TYPE

BTA-5F

BROADCAST TRANSMITTING EQUIPMENT

RCA

TYPE BTA-5F

BROADCAST TRANSMITTER

MI-7260-C and D

INSTRUCTIONS

Manufactured by

RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION
Camden, N. J., U. S. A.

Printed in U. S. A.

IB-30140-1

WARNING

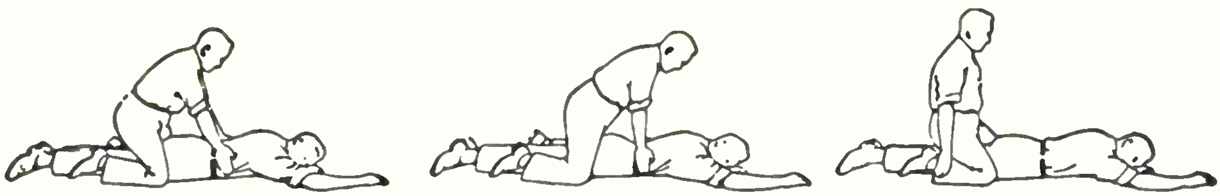
THE VOLTAGES EMPLOYED IN THIS EQUIPMENT ARE SUFFICIENTLY HIGH TO ENDANGER HUMAN LIFE. EVERY REASONABLE PRECAUTION HAS BEEN OBSERVED IN DESIGN TO SAFEGUARD THE OPERATING PERSONNEL. AN IMPORTANT PART OF THE PROTECTIVE SYSTEM IS THE SERIES OF DOOR INTERLOCK SWITCHES, AND ANY TAMPERING WITH THESE SWITCHES SHOULD BE PROHIBITED. THE POWER SHOULD BE REMOVED COMPLETELY BEFORE CHANGING TUBES OR MAKING INTERNAL ADJUSTMENTS.

FIRST AID IN CASE OF ELECTRIC SHOCK

1. PROTECT YOURSELF with dry insulating material.

2. BREAK THE CIRCUIT by opening the power switch or by pulling the victim free of the live conductor.

   DON'T TOUCH VICTIM WITH YOUR BARE HANDS until the circuit is broken.



(A) (B) (C)

3. LAY PATIENT ON STOMACH, one arm extended, the other arm bent at elbow. Turn face outward resting on hand or forearm.

4. REMOVE FALSE TEETH, TOBACCO OR GUM from patient's mouth.

5. KNEEL STRADDLING PATIENT'S THIGHS. See (A).

6. PLACE PALMS OF YOUR HANDS ON PATIENT'S BACK with little fingers just touching the lowest ribs.

7. WITH ARMS STRAIGHT, SWING FORWARD gradually bringing the weight of your body to bear upon the patient. See (B).

8. SWING BACKWARD IMMEDIATELY to relieve the pressure. See (C).

9. AFTER TWO SECONDS, SWING FORWARD AGAIN. Repeat twelve to fifteen times per minute.

10. WHILE ARTIFICIAL RESPIRATION IS CONTINUED, HAVE SOMEONE ELSE:

    (a) Loosen patient's clothing.

    (b) Send for doctor.

    (c) Keep patient warm.

11. IF PATIENT STOPS BREATHING, CONTINUE ARTIFICIAL RESPIRATION. Four hours or more may be required.

12. DO NOT GIVE LIQUIDS UNTIL PATIENT IS CONSCIOUS.

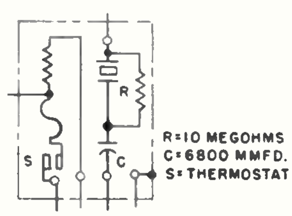
ADDENDA
TO
INSTRUCTION BOOK IB-30140

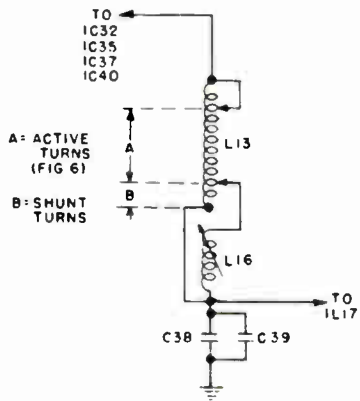
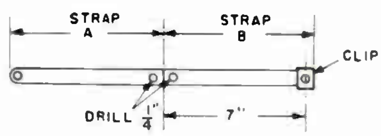
(To be inserted ahead of Table of Contents)

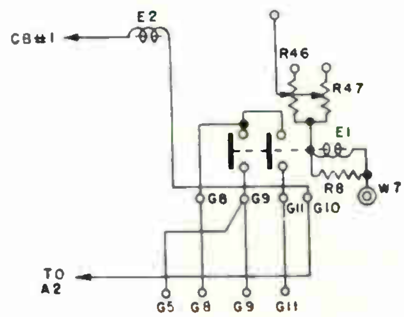
Due to changes made during and subsequent to manufacture, slight differences may exist in BTA-5F units depending upon the time of production and installation. To insure that all units will incorporate the various changes, the following tabulation lists all physical revisions that have been or should be made in the BTA-5F transmitters. If some or all of the changes have already been carried out, these items should be disregarded.

CHANGES IN BTA-5F TRANSMITTERS

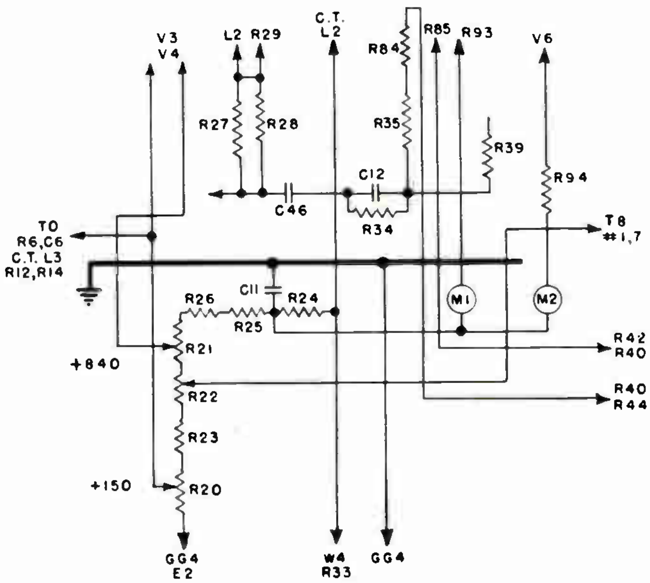
(Disregard items where changes have already been made.)

Compart-ment No. (Left to Right)	Operation	Comments
	CRYSTAL OSCILLATOR (R-F SECTION)	
2	Remove output lead from C4-2 and install 12-ohm, 1-watt resistor, R3, between C4-2 and output terminal.	For unloading crystal. See Figure 27.
2	Add 1 mmfd. capacitor, C6, between terminal 3 of socket X1 and junction of C4 and R3.	To obtain more reliable crystal starting, particularly on frequencies below 800 kc. See Figure 27.
—	Note following schematic showing components within crystal holder: 	Also shown on Figure 23.
	IPA — LOW POWER, R-F UNIT	
2	Remove capacitors 1C46 and 1C47 connected to V5 and V6 grid leads.	Usually required to obtain complete neutralization. See Figure 26.
2	Remove choke 1L22 shown connected across 1R38.	Usually required to obtain complete neutralization. See Figure 26.
	R-F OUTPUT	
1	Substitute a flexible lead from 1C45 so that connection may be made to tap 1C45 between 1R25 through 1R29. Never connect 1C45 between 1L9 and 1R25, to avoid possible failure of this capacitor.	See Figure 25.
1	Remove shorting strap on 1R25.	See Figure 25.
1	If the transmitter is operated on frequencies lower than approximately 800 kc. the plate r-f choke, 1L12 of the power amplifier stage should be checked to make certain that it is partially bank-wound and is not entirely of single-layer construction. If it is a single-layer choke, the RCA representative should be contacted for a suitable replacement.	See Figure 25.

Compart-ment No. (Left to Right)	Operation	Comments
1	Use following procedure to make high-frequency connections in 1,350-kc. to 1,600-kc. range. Note following schematic:	Necessary for reduction of current through variable contacts of 1L16.
		
	(a). Remove bottom shorting strap on 1L13. Cut and drill strap as indicated on following sketch:	See Figure 25.
		
