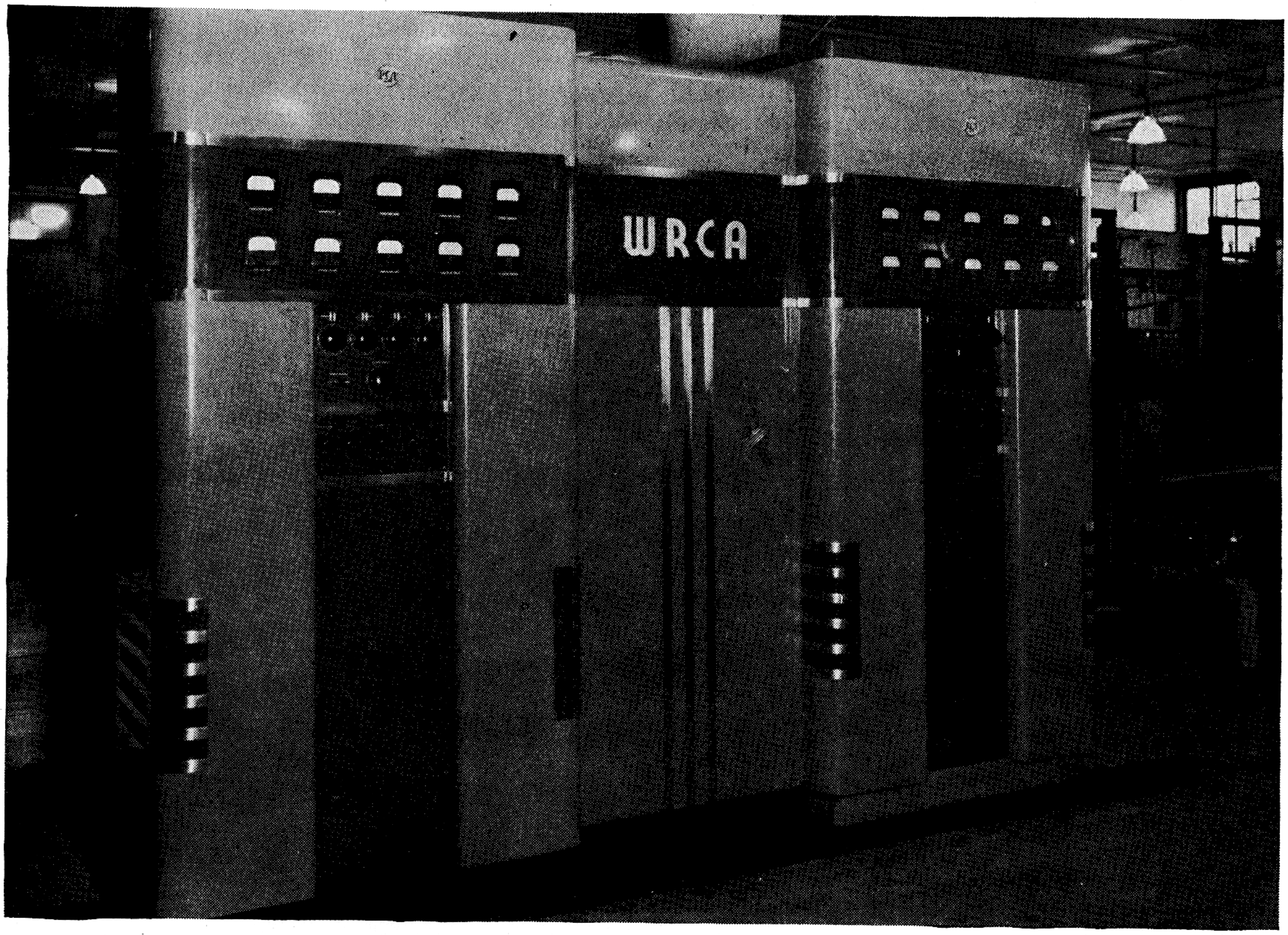

FIG. 10–20. RCA 1-k standard broadcast transmitter.

The equipment is mounted in three cabinets, shown in Figure 10–22 as the 250–K EXCITER, the center unit, and the 1–K AMPLIFIER. The 250–K EXCITER includes the crystal oscillator, the low-power audio and radio-frequency stages, and their power supplies. The center unit contains the heavy power and modulation transformers. The 1–K amplifier cabinet contains the power-amplifier stage, components of the modulator stage, and their power supplies.

10–10d. Circuit Design—A schematic diagram for the complete transmitter is given in Figure 10–22. It will be noticed that the circuit is divided into two sections, one labeled TYPE 250–K EXCITER and the other TYPE 1–K AMPLIFIER. The various items of the first section are designated by code numbers prefixed by the number "1"; the items of the second section have code numbers prefixed by the number "2." The various sub-divisions of the "250–K" section will be referred to in the following discussion as: oscillator; buffer; intermediate power-amplifier; first audio stage; second audio stage; second audio bias rectifier; exciter plate-voltage rectifier. The sub-divisions of the "1–K" section consist of the power-amplifier, modulator, modulator bias rectifier and power-amplifier plate-voltage rectifier.

The names of the switches and controls on the 250–K panel are, in some cases, the same as those on the 1–K panel. To avoid confusion, references to controls located on the 250–K panel will include the control name, preceded by the word "exciter" or by "250–K." Similarly, names of the 1–K panel controls will be preceded by the word "amplifier" or by "1–K."

1. *Radio-frequency Circuits.* Excellent frequency stability is attained by the use of a low temperature-coefficient crystal installed in a temperature-controlled chamber, and connected between the control and screen grids of the RCA–802 oscillator tube. Vernier frequency control is obtained by an adjustment of capacitor 1C2 which is connected in parallel with the crystal.

Two stages of r-f amplification follow the oscillator stage. The first, or buffer, stage uses an RCA–828 tube and the second, the intermediate power-amplifier, uses an RCA–810 tube. The power-amplifier stage includes two RCA–833–A tubes, connected in a push-pull circuit.

The power-amplifier is inductively coupled to the antenna or transmission line through a "T" section