	(b). Remove lead 16 from terminal 2 of 1L16 and terminal 2 of 1L13. Bend the copper tubing so that a new connection can be made from terminal 1 on 1L16 to terminal 2 on 1L13. Portion "A" of the 1L13 shorting strap may be used to make this connection.	——
	(c). Using portion "B" of the 1L13 shorting strap, fasten one end to terminal 2 of 1L16. Clip the other end to the third turn from the bottom of 1L13.	——
	(d). Adjust top shorting strap on 1L13 for correct number of active turns.	See Figure 6. This gives the approximate setting for 1L13 and 1L16.
	(e). Make final adjustment by moving top shorting strap on 1L13 to position where 1L16 is operating in center of its range.	——

Compartment No. (Left to Right)	Operation	Comments
	LOW POWER A-F UNIT	
—	Note following schematic showing new connections to relay 2E1:	See Figure 23.
		
2	Move wire No. 161 from terminal 2 to terminal 3 on 2E1.	These changes, together with those to the Power Control Unit (7E6 and 7E7) and those under "Enclosure" and "Interconnections," were made to permit resumption of transmitter operation after power failures of less than two seconds' duration. See Figure 29.
2	Remove wire No. 102 connecting terminal 4 on 2E1 to terminal 4 on 2E2.	
2	Connect a wire between terminal G11 (just below G10 on terminal board) to terminal 4 on 2E1.	—
2	Using a piece of bus wire, connect terminals 1 and 2 on 2E1.	—
	NOTE: If the spring on relay 2E1 is too strong and prevents relay closing, either stretch or replace the spring.	

Compartment No. (Left to Right)	Operation	Comments
2	Remove resistors 2R24, 2R25, 2R26 if of 4,000 ohms resistance and replace each with resistor of 400 ohms, 200 watts, 10% rating. Observe the following schematic showing proper connections to 2R24, 2R25, 2R26, and 2C11:	Values of these resistors were changed from 4,000 to 400 ohms (see Replacement Parts List) and connected in series to reduce plate supply voltage on second audio stage. See Figure 29.

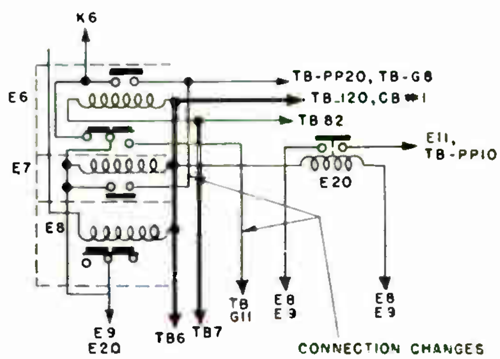


2	Remove jumper No. 4 between terminal 2 of 2R25 and terminal 2 of 2R26.	See Figure 29.
2	Remove jumper No. 1 between terminal 1 of 2R25 and terminal 1 of 2R24.	See Figure 29.
2	Remove wire No. 55 between terminal 1 of 2R24 and terminal 2 of meter 2M2.	See Figure 29.
2	Remove wire No. 57 between terminal W4 and terminal 2 of meter 2M1.	See Figure 29.
2	Remove wire No. 60 between terminal 2 of 2C11 and terminal 1 of 2R33.	See Figure 29.
2	Connect bus bar between terminal 2 of 2R24 and terminal 2 of 2M2.	See Figure 29.
2	Connect bus bar between terminal 2 of 2C11 and terminal 2 of 2M1.	See Figure 29.
2	Connect bus bar between terminal 1 of 2R24 and terminal W4.	See Figure 29.

Compartment No. (Left to Right)	Operation	Comments

POWER CONTROL UNIT

4 — Change the connections to relays 7E6 and 7E7 to conform with the following schematic diagram:



Comments: These changes, together with those to the Low Power A-F Unit (2E1 and 2E2) and those under "Enclosure" and "Interconnections," were made to permit resumption of transmitter operation after power failures of less than two seconds' duration. See Figures 23 and 31.

ENCLOSURE

— — Make the following connection changes:

Lead No.	Old Location	New Location
32	5S1-1 to 5S1-3	Deleted
33	5S1-2 to 5S1-4	Deleted
38	5S1-2 to 5S8-2	5S1-4 to 5S8-3
99	5S1-1 to 5S6-4	5S6-4 to TBJ-6
34	5S8-1 to 5S8-3	Deleted
35	5S8-2 to 5S8-4	Deleted
39	TBJ-9 to 5S8-1	TBJ-9 to 5S8-4
63	5A6-2 to 5S4-3	5A6-2 to 5S5-4
43	5A3-2 to 5A6-2	5A3-2 to 5A4-2
36	5S9-1 to 5S9-3	Deleted
37	5S9-2 to 5S9-4	Deleted
38	5S1-2 to 5S8-2	5S1-4 to 5S8-3

Comments: See Figure 32.

INTERCONNECTIONS

2, 4 — Add a connection from terminal 11 of board "G" in the Low Power A-F Unit to terminal G11 in the Power Control Unit.

Comments: See Figures 29 and 31.

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SUPPLEMENTS

COMMERCIAL BULLETINS

LIST OF ILLUSTRATIONS

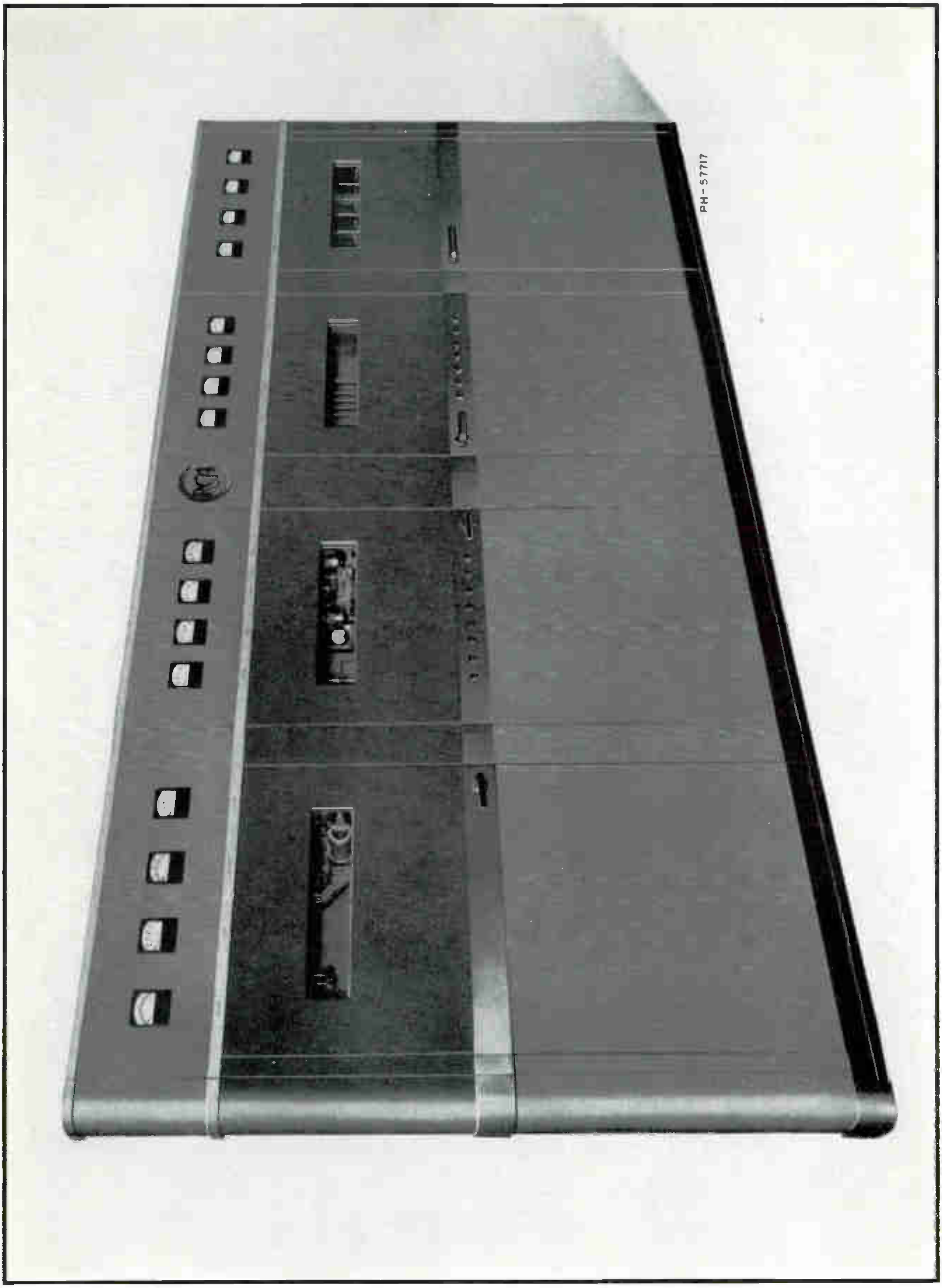


Figure 1—Type BTA-5F Broadcast Transmitter (Front View)

SECTION I

Technical Summary

Electrical Characteristics

Type of Emission	A-3 (Telephone)
Power Output (40 to 250 ohms grounded load)	5/1 kw
Frequency Limits	540 to 1,600 kc
Frequency Stability	assigned frequency ±10 cycles

Power Supply Requirements:

230 volts, 50 or 60 cycles, 3-phase, capable of supplying normal loads up to 18 kw at 85 per cent power factor and peak loads up to 25 kw at 88 per cent power factor with an instantaneous regulation not exceeding 3 per cent and a slow-time drift of not more than 5 per cent. A separate 115-volt, 50- or 60-cycle, single-phase supply is required for the crystal heaters, which consume approximately 30 watts.

Power Input:

Average Program Level	(1 kw output)	approx. 10.8 kw
	(5 kw output)	approx. 17.5 kw
Modulation Factor=1	(1 kw output)	approx. 11.5 kw
	(5 kw output)	approx. 21.5 kw

Type of Modulation	High Level — Class "B"

Audio Frequency Input—600 ohms:

Program Level (5 kw output)	approx. + 4.5 vu
Modulation Factor=1	approx. +12.5 vu

Audio Frequency Response	Uniform within ±1.5 db 30 to 10,000 cycles

Audio Frequency Distortion:

Modulation Factor=0.95	not to exceed 3 per cent RMS, 50 to 7,500 cycles
Residual Noise—(Below 100 per cent Modulation)	60 db (unweighted)

Tube Complement

Radio Frequency:

Crystal Oscillators (1V2)	2 RCA-807
Buffer (1V4)	1 RCA-828
Driver (1V5, 1V6)	2 RCA-810
Power Amplifier (1V7)	1 RCA-892-R

Audio Frequency:

1st Amplifier (2V1, 2V2)	2 RCA-1620
2nd Amplifier (2V3, 2V4)	2 RCA-828
Driver (2V5, 2V6)	2 RCA-828
Modulator (2V7, 2V8)	2 RCA-892-R

Rectifiers:

Bias (3V3, 3V4)	2 RCA-8008
Low Power (3V1, 3V2)	2 RCA-8008
Main (7V1 to 7V6)	6 RCA-8008

Mechanical Specifications

Dimensions:

Overall Length	171½ inches
Overall Height	85½ inches
Enclosure Depth	38½ inches
Plate Transformer (oil-filled)	Base 27⅜ x 21, Height 72½ inches
(air-cooled)	Base 34 x 21, Height 26 inches
Modulation Transformer	Base 26 x 19½, Height 23½ inches
Console	Base 60 x 34½, Height 41½ inches
Building Entrance	Minimum 38½ inches wide, 85½ inches high
Maximum Length of Single Unit	89½ inches

Weight:

Transmitter Weight (net approx.)	6,000 pounds
Modulation Transformer	992 pounds
Plate Transformer (oil-filled)	1,540 pounds
(air-cooled)	735 pounds
Console	393 pounds

SECTION II

Equipment

The complete Type BTA-5F Broadcast Transmitter is identified by the Stock Number MI-7260-C for 60-cycle supply and MI-7260-D for 50-cycle supply and contains the following "Master Items":

Qty.	Description		RCA Reference Nos. 60 cycle	RCA Reference Nos. 50 cycle
1	BTA-5F B/C Transmitting Equipment consisting of:		MI-7098-E	MI-7098-F
	1 R-F Unit		MI-7259-E	MI-7259-F
	1 Low Power Rectifier Chassis		MI-7253-C	MI-7253-C
	1 Audio Unit		MI-7258-E	MI-7258-F
	1 Modulator Output Unit		MI-7087-A	MI-7087-A
	1 Power Control Unit		MI-7257-A	MI-7257-B
	1 Transmitter Base Assembly		MI-7255-A	MI-7255-A
	1 Enclosure		MI-7256-A	MI-7256-A
	1 Interconnection Jumpers		MI-7077	MI-7077
2	UL-4392 Oscillator Units		MI-19458	MI-19458
2	TMV-129-B Crystal Units (Crystal Ground to Specified Frequency)		MI-7467	MI-7467
1	Plate Transformer { air cooled (indoor type)		MI-7088-C	MI-7088-C
	Plate Transformer { oil filled		MI-7088-A	MI-7088-A
*1	Antenna Tuning Unit { with Monitor Rectifier		MI-28902-B	MI-28902-B
	Antenna Tuning Unit { less Monitor Rectifier		MI-28902-A	MI-28902-A
1	Supervisory Control Console		MI-11616-A	MI-11616-A
*1	Relay Panel (Audio level change)	Gray:	MI-4309-B	MI-4309-B
1	Installation Material Kit		MI-7268-E	MI-7268-E
1	Miscellaneous Hardware Kit		MI-7474	MI-7474
1	Tool Kit		MI-7086-B	MI-7086-B
1	Touch-up Kit		MI-7499-A	MI-7499-A
†	Set of Tubes		MI-7083-A	MI-7083-A
1	Set of Frequency Determining Capacitors (specify frequency)		MI-19465-A	MI-19465-A
2	Instruction Books		IB-30140	IB-30140
‡2	Installation Notes		IB-30099-1	IB-30099-1

* Optional Equipment.
† Specify number of sets.
‡ Supplied to customer prior to shipment of transmitter.

SECTION III

Description

The type BTA-5F transmitter has been designed to meet the requirements of the standard broadcast band for a medium-power transmitter representing the latest developments of the industry electrically and mechanically.

Capable of operation over a frequency range of 540 to 1,600 kilocycles the nominal power output is 5 kilowatts with facilities for instantaneous reduction of output to one kilowatt. Full provisions have been made for rapid and economical conversion to 10 kilowatts with virtually no increase in space requirements. Transmitter output may be delivered to a load range of 40 to 250 ohms unbalanced, either transmission line or antenna matching network.

Frequency control is by two Type UL-4392 crystal-controlled oscillators developed specifically for this application. Alternate oscillators may be placed in operation instantaneously by operation of a selector relay which is push-button controlled from the transmitter front panel. The crystals have a low temperature coefficient (less than 1.5 parts per million per degree Centigrade), and are mounted in compensated, temperature-controlled holders, Type TMV-129-B. Both the crystal holders and the complete oscillator assemblies are of the plug-in type. Overall frequency stability is better than ± 10 c.p.s.

Construction

The equipment comprises seven major units or assemblies: (1) radio frequency unit; (2) low power rectifier chassis; (3) audio frequency and main rectifier unit; (4) power control unit; (5) transmitter base (2 sections); (6) transmitter unified front (2 sections); (7) auxiliary equipment, modulation transformer, and plate transformer. The assembled transmitter is shown in Figure 1. Full access to the equipment is provided through the four front doors. All tubes are replaceable from the front and are visible through the viewing ports.

All frames are constructed of formed welded "U" sections heavily copper plated. At installation the frames are bolted to a heavy channel base which has been built in two sections for convenience in handling. The main interconnecting wire duct is formed into the base.

Vertical chassis construction is employed throughout this transmitter. The first compartment on the left contains the high-power radio-frequency tube and the output tank. The second compartment from the left contains the low-power radio-frequency, low-power audio-frequency, auxiliary rectifier, and bias rectifier components. The third compartment from the left contains the modulator tubes and the main rectifier components. The compartment on the right contains the contactor panel and a control (relay) panel. Dead front construction is used on all operating controls most of which are located on the control panel which is accessible during operation through the non-interlocked front door. The control circuits are of the latest design, simplified to provide high-speed protection to the equipment with the minimum of complexity and maintenance requirements.