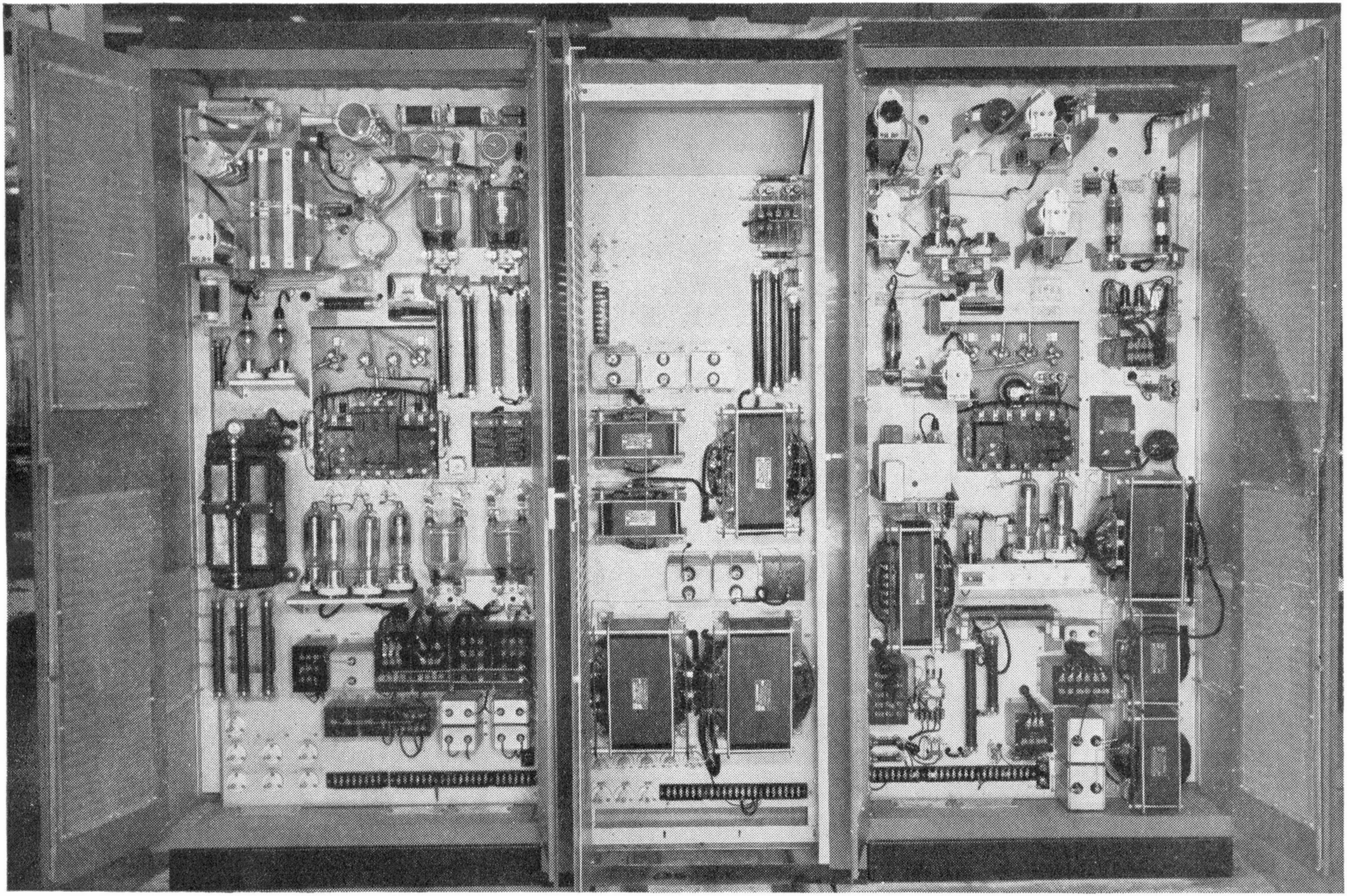

FIG. 10–21. Rear view of RCA 1-K broadcast transmitter.

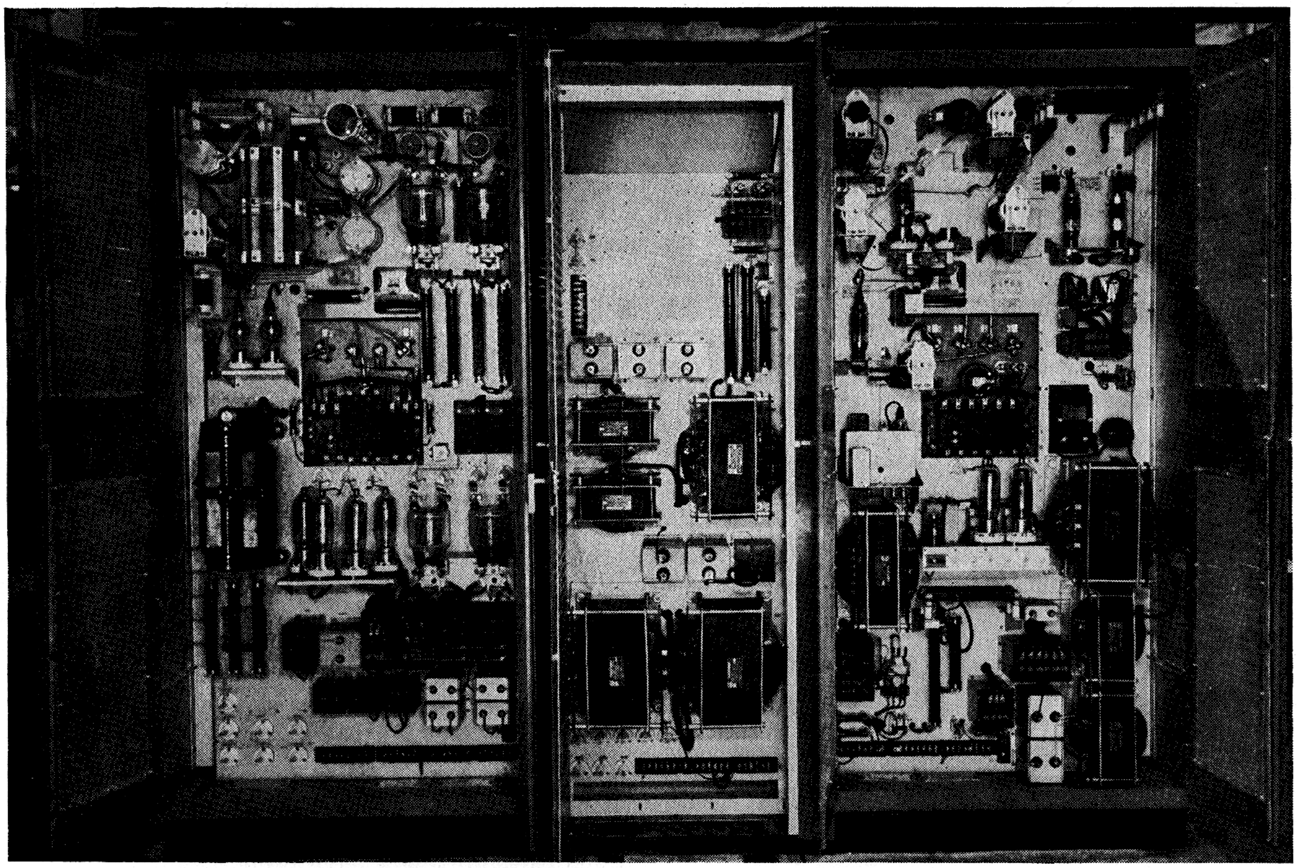

FIG. 10–21. Rear view of RCA 1-K broadcast transmitter.

filter, which effectively reduces radio-frequency harmonics.

2. *Audio-Frequency Circuits.* The audio-frequency amplifier consists of two stages of push-pull amplification, the first containing two RCA–6J7 tubes and the second two RCA–828 tubes operated Class A. The modulator contains two RCA–833–A tubes.

The use of negative feedback around the three a-f stages results in an extremely low order of distortion. The entire audio system is designed in such a manner that it is inherently stable.

A 6-db pad (1A8), is connected across the primary side of the input transformer to the first stage of audio amplification. If it becomes desirable, for any reason (such as insufficient audio level at the output of the line amplifiers), this pad may be eliminated from the circuit without any serious consequent change in the performance of the transmitter.

3. *Control Circuits.* The control circuits serve to provide convenient operation and adequate protection to the tubes and other components. No fuses are used except in the crystal heater circuit, protection elsewhere being afforded by magnetic or thermal circuit breakers.

When the main LINE breaker (2S1) is open, all power is removed from the transmitter. However, voltage is still present in the connections between the power input terminals and this breaker, and power is still applied to the crystal heating circuit. When this breaker is closed, the panel illuminating lamps (2A1 and 1A7) are lighted. The FILAMENT lamp of the 1–K panel is also lighted when the LINE switch (2S1) is closed. The FILAMENT breakers (1S2 and 2S2) protect all filament circuits and in addition, serve as filament switches. When these breakers are closed, and 2S1 and 1S1 are closed, filament power is available to all tubes. Under this condition, a buzz in the transmitter should be heard.

This buzz originates at the holding coils of the PLATE breakers (1S3, 2S3), and is an indication that the electrodes of the time delay relay (1E4) have not yet "closed." The PLATE breakers cannot be closed until this time delay relay which protects the rectifier tubes filaments has operated.

The time delay relay (1E4) is a plunger type, mercury-filled unit. A glass tube, containing two electrodes, is partially filled with mercury, on which floats an iron plunger. The tube is encircled by a solenoid, which is so positioned that when energized, it pulls the iron plunger down. The mercury displaced by the plunger rises and contacts the electrodes, thus closing that circuit. The velocity of rise of the mercury, or "delay," is controlled by the rate of gas seepage through the porous wall of a gas chamber. For this relay the design is such that an interval of about 30 seconds elapses before the electrode circuit is closed. The circuit is opened, however, about 2 seconds after the relay coil is de-energized.

When the time delay relay contacts are closed, the coil of the auxiliary relay (1E5) is energized. This latter relay de-energizes the holding coils of the PLATE breakers (1S3, 2S3), permitting these breakers to be closed (by operation of the front panel levers), and thus allowing application of the plate voltages. The 2 second opening time of relay (1E4) serves to prevent breakers (1S3, 2S3) from opening in case of a momentary power failure. In order to accomplish this, relay (1E5) operates considerably faster than breakers (1S3, 2S3).

Seven interlock switches (1S4, 1S8, 1S9, 2S5, 2S6, 2S7, 2S8) are connected in series with the primary power circuits of the plate transformers. The PLATE indicator lamps (1A4 and 2A2), located on the control panels, are connected directly across the primary terminals of the plate transformers. These lamps are illuminated when the transformers are energized.