The transmitter front has been built in two symmetrical sections for installation ease and to reduce bulk and weight. All meters, with the exception of two audio driver plate ammeters visible through the port, are mounted in a single line across the panel top. All front panel tuning controls are electric and are unusually accessible since they are mounted on the two center access doors.

Each of the RCA-892-R tubes has an associated individual blower fed from a common air-mixing or plenum chamber which is equipped with a single-unit permanent type air filter. A small blower in the top cover of the plenum chamber provides forced draft circulation for the low-power rectifier chamber. The main rectifier compartment is equipped with a blower which functions when plate voltage is applied to provide a "cold spot" for the envelopes of the main rectifier tubes.

Circuit Design

The complete electrical circuit of the transmitter is shown in the multicolored schematic diagram, Figure 23. The different colors employed for the audio, r-f, power and control circuits greatly facilitate circuit tracing. The antenna tuner and console circuits are described in the supplementary Instruction Books (No. 30168 and No. 30157) which are included at the back of this book. As nearly as possible the schematic diagram has been laid out functionally; broken section lines indicating the chassis on which a given component is mounted; the bottom section indicating the equipment mounted on the front panels. Each circuit component is identified by means of a letter and a following number, the prefix numeral indicating the functional use of the item. This identification of a component is rigidly maintained throughout all drawings, photographs, parts lists and descriptive text.

Prefix Identifications:

1. Radio Frequency.
2. Audio Frequency.
3. Lower Power Rectifiers.
4. Power Control.
5. Front Panel.
6. Auxiliary Power Equipment—External.
7. Main Rectifier.
8. Monitor Rectifier.
9. Control Console.

Letter Identification:

A. Auxiliary Equipment—Indicator Lamps, Blowers etc.
C. Capacitors—All Types.
E. Relays and Contactors.

L. Reactors.
M. Meters—All Types.
R. Resistors—All Types.
S. Switches—Manual—Push-Buttons, Toggle Switches, etc.
T. Transformers—All Types.
V. Tubes.
X. Sockets.

As an example, 4E3 is a relay in the power control section of the transmitter and is number "3" in that list. Exact location is shown on the photograph of this section, Figure 18; ordering information in the parts list; wiring information on the connection diagram, Figure 31; and the electrical function on the overall schematic Figure 23, and the control ladder, Figure 24. Thus 4E3 is completely identified in all respects.

Radio Frequency Circuits—The r-f section of the equipment is mounted in the left end of the assembly; the output stage is in the first compartment; the oscillators and drivers are on the left side of the second compartment.

The crystal oscillators employ one RCA-807 tube each. The crystal is connected across the control grid circuit and is shunted by a small vernier capacitor (1C1), permitting adjustment to exact frequency. Final grinding of crystals is made for an identical oscillator so that only very minor adjustments are required. A tapped reactor is employed in the plate circuit, each tap covering a portion of the frequency range as follows:

Tap No.	Freq. range (kc)
1	540- 700
2	700-1,000
3	1,000-1,300
4	1,300-1,600

Taps 5, 6, 7 and 8, which cover frequencies from 1,600 to 3,000 kc, are not used with this equipment. The proper tap should be selected before plate voltage is applied, and if the oscillator should be sluggish in starting the next higher frequency band should be used.

Plate voltage for the oscillator is applied through the selector relay 1E1 controlled by push-button 5S2. The oscillator in use is indicated by pilot lamp 1A8 or 1A9. The oscillator selector relay is of the impulse type and is mechanically latching so that power interruptions have no effect on this circuit.

A single RCA-828 tube is employed in the buffer stage which is tuned by inductor 1L4 and capacitors 1C21, 1C22 and 1C23. 1C24 and 1C25 form a voltage dividing circuit that functions in conjunction with potentiometer 1R11 to furnish a potential for the input circuit of the station frequency monitoring equipment. It is desirable that the concentric feed to this monitor have an outer insulation so that the line may be grounded at one point only to eliminate any possibility of undesired circulating ground currents.

Two RCA-810 tubes operating in parallel furnish driving energy for the modulated amplifier. Inductors 1L7, 1L8, and capacitors 1C30, 1C31, and 1C53 form the plate tank. 1C53 permits adjustment of drive and neutralizing voltage balance. 1L7 is motor driven and front panel controlled for limited range tuning. The motor drive is 1A4, operation of which is controlled by push-button switches 5S4 and 5S5. Neutralizing is accomplished in the circuit 1L6, 1C26, 1C27 and 1C28.

The modulated amplifier (output stage) is a single RCA-892-R tube operating class "C." The tank circuit is formed by inductors 1L13, 1L16 and capacitors 1C34 to 1C37 inclusive. Output coupling to the load is accomplished through capacitors 1C38 and 1C39. The tank is inductively tuned by 1L16 driven by motor 1A6 which is in turn controlled by push-button switches 5S6 and 5S7. 1L17 in series with the output terminal is used to tune out residual reactances in the transmission line and to permit fine adjustment of the load coupling. The use of inductive tuning (1L17) permits a reasonably wide range of output power control because of its broad characteristics. Over this range the power factor of the plate tank remains very close to unity and permits high plate efficiency.

Power for the output stage is obtained from the main rectifier. All voltages for the preceding stages are developed by the low power rectifier (3V1, 3V2) and the associated voltage divider circuit 3R1, 3R2, 3R3, 3R4 and 3R5.

Coils 1L14 and 1L15, inductively coupled to the output tank, provide voltages for modulation level monitoring and test equipment. Resistors 1R23 and 1R24, controlled in value by relay 1E3, provide equalized voltages for 5-kw and reduced power output operating conditions. Antenna circuits and monitoring rectifiers are discussed in IB-30168 which is included at the rear of this book.

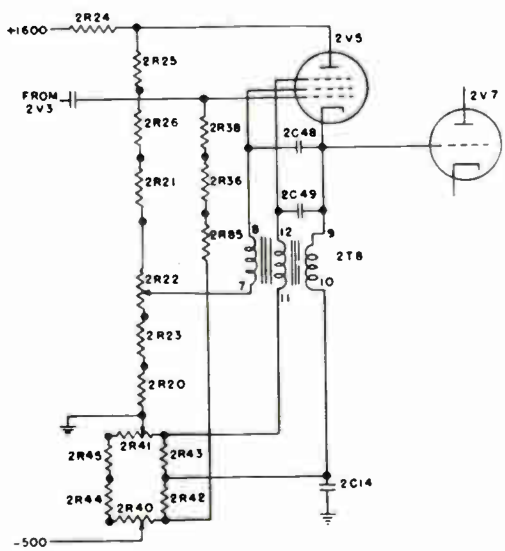
Audio Frequency Circuits—The audio-input and driver circuits are mounted on the right-hand side of number two compartment. The third compartment houses the modulators. The modulation transformer is installed directly behind this section.

Output of the station speech input equipment is delivered to the input transformer (2T1) at approximately +4.5 vu for 5-kw operation. A frequency equalizing circuit comprised of the series connected components 2L1, 2C52, 2R90, 2R91, and 2R92 is connected across the primary terminals of the input transformer, 2T1. When frequency characteristic control is employed, a 6 db isolation pad must be inserted between the program amplifier output and the transmitter input terminals. If frequency characteristic control is not used the frequency equalizing circuit should be disconnected. The first audio stage employs two RCA-1620 tubes. The feedback voltage from the plate circuit of the modulator is inserted in series with the secondary windings of the input transformer (2T1). The first audio stage bias potential is controlled by the values of 2R54 and 2R83 at the base of the feedback ladder and 2R3 in the cathode return. Obviously bias is not correct until plate potential is applied to the modulators.

The feedback ladders function as voltage dividers and are connected between the plates of the modulator tubes and ground. They form a portion of the feedback loop which includes all circuits between the secondaries of the input transformer (2T1) and the primary of the modulation transformer (6T3). Hence, the voltage applied to the grids of the first audio stage is the vector sum of the input and feedback voltages.

A 100-120 cycle hum-frequency attenuator (2L3 and 2C9) is included as a part of the first stage output circuit. Next in sequence are two RCA-828 tubes (2V3, 2V4) which are push-pull, resistance coupled on the input side. The output of this stage is push-pull reactance coupled to the input of the third audio stage.

Two RCA-828 tubes (2V5, 2V6) connected in a push-pull cathode-follower circuit, are used in the third audio (modulator driver) stage. Facilities are incorporated for four tubes to provide for 10-kw operation. In effect the cathode, rather than the plate circuit fluctuates at audio frequencies. The insert is a simplified diagram of a single tube working with its associated transformer windings.



The primary winding of 2T8 acts as the cathode (filament) load. Since the grid of the following stage is directly coupled, fluctuations of the cathode voltage will be impressed upon the control grid of 2V7. In order to duplicate normal pentode operation, the screen and suppressor grids must remain at the same a-c potential as the cathode. This is accomplished by the secondary coils of transformer 2T8 assisted by capacitors 2C48 and 2C49. This type of circuit permits high drive efficiency and minimizes the effect of grid current flow in the modulator. Since the anodes of the drivers are effectively at low audio potential, metering is accomplished directly in this circuit. For safety precaution it is desirable to isolate the plate milliammeters, 2M1 and 2M2. They are fully visible from the access door viewing port.

Two RCA-892-R modulators (2V7, 2V8) function through the modulation transformer (6T3) to control the output of the class C stage (1V7).

The circuit elements and their physical placement through the audio system are designed to reduce phase shift to such a minimum that the feedback (Beta) loop is inherently stable. Adjacent channel interference is minimized through the use of a rapidly dropping frequency characteristic beyond the 10-kilocycle band of audio frequencies. Reactor 6L4 and capacitor 6C1 form a "Splatter Filter" and are determinants of this characteristic.

The modulators receive their plate supply from the main rectifier (7V1-7V6); a bias rectifier (3V3, 3V4) with an adjustable voltage divider system and relay (2E2) supplies proper bias potentials for 5- and 1-kw operation. Anode and screen potentials for the preceding stages are procured from the low-power rectifier (3V1, 3V2) and the voltage divider 2R20-2R26.

Rectifiers—Three rectifier circuits are included in this transmitter. The r-f and audio driver stages are supplied from the low-power rectifier (3V1, 3V2). A bias rectifier (3V3, 3V4) supplies the a-f driver and modulator grids and the main rectifier (7V1-7V6) provides power for the r-f output stage and for the modulators. The bias and low-power rectifiers are of the single phase full wave type. The first employs a single section reactor input type filter and the latter a two section reactor input type filter. The main rectifier uses a single section reactor (7L1) input filter with capacitor-charge-limited starting. At the instant of high potential application the filter capacitors 7C1 and 7C2 are isolated from the negative bus by resistor 7R1. After a short delay of approximately one to two seconds, permitting the capacitors to charge without surge, relay 7E1 closes, shorting out the starting resistor 7R1.

Opening of any protective interlock automatically grounds 7C1 and 7C2 through the arm of relay 7E2.

Power change is accomplished by means of primary taps on the plate transformer and resultant reduction in anode potential on the modulator and power amplifier stages. Contactors 4E3 and 4E4 select proper transformer taps and are manually controlled by the power change switch 4S3 and automatically controlled by the notching relay 4E10. Operation of either 4S3 or 4E10 simultaneously controls the modulation monitor circuit, audio input circuit, audio monitor circuit, and modulator bias.

Control Circuits—Figure 24 outlines schematically the complete control circuit of the BTA-5F equipment. Functional titles of the relays are tabulated below the "control ladder" for easy reference. Diagnosis of circuit faults is most readily accomplished by reference to this diagram. It is well to remember that any given section of the "ladder" originating at control bus No. 1 must, without exception, eventually terminate at control bus No. 2. Should any relay fail to function it is then relatively easy to check for continuity from the relay toward each control bus until the fault is located. Relay contacts normally closed are shown solid; normally open contacts are clear blocks. Dashed lines connect contact sets of any given relay.

All power for the control circuits is derived from the "control bus" which is fed from the incoming power through a protective De-Ion breaker, 4S5. Power enters the equipment through the main line breaker 4S1 and through current transformers 4T1 and 4T2 which in turn energize the protective "Main Line" overload relays 4E12 and 4E13. A branch circuit at this point serves the main rectifier plate transformer through De-Ion breaker 4S2. 4S2 provides additional protection and at the same time serves as a sectionalizing disconnect so that all control and operation functions may be checked without application of potential to the plate transformer, 6T2.

WARNING — THE MAIN RECTIFIER DISCONNECT SWITCH 4S2 SHOULD BE OPEN AT ALL TIMES WHEN SERVICING THE TRANSMITTER.

With 4S1 and 4S5 closed the control circuits are now energized up to the control and filament bus contactor, 4E17. Switches 4S4 and 9S5 must both be closed to "start" the equipment. Opening either one will completely "stop" the transmitter. Operation of the contactor 4E17 energizes all low-power and rectifier tube filaments and the balance of the control ladder. Proper operation to this point is indicated by illumination of the transmitter panel and control desk "FIL. ON" pilot lamps 4A3 and 9A13.

With the closing of contactor 4E17, relay 4E6 begins to function. Normally adjusted for a 30-second cycle its contacts remain open for that time preventing application of plate potential to any of the rectifiers until they have reached operating temperature.

Before proceeding further toward the application of plate potentials it is necessary that the bias rectifier circuit be completely energized. All door interlocks (5S1, 5S8 and 5S9) together with the control desk PLATE ON switch 9S4 must be closed. At this junction the transmitter panel and control desk PLATE ON pilot lamps 5A5 and 9A13 should glow if the circuits are functioning properly and the main rectifier capacitor grounding switch 7E2 should operate removing the protective ground from capacitors 7C1 and 7C2 and simultaneously closing the set of normally open interlocks in the primary circuit of the bias rectifier plate transformer, 3T3. If the bias protective breaker 4S12 is closed, anode potential will be applied to the bias rectifiers (3V3, 3V4). Operation of the bias rectifier circuit will energize relay 2E1 thus completing another step in closing the circuit to the low-power-rectifier primary contactor, 4E19. Transmitter panel indicator lamp 5A3 should now glow, thus indicating that current is flowing normally in the bias bleeder circuit.

The circuit is now continuous from control bus No. 2 through the door interlocks (5S1, 5S8, 5S9), the PLATE ON switch 9S4, the bias protective relay 2E1, the rectifier plate delay relay 4E6 and the coil of the hesitating "carrier off auxiliary relay" 4E20 to control bus No. 1. Since the rectifier-surge relay timer 4E8 has not yet functioned, the circuit is completed through its back contacts to relay 4E20 which will, when closed, complete the circuit to the normally closed relay, 4E11. The PLATE ON push-button 5S10 must now be depressed to continue the circuit unless the AUTOMATIC switch 4S13 is closed. If switch 4S13 is closed the operation of the transmitter is termed automatic; otherwise it is manual. By pressing the push-button of the normally closed PLATE OFF switch 5S11 the circuit to the rectifier contactor 4E19 may be opened thus removing plate potential from the low-power and main rectifiers. If the AUTOMATIC switch 4S13 is open, relay 4E19 will remain open until the PLATE ON push-button switch 5S10 is pressed; otherwise relay 4E19 will reclose when the PLATE OFF push-button switch 5S11 is released.

At this point it is necessary to digress to follow the operation of the filament contactor 4E18 for the air-cooled tubes. When contactor 4E17 closes, the individual blower motors 1A5, 2A1 and 2A2 for the RCA-892-R tubes (1V7, 2V7 and 2V8) will be started. Proper airflow will cause the airflow interlocks 1S1, 2S1 and 2S2 to close, thus completing the circuit through the coil of the filament contactor 4E18, operation of which will apply filament power to the 892-R tubes through the contacts of MASTER FILAMENT circuit breaker 4S6 (not shown in Figure 24). Pilot lamp 5A4 should glow when the airflow interlocks are closed.

Assuming that no overloads have occurred, the ratchet type relay 4E10 will be closed. Contacts of the high speed plunger type overload relays 4E12, 4E13, 4E14, 4E15 and 4E16 will normally be closed and proper functioning of the bias rectifier has previously been established. Hence, when contactor 4E18 closes, its normally open pilot contacts will close and the circuit to the low-power-rectifier plate-contactor 4E19 will be completed. When contactor 4E19 operates the back pilot contacts will close and form a seal around the START push-button switch, 5S10. This operation has no effect if the AUTOMATIC switch, 4S13, is already closed.