4. *Power Supply Circuits.* A full-wave rectifier containing two RCA–872 tubes supplies plate voltage for the oscillator, buffer, and intermediate power-amplifier, and for the first and second stages of audio amplification. Bias voltage for the second audio stage is supplied by a rectifier using an RCA–80 tube. A full-wave, bridge type rectifier employing four RCA–872 tubes supplies plate power for the power-amplifier and modulator. Modulator bias is provided by a rectifier using two RCA–866 tubes.

Power reduction may be obtained by means of the resistors which are connected, in series with the high-voltage plate supply of the power-amplifier and by changing the connections to the taps on the plate transformer (2T7). The wiring diagram shows the connections which are required for different power operating conditions. For 500/1000-watt operation, the resistors 2R26 to 2R33 are combined to total 2050 ohms (maximum). For 250/1000-watt operation, these resistors are combined to total 4600 ohms (maximum). For 250/500-watt operation, the plate voltage is reduced by means of the taps on the plate transformer, and the change is obtained with the resistors combined to total 2050 ohms. One of these power change resistors is variable in order that adjustments may be made as required for a specific installation. When the power change is desired, these resistors may be inserted and removed from the circuit by means of a relay (2E1), which is operated by the POWER CHANGE switch, located on the control panel of the exciter unit. When the transmitter is to be operated only at 500 watts, the plate voltage may be reduced by means of the taps on the plate transformer. In this case the relay, resistors and switch are not employed. When the modulator is operated at reduced plate voltage, such as in 500 and 250/500-watt operation, it will be necessary to change wires numbered 43 and 44 from taps 1 and 2 on the modulator bias transformer (2T5) to taps 4 and 5.

5. *Monitoring Provisions.* Terminals 15C and 16C are provided for connection of an audio-frequency monitor. A maximum level of approximately + 10 vu is available. A jack is provided in the buffer stage for connection of the frequency monitor. Another jack is provided in the power-amplifier for connecting the modulation monitor. An extra plug is supplied to permit connection of a cathode ray oscillograph for sampling the r-f voltages.

10–10e. Preliminary Adjustments—All breakers should be opened before power is applied to the transmitter. It should be noticed that when the exciter P. A. OVERLOAD and MOD. OVERLOAD breakers, and the 1–K MOD. OVERLOAD breaker (1S5, 1S6 and 2S9 respectively) are open and high voltage is applied to the transmitter, the cathodes of the associated tubes are at a high potential with respect to ground.

Refer to the CAPACITOR AND P. A. TANK TAPS CHART and connect the proper capacitors[7] and taps in the various tank circuits. These circuits are normally adjusted for 1000 kc when shipped. Since some capacitors will have been relocated in 250–K exciters which have been converted from 250–K transmitters, it would be well to refer to the stock numbers and capacity values given in the parts list if any difficulty is experienced. A sufficient number of links and connectors are provided to enable the connecting of any capacitor combination required.

Check the primary tap connections on all transformers. Those in the exciter should be made to the 110 volt tap, with the exception of the plate transformer (1T5), which should be set on the 115 volt tap, so that the rated plate dissipation of the tubes will not be exceeded. The primary connections in the amplifier should be made to the 230 volt tap.

Insert all tubes in their proper sockets.

Caution. Do not connect the plate caps of the 6 RCA–872 rectifier tubes. Be sure that the plate caps of the RCA–828 tubes *are* connected.

Close the exciter and amplifier LINE breakers. The panel illuminating lamps (1A7, 2A1) should light and the LINE VOLTAGE meters (1M12, 2M11) should indicate. Adjust the variable transformer (2T2) until the meter 2M11 indicates 230 volts. Check all filament voltages. Adjust the controls 1R23, 1R27 and 1R28 (located on the back of the rectifier chassis) if variation of filament voltages in the exciter unit is necessary. All filament volt-

[7] As stated previously, the terms "capacitor" and "condenser" can be used interchangeably.

ages should be brought to within 2 per cent of their rated value.

A total of about 95 volts should be available across the exciter bias-rectifier output. This voltage may be measured across 1C61. Set the potentiometers (1R22 and 1R54), which are located on the back of the 250–K rectifier shelf, fully clockwise to provide maximum 2nd audio amplifier bias voltage.

Allow the filament voltages to remain on. Insert the crystal holders in their proper sockets. Make certain that fuses (F1, F2) are installed in the fuse holders and then connect terminals 17B and 18B to a 115 volt power supply line. The crystal holders should reach their operating temperature (approximately 60° C, 104° F) in about 30 minutes. Do not proceed further with any adjustments requiring the application of plate voltage during this period, since the rectifier tubes should have filament voltage applied for approximately this length of time before the plate voltage is applied.

Note: When an RCA–872 tube is first placed in service, it should be operated for at least 15 minutes with the normal filament voltage, but without plate voltage applied, in order to properly distribute the mercury within the tube. This procedure need not be repeated unless during subsequent handling, the mercury is spattered on the filament or plate.

Caution. During all tuning adjustments, it is essential that the 250–K MODULATOR OVERLOAD and 1–K MODULATOR OVERLOAD breakers (1S6 and 2S9) be kept open. Since the audio system will oscillate violently if the feed-back connections happen to be reversed, the plate voltage must not be applied to the audio tubes until after the feed-back polarity has been checked. The check will be described later in this instruction book.

10–10f. Tabulation of Controls—

EXCITER (250-K)		AMPLIFIER (1-K)	
Panel Designation	Symbol No.	Panel Designation	Symbol No.
Buffer	1L5	P.A. Plate	2L6
P.A. Neut.	1L7	Modulator Bias, Left	2R16
P.A. Plate	1L9	Modulator Bias, Right	2R17
Power Output	1R15	Line Voltage	2T2
Loading	1L10	Power Output	2L7
*None	1L11		
Power Change	1S7	Mod. Overload	2S9
Mod. Overload	1S6	Line	2S1
Line	1S1	Filament	2S2
Filament	1S2	Plate	2S3
Plate	1S3	P.A. Overload	2S4
P.A. Overload	1S5		

* 1L11 is controlled by means of the knob at the rear of this inductor. It is accessible from the rear of the chassis after the rear doors have been opened. This control is referred to as "p-a grid tank coil."

10–10g. Tuning—The crystal oscillator utilizes an RCA–802 tube with the crystal connected between the control and screen grid. Any one of four reactors may be selectively connected in the plate circuit of this stage, each covering a portion of the total frequency range (550 to 1600 kc) as indicated in the tabulation which follows:

Band Coverage (kc)	*Coil*
550 to 700	4
700 to 1150	3
1150 to 1400	2
1400 to 1600	1

The tuned circuit comprising coil of 1L3 and capacitor 1C10 is provided so that this oscillator may be used to cover the frequency band of from 1600 to 2500 kc.

The proper coil in the oscillator plate circuit should be connected before plate voltage is applied. If the oscillator should be sluggish in starting, the coil listed for the next higher frequency band should be employed.

After the 30 minute "aging" interval has elapsed, connect the plate connectors to the 2 RCA–872 mercury-vapor rectifier tubes in the exciter unit. The exciter PLATE breaker (1S3) may then be closed, thus applying plate voltage to the high-voltage rectifier. The control circuits should then be checked to see that all elements operate properly as previously described. The PLATE breaker should be checked to determine that the holding coil functions properly during the thirty-second warm-up periods, and the operation of the auxiliary relay (1E5), should be checked thoroughly. Each of the rear doors should be opened separately while plate voltage is applied to the rectifier. Opening either door should remove the plate voltage. The meter panels should then be opened to check the operation of the meter panel interlock switches. It should not be possible to apply plate voltage to the rectifier while either meter panel is open.

This check should be repeated immediately after plate voltage has been applied to the 1–K rectifier.

When plate voltage is applied, three milliammeters should indicate current. They are, the OSCILLATOR PLATE (1M1); the 1ST AUDIO PLATE (1M9); and the BUFFER PLATE (1M2) meters. The indications on these meters should correspond to those given in the chart of TYPICAL METER READINGS.

The 1ST AUDIO PLATE meter should at first indicate approximately 2.5 ma. When plate voltage is later applied to the modulator stage, the plate current of this stage will change to that listed in the chart of TYPICAL METER READINGS. Measurement of plate current and plate voltages on the first a-f stage serves as a good check on these circuit elements. The plate voltages to this stage should be read with a high resistance voltmeter, i.e., one having a resistance of at least 1000 ohms per volt.

The oscillator may be checked for oscillation by removing the crystal holder from its socket. When this is done, the oscillator plate current should increase.

The buffer stage may be tuned by means of the control marked BUFFER (1L5). It should be adjusted to the point which produces maximum grid current (on meter 1M4) in the intermediate power-amplifier tube. Minimum plate current in the buffer tube should be obtained at approximately the same point. When adjustments are made in the intermediate power-amplifier stage, it may be necessary to readjust the BUFFER tuning. It will be noted that the tank capacitors are arranged to form a capacitance voltage-divider in such a manner that when the values designated are used, proper excitation is supplied to the intermediate power-amplifier grid. Links are provided for capacitor connections in all exciter circuits in order that connections may be readily changed.

Excitation for a frequency monitor is obtained from the potentiometer (1R14), which is connected across a capacitor in the ground side of the buffer-tank circuit. This potentiometer is provided in order that the excitation may be adjusted as required. After the frequency monitor has been adjusted, the frequency of the oscillator should be adjusted to zero beat with the monitor by means of the vernier capacitor (1C2), which is connected across the crystal. A screwdriver slot in a bakelite shaft, accessible from the rear of the oscillator unit, is provided for this adjustment. The spare crystal should also be checked against the frequency monitor by inserting it in the socket provided in the oscillator unit. The setting of capacitor 1C2 will probably be different for each of the two crystals.

A shunt is connected across the intermediate power-amplifier plate-tank meter thermocouple (1M8). This shunt should be removed during the neutralizing adjustment and then replaced. The shunt gives the meter a multiplying factor of approximately 1.6. After the transmitter has been completely adjusted and is operating at normal load, the shunt may be removed if the product of the meter indication and this factor (1.6) is less than 3 amperes.

The intermediate power-amplifier should first be neutralized. Disconnect the two leads connecting the LOADING inductor, 1L10, at the point designated as "A" in Figure 10–22 and bolt them together. Then remove plate voltage from the intermediate power-amplifier by opening the plate lead at some point in the circuit, such as the plate terminal on the exciter modulation transformer (1T6). Close the 250–K P A OVERLOAD breaker (1S5). Then, apply plate voltage to the rest of the exciter and tune the intermediate power-amplifier to resonance by means of the 250–K control marked PLATE.

The approximate setting for this control may be obtained from the intermediate power-amplifier tuning chart. Resonance will be indicated by maximum current on the 250–K OUTPUT CURRENT meter (1M7) and on the 250–K POWER AMP GRID meter (1M4). The intermediate power-amplifier neutralizing control (1L7) should now be adjusted to the point where minimum currents are indicated for the intermediate power-amplifier plate tank and intermediate power amplifier grid circuits. As the neutralizing control is varied, it will be found necessary to readjust the buffer and intermediate power-amplifier plate-tank tuning.

If a noticeable peak on 1M7 and 1M4 is not obtained when tuning over the range of the plate tank inductor (P A PLATE), the setting of the neutralizing tank coil (P A NEUT) is probably near the neutralizing point and it should be changed.

Remove the plate voltage; reconnect the plate voltage lead of the intermediate-power-amplifier; turn the POWER OUTPUT control (1R15) fully counter-clockwise; reapply plate voltage and adjust the 250–K P A PLATE control for minimum plate current as indicated by the 250–K POWER AMP PLATE current meter (1M3).

The two leads to 1L10, previously disconnected, should be replaced and coils 1L10 and 1L11 should be adjusted in accordance with the data of the tuning charts. Apply plate power to the r-f stages in the exciter and adjust the exciter LOADING control to the point that provides maximum power-amplifier grid currents. The grid circuit, consisting of LOADING COIL 1L10, coil 1L11 and the grid tuning capacitor 1CA which is connected across these two coils, should now be tuned to parallel resonance. As this circuit is tuned, it may be found necessary to readjust the 250–K P A PLATE coil (1L9).

If the p-a grid currents are found to be unbalanced when the grid circuit is first tuned to resonance, balance may be obtained by rotating the p-a grid tank coil (1L11) a few turns and then readjusting the LOADING control to obtain the proper grid currents (see table: TYPICAL METER READINGS.)

When the proper loading has been obtained, assuming that the 250–K P A PLATE coil (1L9) has been adjusted for minimum intermediate power-amplifier plate current, the intermediate power-amplifier should then be adjusted for maximum efficiency. This condition does not occur at the point of minimum plate current. It is obtained by making the plate-tank circuit slightly capacitive and then adjusting the 250–K LOADING inductor for the proper output. A few such adjustments may be required to arrive at the point of maximum efficiency.

It is possible to adjust the grid circuit in a manner such that the grids of the power-amplifier are excited in parallel. If the LOADING coil (1L10) is tuned to parallel resonance with the grid coupling capacitor and if there is sufficient reactance in the p-a grid tank coil (1L11), one power-amplifier tube (2V1) will be excited directly and the other tube (2V2) will be excited practically in phase through the p-a grid tuning capacitor (1CA). If this improper adjustment should be obtained, only a slight dip will result when the p-a plate tank coil (2L6) is tuned through resonance. Under this condition, when the p-a grid currents are balanced, changing the setting of 1L11 will have little effect on this balance, i.e., changing the inductance of 1L11 will not unbalance the p-a grid currents.

The transmitter, as shipped from the factory, has capacitor 1C58 (which is connected between the low potential terminal of coil 1L10 and ground) short-circuited by means of a link. This link should be removed when the transmitter is operated at a frequency between 550 and 850 kc. When the transmitter is operated at a frequency between 1050 and 1600 kc, capacitors 1C55 and 1C56 should be connected in series between the low potential terminal of 1L10 and ground. This introduces a capacitive reactance at this point in the p-a grid tank circuit and prevents a parasitic condition from existing in the intermediate power amplifier stage in these two bands. No reactance is required at this point during operation in the frequency band between 700 and 1050 kc.

10–10h. Power-Amplifier Tuning—Initial tuning of the power-amplifier should be performed with only a portion of the normal plate voltage applied. This may be effected by shifting the lead connected to terminal "2900" on the secondary side of the plate transformer (2T7) to tap "1450." After the circuits have been tuned to resonance, the lead should be returned to the "2900" tap.

The magnitude of the d-c voltage available from the power supply varies, depending upon the transformer secondary taps connected, as follows:

Secondary Terminals Used	*Approximate Rectified Voltage (d-c)*
0 and 2900	2650
0 and 2050	1870
0 and 1450	1325
2050 and 2900	780

The number of turns on the tank coil (2L7) should be adjusted as specified in the CAPACITOR AND P-A TANK TAPS CHART. At the lower broadcast frequencies, only a few end turns normally will be shorted out of the circuit. If only one or two turns are left unused, they should be "opened" (instead of shorted) by detaching the end turn from its terminal post inside the coil form) at each end of the coil assembly. The tuning coil (2L6) should be set in its mid-position until the proper taps are found, in order to permit tuning through resonance. The plate tank capacitors, 2C10–11–12–13, should be connected as indicated in the CAPACITOR AND P-A TANK TAPS CHART, utilizing the connectors supplied as MI–7185–10B, C, D. Neutralization is unnecessary since fixed neutralizing capacitors are employed.

The plate caps should now be attached to the four RCA–872 rectifier tubes of the power-amplifier supply.

CAPACITOR AND PA TANK TAPS CHART

Frequency (kc.)

Coil		Capacitor Schematic Symbol	550–700	700–750	750–850	850–1000	1000–1050	1050–1250	1250–1350	1350–1500	1500–1600
Buffer	1L5	—	A	A	A	A	A	B	B	B	B
IPA Neutralizing	1L7	—	C	C	D	D	D	E	E	E	E
IPA Plate Tank	1L9	$1C_B$	F	F	F	G	G	G	H	H	H
PA Grid Coupling	1L10	$1C_C$	I	I	I	J	J	J	K	K	K
PA Grid Tank	1L11	$1C_A$	L	L	M	M	N	N	P	P	Q
PA Plate Tank	2L6	$2C_D$ $2C_B$	R	S	S	S	T	T	T	U	U
Tank Coil Approximate No. of Turns Not Used	2L7	—	0 to 5	0 to 10	0 to 10	0 to 10	6 to 12	6 to 12	6 to 12	10 to 12	10 to 12

Note: The combinations of capacitors corresponding to the letters in the above chart are given below:

A. 1C17 connected in series with 1C18 and 1C19 in parallel. 1C18 and 1C19 connected from IPA grid to 1C16.
B. 1C17, 1C18 and 1C19 connected in series. 1C19 connected from IPA grid to 1C16.
C. 1C20 and 1C21 connected in parallel.
D. 1C20 and 1C42 connected in parallel.
E. 1C21 connected in series with 1C20 and 1C42 in parallel.
F. 1C54 and 1C57 connected in series.
G. 1C48.
H. 1C49.
I. 1C52 and 1C53 connected in parallel.
J. 1C52.
K. 1C52 and 1C53 connected in series.
L. 1C48 and 1C51 connected in parallel.
M. 1C49 and 1C50 connected in parallel.
N. 1C49 and 1C51 connected in parallel.
P. 1C50 and 1C51 connected in parallel.
Q. 1C48 connected in series with 1C50 and 1C51 in parallel.
R. 2C10 and 2C12 connected in parallel. 2C11 and 2C13 connected in parallel. Connect the two combinations in series.
S. 2C12 and 2C13.
T. 2C10 and 2C11.
U. 2C10 and 2C12 connected in series. 2C11 and 2C13 connected in series. Connect the two combinations in series.