Next it is necessary to complete the circuit to either the reduced voltage plate contactor 4E4 or the full voltage contactor 4E3. Note that one of these contactors must be open to permit the other to function because each operating coil is fed through a set of normally closed pilot contacts on the other relay. It has been shown that the control circuits are already energized to terminal G9 at the left of the upper contacts of the bias protective relay, 2E1. Proceeding to the left, contactor 4E19 is already closed but any failure of the 4E19 circuit will of course open the 4E3, 4E4 circuits. Which contactor will be energized is dependent upon the position of the power change auxiliary relay 4E5. If switches 4S3 and 9S2 are closed in the HIGH POWER position and if no overloads have occurred to operate overload relay 4E10, the power change auxiliary relay, 4E5, will be powered and the circuit to the full voltage contactor 4E3 will be completed. If overload relay 4E10 has operated or if either power change switch 4S3 or 9S2 is opened, the power change auxiliary relay, 4E5, will open and the reduced voltage plate contactor 4E4 will function instead. When the power change auxiliary relay 4E5 is energized the bias change relay 2E2 and the power change compensating relay 1E3 will operate to provide proper bias and correct monitoring voltages for 5-kw operation. When contactor 4E4 is energized pilot lamps 5A8 and 9A9 and the audio power change relays on the MI-4309-B relay panel will also be energized. Input level and monitoring loudspeaker level will now be correct for reduced power operation. If contactor 4E3 operates, the audio relays will be de-energized and pilot lamps 5A7 and 9A10 will function to indicate full power.

When either 4E3 or 4E4 closes, the motor of the rectifier surge relay timer, 4E8, is started. After an interval of approximately two seconds delay, relay 4E8 operates and closes the circuit to relay 7E1 which in turn shorts out the capacitor surge resistor 7R1, permitting normal operation of the main rectifier filter. At the instant plate voltage is applied and before relay 4E8 has completed its cycle, carrier voltage appears at the monitoring rectifier and the CARRIER OFF relay, 4E9, is closed so that operation of relay 4E8 does not disturb the position of relay 4E20.

If, however, the carrier fails at the monitoring rectifier because of an arc on the transmission line or elsewhere, relay 4E9 will open as will relay 1E2. Relay 4E20 will start to open but will not actually break circuit for approximately ¾-second. In the meantime, de-energizing of relay 1E2 removes carrier excitation for 250 milliseconds (sufficiently long to extinguish the arc). Relay 4E9 is then re-energized before relay 4E20 opens and normal operation is resumed without interruption of operating plate potentials. Should the fault persist relay 4E9 will not reclose and relay 4E20 will open thus de-energizing contactors 4E19 and 4E3 (or 4E4) and relay 4E8. The cycle will then recommence as the back contacts on relay 4E8 reclose and will continue to recycle until the fault is cleared automatically or the PLATE ON switch 9S4 or the AUTOMATIC switch 4S13 is opened.

The ratchet type overload relay 4E10 and its auxiliary, 4E11, are the "brain center" of the control circuit. Should a fault cause any one of the overload relays 4E12, 4E13, 4E14, 4E15, or 4E16 to operate, the notch coil on relay 4E10 and the operating coil on relay 4E11 will be energized. The overload relays operate with such a degree of rapidity that the ratchet and pawl device on relay 4E10 would fail to function if the 4E19 contactor circuit were not held open momentarily. Relay 4E11 accomplishes this purpose since it opens instantaneously but does not reclose for approximately 250 milliseconds. A first overload closes the contact on relay 4E10 which completes the circuit to the OVERLOAD pilot lamps 5A6 and 9A11. A second overload notches relay 4E10 a second time and carrier is reapplied and operation proceeds. If a third overload takes place, the normally closed contacts on relay 4E10, in series with relay 4E5, are opened, automatically reducing power. Should a fourth overload occur the normally closed contacts in series with contactor 4E19 are opened and all rectifier plate voltages (except bias) are removed and operation ceases until the transmitter PLATE VOLTAGE ON push-button 5S10 or the control desk OVERLOAD switch 9S3 is depressed thus operating the reset coil of relay 4E10. If the fault persists the transmitter should be turned off until the difficulty is cleared.

After a single overload which does not at once recur, push-button 5S10 or 9S3 should be operated so that single isolated overloads do not act accumulatively on relay 4E10 and result in an unnecessary interruption of program.

Relay 4E7 performs an isolated function which permits transmission to be resumed instantaneously after a power failure of short duration. Without this relay a momentary cessation of power would trip relay 4E6 and it would require 30 seconds to recycle. Relay 4E7 remains closed one to two seconds after power interruption and if the failure is not greater than this interval all circuits will reclose instantaneously after the interruption. Relay 4E7 may be set for a greater "hold in" delay, but after two seconds the rectifier filament requires the usual delay of 30 seconds for protection.

During normal operation relay 1E2 is energized and as a result capacitor 1C42 is continuously charged. Operation of relay 1E2 causes capacitor 1C42 to discharge into the grid circuit of the buffer amplifier, blocking the carrier momentarily. As capacitor 1C42 discharges, the carrier gradually returns to its normal amplitude, depending upon the time constant of the 1C42-1R22 circuit. The CRYSTAL OSCILLATORS OFF push-button, 5S3, is provided to permit operation of the buffer amplifier blocking circuit at will for checking the operation of the r-f stages without excitation. The normally interconnected terminals, P11 and P12, are provided to permit insertion of an auxiliary relay to remove the carrier momentarily when such function is desired.

The operation of the transmitter and control desk pilot lights has been noted in the foregoing description. A thorough knowledge of the physical location and the interpretation of the meaning of ON or OFF for any given light is invaluable for rapid determination of faults and their correction.

Power Supply and Distribution

The power supply for the transmitter itself should be 230-volts, 3-phase, 60 cycles (50 cycles for MI-7098-F), capable of handling loads up to 25-kw at a power factor of approximately 88 per cent. This permits 100 per cent tone modulation and a reasonable percentage of accommodation for test without overloading the power source. No allowance has been made for building requirements: lighting, tower lights, exhaust fans and shop equipment. A single-phase source of 115 volts, 60 cycles is required for the crystal heaters (approx. 30 watts) and provisions should be made for test and speech equipment.

The RCA-892-R tubes are lighted by power supplied from 2-phase Scott-connected high-reactance filament transformers. The use of high reactance current limiting transformers obviates the need of step starting since the units are designed to hold the filament starting current to a safe value (less than 200 per cent of rated flow). The primary of each set of filament transformers is controlled by a 3-gang rheostat to permit voltage adjustment required because of line variations and tube aging. A selector switch, 4S14, permits readings of individual filament potentials of the RCA-892-R tubes. Switches and rheostats are front-panel controlled at the power control panel, the extreme right-hand unit of the equipment.

With the exception of five small relays (1E1, 1E2, 1E3, 2E1 and 2E2) which are located functionally for simplification and optimum performance, all control relays, contactors, and protective breakers are centralized in the power control unit. Power and control circuits are distributed to the balance of the compartments through a channel in the transmitter base designed for this purpose. All terminals to be interconnected have a like designation; for example, terminal H4 at the power control panel connects to terminal H4 on the modulator chassis. Terminal block locations are shown on installation drawing M-429173.

Two types of transformer are available for the main plate rectifier transformer 6T2. MI-7088-A is an oil-filled transformer for both inside and outside installation. MI-7088-B is an air-cooled transformer and may be installed inside only.

Either transformer may be used with the BTA-5F or the BTA-10F. A tap switch is provided for raising or lowering the plate voltage 5 percent. Line reactors 6L1, 6L2 and 6L3 (inside the transformer) are connected in series with the primary windings in the full voltage position. Normally shorted, it is advantageous to remove the shorting links from these reactors in installations where the installed kva capacity is large and the power supply system impedance is low. The reactors have the advantage of limiting the peaks of fault current surges so that the a-c overload relays may function without tripping the main line and plate circuit "De-Ion" breakers. Unless the overall regulation becomes too poor the reactors should be employed as a general protective measure.

The BTA-5F equipment has been designed for 5-kw or 1-kw operation for stations requiring night time power reduction and to provide automatic power reduction under fault conditions. In order that the audio input level and the monitoring speaker level may be automatically corrected for power changes in the transmitter, an audio relay panel (MI-4309-B) is furnished for installation in the speech racks. A schematic diagram of this relay panel is shown in Figure 35. Equipment interconnections are shown on the wire chart, Figure 36.

SECTION IV

Installation and Adjustment

Planning the Installation

Each type BTA-5F transmitter equipment includes a complete set of installation drawings dealing with constructional details and suggested typical layouts of the equipment. The numbers of all drawings required for the installation are as follows:

* M-429173	Terminal Board Location
T-617280	Wire Chart
* P-714940	Grounding System
P-714559	Control Ladder
*W-303537	Transmission Line
* P-714961	Desk Outline
* T-617155	Antenna Tuning House
*TT-617275	Typical Installation
TT-611870	Overall Schematic
P-714929	Modulator Output Unit Connections
* T-601899	Enclosure Extension Layout
*W-303939	Overall Assembly
* K-896911	Erection Instructions
* P-722553	Base Erection Plan
* T-618453	Enclosure and Frames Erection Plan
K-892175	Installation Material List

*Shipped with IB-30099-1.

These drawings in turn tabulate the dimensions of all equipment, the locations of terminals, wire sizes and types, conduit requirements and trench dimensions. Utilizing this information, it is possible to lay out a floor plan to suit the requirements of the individual station.

Location

The location of the transmitter should be carefully selected and provision should be made for installing the external connections before the equipment is set in place. The equipment should be installed in a well-ventilated room where there is a free circulation of clean dry air. The ambient temperature should not be allowed to exceed 45° C. Other important factors to consider in choosing a location are (1) adequate illumination, both natural and artificial; (2) provision for incoming power-supply lines; (3) accessibility of good ground connection; and (4) direction of transmission line wiring.

The relative location of the components should follow the general plan outlined in drawing TT-617275. This grouping is designed to permit the shortest and most direct interconnection wiring, using a minimum of floor space. The plate transformer, control console and test-speech equipment racks may be placed at any desired location without affecting the operation of the transmitter equipment; but if this is done, changes in space requirements and in the quantities of wiring materials necessary for connections must be considered.

As an alternate layout to that shown in drawing TT-617275, the plate transformer may be placed directly behind the transmitter. However, if a clear walk-way is required along the full length of the equipment, the distance of the transmitter front from the rear wall must be increased. The oil-filled transformer may be mounted outdoors if suitable shelter is provided. In this instance, high-voltage outdoor type pot-heads must be provided for the primary and secondary cables.

The equipment may be placed directly against the rear wall of the housing structure, if space limitations require such an installation. Openings in the wall must be provided for the air intake to the plenum (air mixing) chamber, and to the high-voltage rectifier blower. The modulation output unit and the plate transformer should then be located in a vault directly behind, or under, the transmitter room. The location should be designed for minimum bus lengths to the modulation transformer.

These equipments have been so designed that all interconnecting wiring (with the exception of that to the plate and modulation transformers) may be installed in wire ducts which are an integral part of the equipment, thus appreciably reducing the time and cost of an installation. To simplify the installation still further, RCA provides a wire kit containing all the necessary wiring materials for the complete installation as detailed below. This kit is identified as MI-7268-E.

To facilitate the planning of special layouts, the material contained in the MI-7268-E kit, together with the maximum permissible run lengths, are listed here. For run details, refer to the wire chart T-617280.

MI-7268-E WIRING KIT

Item	Type and Quantity	Use
1	500 feet, PS-496, 600 volt, No. 12 solid, VCLC, PS-496	For console transmitter control circuits. Maximum permissible horizontal distance of transmitter terminal position "C" to console wire ports is 18 feet. Allowance has been made for risers and connections.
2	100 feet R-F coaxial cable, K-99208-2	For three runs from terminal position "A" to test equipment racks. Maximum permissible horizontal distance is 25 feet.

Item	Type and Quantity	Use
3	800 feet, No. 12, 600 volt stranded, gray, flame-proof, K-870141-10	For interconnection within the transmitter itself. There will be no variation with placement of equipment. Includes two spare runs.
4	150 feet, No. 0, 600 volt, VCLC, PS-496	For transmitter power supply and plate transformer primary circuits. Based on 6 primary runs of 15 feet each (total length), and 3 feed circuits to meter center of 20 feet each.
5	60 feet, No. 6, 10,000 volt, VCLC, M-429906-11	For plate transformer secondary circuit. Three runs of 20 feet each (total length).
6	650 feet, No. 19, twisted pair, 200 volt, RCLC, K-842681-1	For all audio circuits. Based on a maximum horizontal run from desk to equipment racks of 20 feet. Allows 2 spare circuits.
7	160 feet, No. 6, AWG bare copper	For grounds.
8	20 feet, copper tubing, ½ inch x .035 wall, PS-35	For transmitter output leads.
9	96 inches soft copper strap, .043 x 6 inches	For grounds.
10	96 inches soft copper strap, .043 x 4 inches	For grounds.
11	300 feet soft copper strap, .032 x 2 inches	For grounds.
12	Set containing:	
	(A) 4 90° elbows	For use with item 7.
	(B) 225 terminals (K-818337-9)	For use with item 3.
	(C) 10 terminals (K-99012-4)	For use with item 5.
	(D) 25 terminals (K-99012-7)	For use with item 4.
	(E) 6 terminals (K-99012-9)	For use with item 7.

The plate transformer supplied with this equipment has a full 10-kilowatt operation rating and may therefore be used with either the BTA-5F or BTA-10F transmitter. It is equipped with a high-voltage ±5 per cent tap switch, which may be operated from a hand-hole in the transformer case. In addition, the transformer is equipped with series line reactors, in order to limit fault current in those installations where the impedance of the power supply system is unusually low. If the supply system has a normal or a high impedance, the reactors may be shorted out by means of the links provided. Always use the series reactors during test periods unless voltage regulation becomes excessive.

The oil-filled plate transformer weighs 1,540 pounds and has an oil content of 76 gallons of type C transil oil. The air-cooled transformer weighs 735 pounds. Plans for the transformer installation should be submitted to the local Code Authority and the Board of Fire Underwriters for approval. Such plans should show the location of the transformer, the type of enclosure used, and the facilities for draining oil leakage. (After installation of the oil-filled transformer, a sample of oil should be drained from the case and be cup-tested at 25 kv. The local electric power company usually has facilities for such a test.)

An outline of a grounding system for the equipment is shown on drawing P-714940. Care should be taken that all component parts of the equipment are well grounded; it is a precaution well worth while. If the center of the radiation system is an appreciable distance from the transmitter house, a grounding pit filled with charcoal is recommended for the station system. It is desirable to keep the grounds of the two systems as far apart as installation conditions will permit, in order to minimize the possibility of coupling due to circulating ground currents.

A complete channel base, supplied in two sections for ease of handling, is included as a part of the equipment. This eliminates the necessity of setting channels in the floor. If reasonable precautions are taken to secure a smooth and level floor slab, the channel base may readily be shimmed to secure proper alignment of the transmitter. If a building is being constructed to house the transmitter, it is desirable to install two small sections of I-beam, as shown on the installation drawing TT-617275, on which to mount the modulation transformer. In the case of an existing building, smaller I-beam or wood sections may be mounted on the floor. It is desirable to adhere to the dimensions shown in the installation drawing, since the connecting busses for the modulation transformer are pre-formed at the factory. All bus connections for the transformer are furnished as part of the equipment.

Although a built-in wall mounting is shown on the standard installation drawing, the installation may readily be adapted for mounting with grille work. The curved radius sections at each end of the transmitter front-panel may easily be attached to the framework of any standard type of expanded metal grille.

Where a drop wall over the transmitter is planned, particular attention should be given to the details of the assembly drawing W-303939. The top trim member of the transmitter front projects slightly upward to permit blending with the wall.

When planning a building layout, provisions must be made for electrical circuits to the interlock switches on those transmitter enclosure access doors which are not an integral part of the equipment. A power circuit for the transmitter room exhaust fan is also required.

A number of standard makes of exhaust fans for the transmitter room are available. It is desirable to install automatic louvres to work in conjunction with them in order to prevent reversal of the air flow and rain seepage while the fan is idle.

The number of antenna control, monitoring and tower lighting circuits justifies the use of a distribution center at the transmitter building. This is especially true where more than one radiator is required. A distribution center establishes a definite point between the indoor and outdoor installations at which circuits may be isolated for purposes of checking, or from which circuits may be run to additional towers. Normal tower lighting requirements of the present time preclude the possibility of direct control of lighting through the console. A small contactor may readily be inserted to permit any desired degree of flexibility of control. Wiring materials for connections from the distribution center to the tower (or towers) are not included either with the equipment or with the MI-7268-E wire kit. Refer to the wire chart (drawing T-617280) for the type of materials required for these circuits. The wide variation in the requirements for different installations makes it impossible to predict the quantities of material which might be necessary.