Close the PLATE and PLATE OVERLOAD breakers (2S3 and 2S4, respectively) and with the coupling coil set for least coupling, tune for resonance as indicated by a minimum plate current indication on the P.A. PLATE TOTAL meter (2M5). With minimum coupling to the antenna, the plate current of the final amplifier tubes should be low since the tubes are unloaded.

10–10i. Output Circuit—The variable coupler in the PA plate coil 2L7 is designed to terminate into approximately 40 ohms, and it is necesesary to adjust the T network to match this input impedance and the output load impedance. Electrically, the T network consists of a low-pass filter in which the series arms (2L9, 2L10) are inductive and the parallel section (2C15–2C17) is capacitive. The equivalent circuit is illustrated in Figure 10–23. The portion of each coil to be utilized and the selection of the coupling capacitors (2C15–2C17) will depend upon the resistance and reactance of the antenna or characteristic impedance of the transmission line, and on the operating frequency.

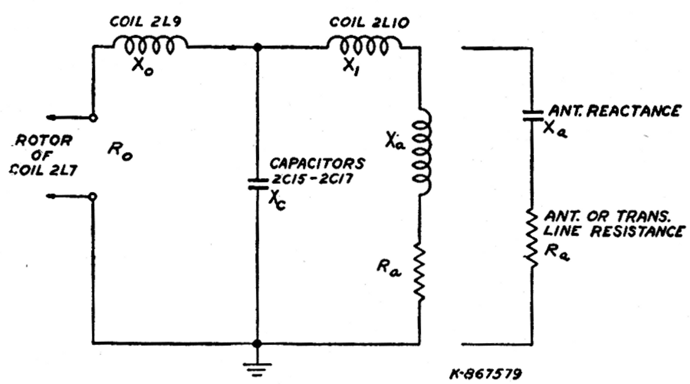

FIG. 10–23. Equivalent output circuit.

The operation of transmitters into different types of load may be classified as follows:

Case 1: Operation directly into an antenna.
Case 2: Operation into an open-wire grounded transmission line.
Case 3: Operation into a concentric transmission line.

The correct values of capacitance and inductance for the respective output networks may be computed by means of the formulae which are explained and illustrated in the following paragraphs.

Case 1. Output Directly into an Antenna:

Let R_o = input impedance of network (approx. 40 ohms)
R_a = resistance of antenna
X_a = reactance of antenna (either inductive or capacitive)

These three quantities have known values. The three quantities to be determined are:

(1) X_o = required inductive reactance of input branch of network (coil 2L9)
(2) X_1 = required inductive reactance of output branch of network (coil 2L10)
(3) X_c = required capacitive reactance of shunt capacitance (capacitors 2C15–2C17)

To be strictly correct, X_o equals the required inductive reactance of the input branch of the network minus the leakage reactance of the coupling coil 2L7. In most cases this leakage reactance is small, and therefore it is neglected in the following description and calculations.

Starting with the output load conditions, the antenna reactance may be highly inductive, only slightly inductive, or capacitive. Since the algebraic sum of X_1 and X_a (hereinafter called X_{an}) must always be inductive but should be held reasonably low, coil 2L10 may be short-circuited when the antenna reactance is highly inductive. If the antenna reactance is only slightly inductive, such as from 0 to 100 ohms, a portion of coil 2L10 should be used to give the output circuit a definite inductive reactance (X_{an}). A good assumed value of X_1 for this purpose is the inductive reactance corresponding to about one-fourth of the total inductance available in the coil, or 25 microhenries. The inductive reactance (X_1) for this value depends upon the operating frequency according to the following table:

Frequency (kc.)	X_1 *(ohms)*
500	78.3
750	117.5
1000	156.6
1250	195.8
1500	234.9
1750	274.1
2000	313.2

If the antenna reactance is capacitive, sufficient turns of coil 2L10 must be used to make the sum of X_1 and X_a (X_{an}) inductive and of a value large enough to provide a definite assurance that the output branch (X_{an}) will never become capacitive due to climatic or other variations. When R_o is greater than R_a, the minimum permissible value of X_{an} is given by:

$$X_{an}\ (\text{min.}) = \sqrt{R_a(R_o - R_a)}\ \text{ohms}$$

Assuming that:

$$Z^2_{an} = R_a^2 + X^2_{an}\ (\text{algebraic values}),$$

then the values of X_o and X_c for correct impedance match may be computed from the following formulas:

$$(1)\quad X_o = \sqrt{\frac{R_o}{R_a}(Z^2_{an} - R_aR_o)}\ \text{ohms}$$

$$(2)\quad X_c = \frac{Z^2_{an}}{X_{an} + \dfrac{R_aX_o}{R_o}}\ \text{ohms}$$

The value of X_o thus obtained should be checked against the total value available (coil 2L9) as shown in the following table:

Frequency (kc.)	X_0 *(ohms)*
500	314
750	471
1000	628
1250	785
1500	942
1750	1099
2000	1256

The value of the total shunt capacitance (2C15–2C17) may be calculated from the equation:

$$C = \frac{10^3}{6.28 \times f \times X_c} \text{ microfarads}$$

(X_c found from Eq. (2) above)

where C = capacitance in microfarads
f = operating frequency in kilocycles

The values of the capacitors 2C15, 2C16, and 2C17 in various parallel and series combinations, and alone are given in the following table:

	Capacitance ($\mu\mu f$)	*Combination*
A	5300	...2C15, 2C16 and 2C17 in parallel.
B	4500	...2C15 and 2C16 in parallel—2C17 is not used.
C	3800	...2C15 and 2C17 in parallel—2C16 is not used.
D	3000	...2C15 alone—2C16 and 2C17 are not used.
E	2300	...2C16 and 2C17 in parallel—2C15 is not used.
F	1500	...2C16 alone—2C15 and 2C17 are not used.
G	1000	...2C15 and 2C16 in series—2C17 is not used.
H	800	...2C17 alone—2C15 and 2C16 are not used.
I	630	...2C15 and 2C17 in series—2C16 is not used.
J	520	...2C16 and 2C17 in series—2C15 is not used.
K	445	...2C15, 2C16 and 2C17 in series.

When properly adjusted, the antenna current (I_a) should be very close to the value determined by the equation:

$$I_a = \sqrt{\frac{W}{R_a}} \text{ amperes}$$

where W = expected power output in watts
R_a = antenna resistance in ohms

As an illustrative example of the foregoing calculations for Case 1, it is assumed that the power output (W) is 1000 watts, the antenna characteristics ($R_a + jX_a$) are $25 + j34$, and the operating frequency (f) is 1250 kc. The known values are:

R_o (network input impedance) = 40 ohms
R_a (antenna resistance) = 25 ohms
X_a (antenna reactance) = $+j34$ ohms

Since the antenna is only slightly inductive, about one-fourth of the inductive reactance of coil 2L10 should be used as a trial value. At 1250 kc, the table shows that this inductive reactance (X_1) is approximately equal to 196 ohms.

Then

$$X_{an} = X_1 + X_a = 196 + 34 = 230 \text{ ohms}$$

The minimum permissible value of X_{an} is:

$$X_{an} \text{ (min.)} = \sqrt{25(40 - 25)} = \sqrt{375} = 19.4 \text{ ohms}$$

This indicates that the above selection of X_1 is amply large and probably should be reduced if a recalculation becomes necessary. Proceeding to determine X_o and X_c, we have:

$$Z^2_{an} = 25^2 + 230^2 = 53{,}525$$

Then

$$X_o = \sqrt{\frac{40}{25}[53{,}525 - (25 \times 30)]}$$

$$= \sqrt{1.6 \times 52{,}775} = \sqrt{84{,}440} = 290 \text{ ohms}$$

Checking this value against the total available (coil 2L9) as shown in the tabulation, it is found that the maximum inductive reactance at 1250 kc is 785 ohms. Therefore, the preceding value of 290 ohms (approximately one-third of 2L9) is satisfactory for X_o.

$$X_c = \frac{53{,}525}{230 + \left(\frac{25}{40} \times 290\right)} = \frac{53{,}525}{230 + 182}$$

$$= \frac{53{,}525}{412} = 130 \text{ ohms}$$

$$C = \frac{10^3}{6.28 \times 1250 \times 130} = \frac{1}{1020}$$

$$= .00098\ \mu f = 980\ \mu\mu f$$

Referring to the table of capacitor values it will be seen that the combination G (1000 $\mu\mu$f) comes nearest to the value required.

The antenna current

$$(I_a) = \sqrt{\frac{1000}{25}} = \sqrt{40} = 6.32 \text{ amperes}$$

(no modulation).

Case 2. Output into an Open-Wire Grounded Transmission Line:

A four-wire or six-wire transmission line with two or four wires grounded is the most usual form of Case 2. Such a line will have an impedance of approximately 235 ohms when constructed according to RCA recommended specifications.

The calculation for the value of the shunt capacitors (2C15–2C17) and for the adjustment of coils 2L9 and 2L10 is the same as for Case 1, substituting the known surge impedance, 235 ohms, of the transmission line for R_a and letting $X_a = 0$. Care must be exercised in terminating the antenna end of the transmission line into its own impedance, so that no standing waves will appear on the line itself.

Therefore:

$$X_{an} = X_1 + X_a = X_1 + 0 = X_1$$

where X_1 = inductive reactance of coil 2L10
X_a = transmission line reactance, which should always be zero

Assuming the characteristic impedance of the transmission line to be 235 ohms, the known values are:

R_o = input impedance of network (approx. 40 ohms)
R_a = transmission-line impedance = 235 ohms
X_a = transmission-line reactance = 0

The three quantities to be determined are:

(1) X_o = required inductive reactance of the input branch of the network, coil 2L9.
(2) X_1 = required inductive reactance of the output branch, coil 2L10.
(3) X_c = required capacitive reactance of the shunt capacitance, capacitors 2C15–2C17.

Starting with the output load conditions, the transmission line is considered as a pure resistance, whence:

$$X_a = 0, \quad \text{and} \quad X_{an} = X_1$$

From the formula for the minimum permissible value of X_{an}:

$$X_1\,(\text{min.}) = \sqrt{R_a(R_o - R_a)} \text{ ohms}$$

it is evident, since R_o is less than R_a, that coil 2L10 may be short-circuited. However, it is usually advisable to use a few turns of the coil to aid in suppressing harmonic radiation. As before, a good assumed value for X_1(2L10) for this purpose is the inductive reactance corresponding to about 25 microhenries of inductance. Then

$$Z^2_{an} = R_a^2 + X_1^2$$

and:

$$X_o = \sqrt{\frac{R_o}{R_a}(Z^2_{an} - R_aR_o)} \text{ ohms}$$

$$X_c = \frac{Z^2_{an}}{X_1 + \dfrac{R_aX_o}{R_o}} \text{ ohms}$$

$$C = \frac{10^3}{6.28 \times f \times X_c} \text{ microfarads}$$

where C = shunt capacitance in microfarads
f = operating frequency in kilocycles

The transmission line current is:

$$I_a = \sqrt{\frac{W}{R_a}} \text{ amperes}$$

where W = expected power output in watts
R_a = characteristic impedance of transmission line in ohms

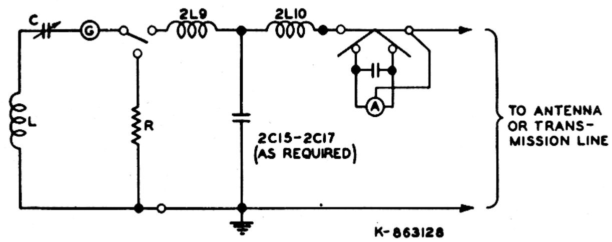

FIG. 10–24. Output test circuit.

As an illustration of Case 2, it is assumed that the power output (W) is 1000 watts, the transmission line has a characteristic impedance (R_a) of 235 ohms, and the operating frequency (f) is 1250 kc.

$$Z^2_{an} = 235^2 + 196^2 = 55{,}225 + 38{,}416 = 93{,}641$$

Then

$$X_o = \sqrt{\frac{40}{235}(93{,}641 - 9400)} = \sqrt{14{,}320} = 120 \text{ ohms}$$

$$X_c = \frac{93{,}641}{196 + \left(\dfrac{235}{40} \times 120\right)} = \frac{93{,}641}{901} = 104 \text{ ohms}$$

$$C = \frac{10^3}{6.28 \times 1250 \times 104} = \frac{1}{816} = 1225\ \mu\mu\text{f}$$

This value may be obtained approximately by connecting capacitor 2C15 in series with the capacitor (2C16), for a total of 1000 $\mu\mu$f. (Combination G on capacitor table.)

Thus an impedance match for this assumed illustration of Case 2 may be obtained by using approximately one-fourth of the reactance of coil 2L10, one-seventh of the reactance of coil 2L9, and capacitors 2C15 and 2C16 in series.

The transmission line current for zero modulation is:

$$I_a = \sqrt{\frac{1000}{235}} = \sqrt{4.26} = 2.06 \text{ amperes}$$

At 100-percent modulation, this would increase to:

$$2.06 \times 1.22 = 2.52 \text{ amperes}$$

It is advisable to check the accuracy of the foregoing calculations by computing the r-f voltage across the shunt capacitors, from both the input and the output circuits. If the two calculations give identical results, a perfect impedance match has been obtained.

From the output load circuit:

$$\begin{aligned} E_c &= \sqrt{(I_aR_a)^2 + (I_aX_1)^2} \\ &= \sqrt{(2.06 \times 235)^2 + (2.06 \times 196)^2} \\ &= \sqrt{397{,}500} = 630 \text{ volts} \end{aligned}$$

From the input circuit:

$$I_o = \sqrt{\frac{1000}{40}} = \sqrt{25} = 5 \text{ amperes}$$

$$E_o = \sqrt{(I_oR_o)^2 + (I_oX_o)^2}$$
$$= \sqrt{(5 \times 40)^2 + (5 \times 120)^2}$$
$$= \sqrt{400{,}000} = 632 \text{ volts}$$

Case 3. Output into a Concentric Transmission Line:

The two rotor terminals of coil 2L7 may be connected directly to the two terminals of this transmission line with approximately 0.002 μf in series. It is recommended, however, that the concentric transmission line be connected identically as in Case 2 for the open-wire grounded line, thus obtaining attenuation of harmonic radiation in the T network.

When connected in this manner, the calculation of values for impedance match is the same as for Case 2, using the characteristic impedance of the concentric line (70 ohms) for R_a, instead of the higher value of 235 ohms for an open-wire grounded line.

The values of capacitance and inductance determined as above should be applied to the network and final adjustments made with the aid of an r-f bridge connected to the input of the network. If a bridge is not available, the following substitution method may be used in adjusting the input resistance of the network (R_0) to 40 ohms, and the output to the impedance of the antenna or transmission line.

10–10j. Output Adjustment—Referring to Figure 10–24, the coil, L, should be loosely coupled to a low-power source of radio frequency. Only sufficient power to afford a readable deflection on the thermo-galvanometer, G, is necessary. It is desirable that the test circuit be shielded and wired in such a manner that stray capacities are reduced to a minimum. The test resistor, R, should be a non-inductive, 40 ohm resistor capable of dissipating about five watts. The calculated value of shunt capacitance should be connected in the circuit and adjustments made as follows:

First, throw the switch to the resistor position and adjust capacitor C for maximum current indication. Note the capacitor dial and current readings. If the maximum current indication is too low for accurate observation, increase the coupling slightly.

Shift the switch to the network position and vary the taps of inductor 2L10 until a point is found at which the galvanometer reading is the same as that previously observed when capacitor C is tuned for maximum indication.

When this adjustment has been completed, adjust the taps of 2L9 to a point which gives maximum current indication for the setting of capacitor C used with the switch in the resistance position. Finally, repeat the procedure again and make slight adjustments of 2L9 and 2L10 as required.

A value of X_0 slightly smaller than that calculated must be used to "tune out" the coupling coil inductance. This value can best be determined by inserting a low range r-f ammeter in the input arm of the network, and with very loose coupling and the lowest plate voltage applied, reducing the inductance of 2L9 until the maximum current point is reached.

When the output circuit has been properly adjusted, full plate voltage may be applied and the coupling adjusted for the normal power output as indicated by the antenna ammeter. When the transmitter is to be operated at two output powers, all adjustments should be made at the higher power.

When the antenna network has been properly adjusted, the exciter POWER OUTPUT control (1R15) should be rotated until the amplifier grid current meters indicate their recommended value. The grid currents of the two power-amplifier tubes should be balanced, but if not, a slight adjustment of inductors 1L10 and 1L11 will bring them into balance. Check all r-f stage meter readings against the TYPICAL METER READINGS table and make whatever adjustments are necessary.

The power output of the final amplifier may be varied by means of the 1–K POWER OUTPUT control (2L7) if, for any reason, the antenna resistance varies and changes the transmitter load.

When the proper loading has been obtained, assuming that the 1–K PA PLATE variable inductor (2L6) has been adjusted for minimum power-amplifier plate current, the power-amplifier should be adjusted for maximum efficiency. This condition does not occur at the point of minimum plate current. It is obtained by making the plate-tank circuit slightly capacitive and then adjusting the coupling for the proper output. Since there are four positions of the coupling coil (2L7) that give the same degree of coupling, each of these positions should be tried. It may be found that with the grid currents of the power-amplifier tubes balanced, the plate currents may be slightly unbalanced. This unbalance will usually vary with each of the four positions of the coupling coil. The position which gives the maximum efficiency will usually result in the best balance. It may be necessary then to unbalance the location of the taps on the two sides of the power-amplifier tank coil (2L6) slightly in order to completely balance the power-amplifier tubes.

A cathode resistor is provided in the cathode circuit of each power output tube in order to keep the plate currents of these tubes within the maximum rated value when plate voltage is applied in the absence of excitation. These resistors (2R3, 2R4) are provided with taps. The 250–K PLATE breaker should be opened and the 1–K PLATE breakers should be closed, thus applying plate voltage to the power-amplifier tubes with no excitation at the grids. The tap to be used is that which inserts sufficient resistance in the cathode circuits to keep the

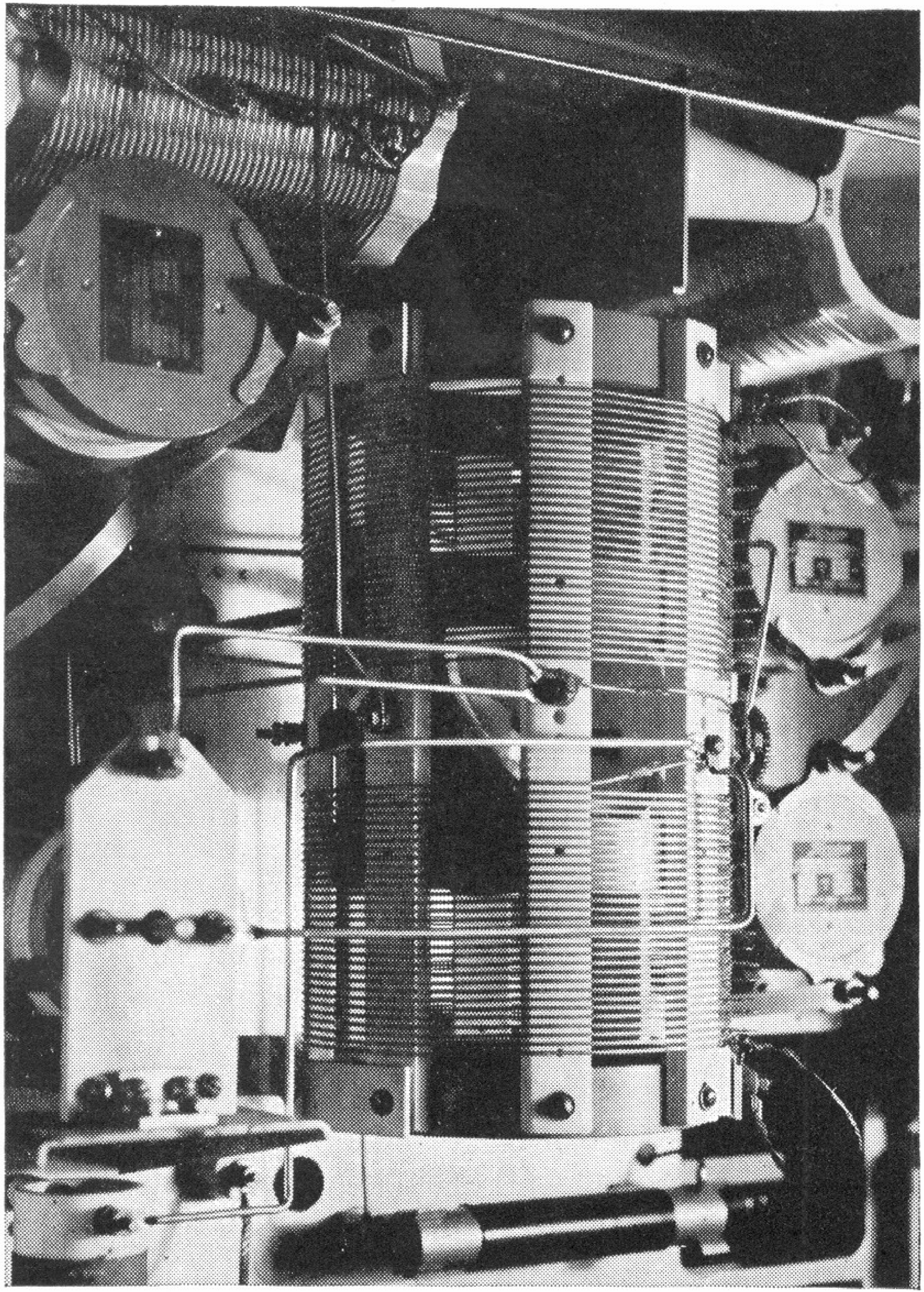

Fig. 10–25. The tank coil in the 1-K is a high Q inductor. Variable inductive coupling is employed which provides an extremely simple arrangement for coupling the load to the power amplifier tank circuit.

power dissipation of each tube just under 300 watts. Plate voltage and current for each tube are indicated by the panel meters.

A pickup coil (2L8), which supplies excitation to the modulation indicator, is coupled to the coil (2L7). It may be necessary to remove turns from this coil to obtain sufficient excitation to the modulation indicator. The effect is to resonate the inductance of the coil with the capacitance of the connecting cable. This adjustment is rather critical and turns should be removed from the coil one at a time. While the adjustment is being made, the coil should be in the position for maximum coupling. After maximum output is obtained, the coupling may be adjusted to the desired value by rotating the coil on its mounting.

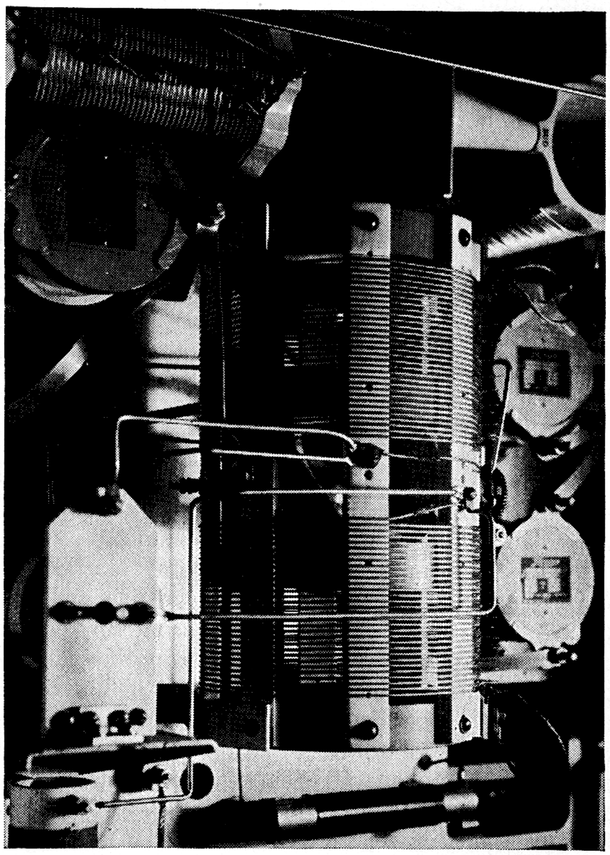

FIG. 10-25. The tank coil in the 1-K is a high Q inductor. Variable inductive coupling is employed which provides an extremely simple arrangement for coupling the load to the power amplifier tank circuit.

10-10k. Modulator Adjustment—When the r-f stages have been correctly adjusted for normal operation, close the second audio stage plate breaker, 250-K MOD. OVERLOAD (1S6). (Be sure that the modulator breaker 1-K MOD. OVERLOAD (2S9) is open before closing 1S6. Leave breaker 2S9 open during this adjustment.) The tubes should not draw plate current with the grid bias potentiometer set as previously indicated. These potentiometers (1R22 and 1R54) should now be adjusted so that the sum of the plate and screen-grid currents (which is what is actually indicated on the plate current meters) for each of the second audio stage tubes is 100 ma. The designations LEFT and RIGHT on the meters refer to the tubes as viewed from the front of the transmitter. Taps are provided on the bleeder resistors (1R62 and 1R63), in order that the screen and suppressor voltages of the tubes may be changed when necessary. *Caution.* Open 1S6 before proceeding.

Inspect the safety gaps on the primary of 2T4. These gaps should have a spacing of 0.050 inch and should always be kept well polished. Next, the grid bias of the modulator tubes should be set by closing the MOD. OVERLOAD breaker 2S9 (be sure 1S6 is open before closing 2S9) and adjusting the MODULATOR BIAS potentiometers 2R16 and 2R17 for plate current as indicated in the table of TYPICAL METER READINGS. Approximately 90 volts should be available across the modulator bias rectifier bleeder (2R18). This voltage may be measured across capacitor 2C20 or 2C21.

Since the inverse feed-back is connected externally between the two units, it is quite possible that the polarity of this feed-back has been reversed in these connections. It is necessary to check this as follows: Reduce the plate voltage on the modulators by moving the tap connection on the plate transformer (2T7) from tap "2900" to tap "1450." Turn on the transmitter, but do not close the two MOD. OVERLOAD breakers (1S6 and 2S9). Next, close the 250-K MOD. OVERLOAD breaker. Then, observing the modulator plate current meters, close the modulator breaker (2S9). If the indicated modulator plate current is low (between 0 and 50 ma per tube) then the feed-back polarity is correct. However, if the indicated plate current is high (150-300 ma per tube) then the audio system is oscillating, and the feed-back polarity must be reversed. To do this, reverse the twisted pair going to terminals 19 and 20 on terminal board "B" in the exciter unit. Then recheck for oscillation by turning on the transmitter and closing the audio overload breakers. The plate current should no longer rise excessively. Restore the plate voltage to normal value. With correct feed-back polarity, there should be no appreciable change in the no-signal value of the modulator plate current when the 250-K MOD. OVERLOAD breaker is opened and closed. If necessary, readjust the bias controls for the drivers (RCA-828) and modulators (RCA-833-A) for the correct static (unmodulated) plate currents as indicated in the table TYPICAL METER READINGS. (When the transmitter is set up for straight 500-watt operation, it is not necessary to reduce further the plate voltage when checking the feed-back polarity.)

10-10l. Operation—After the transmitter has been tuned to the operating frequency and the other adjustments just described have been completed, the

TYPICAL METER READINGS
EXCITER

Line Voltage 110 Volts

Tube	E_p (volts)	I_p (ma)	E_g (volts)	I_g (ma)	E_{sg} (volts)	E_{sup} (volts)
Crystal Oscillator	240	15–18			160	
Buffer	1250	60–70			210	65
Intermediate Power-Amplifier	1500	180–205		45–60		
1st Audio	270	*7–8			160	
2nd Audio	780	80–100	−73		690	65
(per tube)					670–690	

Plate Tank (Output) Current—2.0 to 4.5 amp
* This value includes screen current.

TYPICAL METER READINGS
AMPLIFIER

Line Voltage 230 Volts

Tube	1000 Watts	500 Watts Power Change Panel	500 Watts Straight	250 Watts Power Change Panel (250/500)	250 Watts Power Change Panel (250/500)
Grid Current (ma per tube)	95	1000	100	100	100
Amplifier Plate Current (ma total)	550	403	403	286	286
Amplifier Plate Voltage (volts)	2450	1770	1770	1250	1250
* Modulator Plate Voltage (volts)	2550	2600	1850	1850	2600
Modulator Plate Current (ma) (100 per cent modulation)	210	160	185	115	100
Modulator Plate Current (ma) (0 per cent modulation)	50	50	45	48	50
* Modulator Grid Voltage (volts)	61	61	40	40	61

* Must be measured with an external meter.

equipment is ready for operation. In normal use, with the transmitter shut down, the following breakers should be in their closed position: 1S1, 1S2, 1S5, 1S6, 2S2, 2S4 and 2S9.

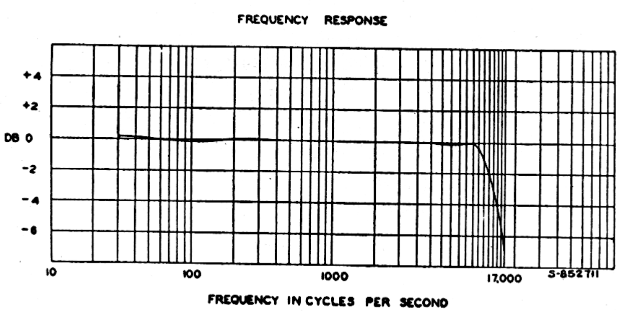

FIG. 10–26. This curve taken at 25-percent modulation indicates the high-frequency cutoff obtained in the output circuits of modulator in order to reduce adjacent channel interference.

1. *To Place the Transmitter in Operation.* The following operations should be performed, in the order listed:

(a) Close the 1–K LINE breaker.
(b) After the time delay relay has operated, close the 250–K PLATE breaker.
(c) Close the 1–K PLATE breaker.
(d) Adjust the 1–K LINE VOLTAGE control for 230 volts.
(e) Adjust the POWER OUTPUT control, if necessary, for correct antenna current.

2. *To Shut Down the Transmitter.* The following operations should be performed in the order listed:

(a) Open the 1–K PLATE breaker.
(b) Open the 250–K PLATE breaker.
(c) Open the 1–K LINE breaker.

10–10m. Maintenance—With ordinary care, little attention will be required to keep this transmitter in operation. However, to avoid program

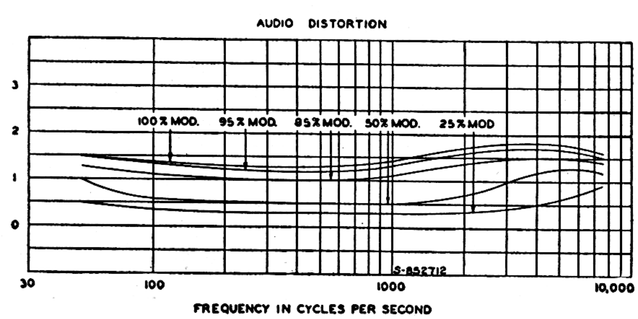

FIG. 10–27. Distortion has been reduced to low levels in the 250-K.

interruption through failure in the transmitter, a regular schedule of inspection should be established.

It is important that the transmitter be kept free from dust and for this purpose a small electric hand-blower may be used to advantage.

The transmitter should be inspected periodically for poor contacts and loosened connections. At such times, each contact of every switch and relay should be inspected and cleaned. The contacts should be cleaned with carbon tetrachloride applied with a soft brush. A *small* amount of vaseline should be applied to the contacts of the door-interlock switches after they have been cleaned. All r-f and ground connections should be kept tight.

A regular check should be made of all tubes in the transmitter. Each tube should be inspected and tested immediately upon its receipt, to make certain that no damage has been caused by shipment. So far as possible, tube failure should be anticipated by keeping a log of tube life. All meter readings should be recorded and checked against readings previously taken.

When a rectifier tube is replaced in the transmitter, make certain, before placing the equipment in operation, that the new tube has been properly "aged." The procedure is described under *preliminary adjustments.* Spare rectifier tubes may be aged before they are stored. If they are then stored in an upright position and are not subsequently jarred, the initial warm-up period when they are placed in service may be reduced to approximately one minute.

The external appearance of the transmitter may be kept like new by judicious applications of the matching lacquers, which are included as a part of the equipment.

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