A tuning house is highly desirable, especially when multi-element arrays are used, since it offers protection from the weather and the proper facilities for the use of test and measuring equipment. It provides space for mounting the tower lighting equipment and auxiliary intercommunication equipment. An interconnecting phone system (not shown on the schematics) between the transmitter building and the antenna tuning house (or houses) may prove to be of considerable convenience.

The six-wire, open-type transmission line is definitely recommended because of its simplicity. It is economical, both to install and to maintain. The radiation from an open-wire line of this type is negligible, and has no appreciable effect on even the sharpest of directional patterns. Further, the relatively high impedance (240 ohms) of this line offers less loss, and requires less adjustment, in the terminating equipment. Drawing W-303537 shows a standard six-wire transmission line installation. Such a line, when properly constructed, makes an excellent appearance, and in no way detracts from the neatness of a planned installation. A standard bayonet assembly, complete with wire clamps and insulator, is available from RCA, and may be ordered as MI-19421.

In order to secure a properly "dressed" appearance, it is desirable to make neat installations of the cables at the various terminal positions. A photograph of a typical cable form at a multiple terminal block is shown in Figure 2. A lead-sheathed, high-voltage cable termination, and primary power supply lines at their respective terminals, are shown in Figure 3. The high-voltage cable should have the lead sheath skinned back approximately 3 inches. The insulation should then be tapered and wound spirally with lacing twine. Several coats of shellac should be applied over the twine to prevent the entrance of moisture at the end of the cable. The power cables will maintain a symmetrical form if they are laced with a standard Chicago stitch, as shown in the photographs.

The unified front for these transmitters is so designed that the curved end-sections may be moved, and additional sections of front panel (and equipment) may be installed. The manufacturer has available a design for a front section, complete with an enclosure for phasing equipment, to mount at the left of the original front panel, and a similar section for speech-input and test equipment, to mount at the right. This feature offers the unique advantage of a complete transmitter installation behind a single unified front panel. (See RCA drawing T-601899.)

Unpacking and Assembling

Each transmitter equipment shipped is accompanied by a shipping voucher which lists the complete contents of that shipment. Groups of components are identified by MI (master item) numbers. MI-7260-C lists the entire equipment of the BTA-5F transmitter (60-cycle), and is reproduced in full in Figure 4. Item 1 of this MI lists the r-f unit, MI-7259-E. The packing case for this unit, and associated smaller containers for component parts, are stenciled with MI-7259-E and its sub-division numbers. Thus it is possible to identify the contents of all packing cases and to plan their uncrating systematically. All items listed on the MI sheets should be located before any crates or boxes are destroyed, so that no small items will be lost during unpacking. In some instances, the MI sheet for the small equipment is packed in the carton containing the equipment, rather than with the shipping voucher.

Various components are removed from their operating positions and packed separately for safe shipment. All such parts are individually tagged, each containing the MI number and the item number of the component. The electrical identification of the part will be found on the MI sheet. For example, if a part is identified as MI-7259-E, item 5, a reference to this MI sheet indicates that item 5 is the plate-tank inductor (symbol 1L13) of the power amplifier unit. Following such a procedure, all component parts may readily be identified and replaced in the transmitters. Reference to the photographs in this Instruction Book will simplify the assembly process still further.

All of the necessary hardware for re-assembly is packed with each unit. In addition, an MI-7474 hardware kit is included in all transmitter shipments. This kit is composed of a complete set of miscellaneous hardware, duplicating all types of nuts, bolts, washers and lockwashers necessary for the transmitter assembly.

All bus connections have been formed and should fit exactly. Before reforming any bus wire, make certain that another, correctly-fitting one is not to be found.

NOTE—IT IS DESIRABLE TO PERMANENTLY LOCATE ALL MAJOR UNITS OF THE EQUIPMENT BEFORE RE-INSTALLING THE COMPONENTS ORIGINALLY REMOVED FOR SHIPMENT.

Details for placement of the channel base sections and assembly of the equipment behind the unified front panel are shown on drawings P-722553 and T-618453 (packed with the base assembly). Note that item 2 of MI-7255-A is the right base section, and item 1 is the left base section. The two sections must be so assembled that a wire trough is formed at the center by the junction of the inverted channel members. The driver section compartment of the transmitter (the second from the left, facing the front) is formed by interconnecting the radio-frequency section frame, and the audio section frame. The main tie plate is the low-power rectifier chassis (item 1, MI-7253-C). This chassis, together with the rear trim plate and the top plate (items 5 and 6 MI-7253-C), complete the enclosure for the driver section. The r-f and audio section frames must be carefully placed, so that the distances between mounting holes for the low-power rectifier chassis are in close accordance with the dimensions shown on the overall assembly drawing W-303939. Also, the two sections must be parallel so that the top plate and the rear trim plate will fall readily into place. The distance of 2⅝ inches between the front edge of the channel base and the bottom frame members of the r-f and audio units, as well as the distance of 5¾ inches between the channel base and the power control unit, must be accurately maintained if the unified front is to be mounted with a minimum of difficulty.

The transmitter front panel is shipped in two sections. Item 1 of MI-7256-A is the right section, and item 2 of MI-7256-A is the left section. The front panel has been pre-fitted at the factory; consequently, there should be no difficulty obtaining a fit at the time of assembly. Study the assembly drawing W-303939. There are five tie-plate positions. The tie-plates should not be pulled up tightly until the front-panel alignment is satisfactory along its entire length.

After all units, including the front panel, are in their permanent positions, jumper connections should be installed between the low-power rectifier and its adjacent units, and also between the unified front components and those of the transmitter assembly. Connections should be made as shown on the terminal block location drawing M-429173. These jumper connections are furnished with the equipment. All such connections are made directly between terminals having like designations; therefore, the installation of this wiring should require but little time.

The contactor panel of the power control unit is shipped with solid block mountings at each of its four corners. These blocks should be removed and replaced with the coil springs furnished for this purpose. The springs may be found in a cloth sack which is attached to one of the mounting posts.

If the transmitter is to be installed at a wall opening, as shown in the standard layout, it is desirable to place the modulator output unit (and the plate transformer, if it is to be located at the rear of the transmitter) at the planned location before the rest of the transmitter is assembled in position, in order to avoid the moving of heavy equipment through the wall openings and around the transmitter.

Wiring

Before starting the interconnection wiring a layout plan should be drawn up, so that cables may be formed in the trench. The make-up of these cables should be planned to avoid unnecessary cross-overs as they enter and leave the trench. A few extra hours spent in planning and neatly installing the wiring is more than justified by the resulting improvement in the overall appearance of the installation.

Where lead-sheathed wire is used for connections, the lead sheath should be skinned back from the end of the wire, so that all the sheaths terminate at the same distance (several inches away) from the terminal block. This permits the forming of smaller, neat, simply laced cables. The lead sheaths should be cables in a rectangular form. They should be spotted together with solder at regular intervals along the run and then well grounded. Several spares should be run in each cable, in order to avoid a shortage of connecting wires due to errors in planning, or to permit the inclusion of additional circuits. As the wires are laid in the trenches, each wire should be tagged at its ends with the terminal connection identification.

IMPORTANT: When installing the lead-sheathed input cable to the air-cooled plate transformer, the cable MUST be kept away from the high-voltage secondary windings by as great a distance as possible. It is recommended that the cable be dressed in place AT LEAST ONE INCH from the transformer windings. If this precaution is not observed, arc-over and possible damage to the transformer will result.

On some power control units the "K" terminal board on the contactor panel is located at the rear of the panel. Since it is necessary to remove the transmitter end shield when connecting leads 76 through 81, as shown on Figure 33, space must be available at the rear of the transmitter for removal of the shield. When conditions do not permit shield removal after installation, the leads should be connected prior to installing the power control unit.

When cutting lengths of heavy cables designed for the conduit runs, allow some excess length. It is better to end up with a cable a foot too long than with one two inches short. Also, having some additional length of line facilitates the forming of individual cables.

All of the safety interlocks should be checked for correct operation before high voltage is applied to the transmitter. The air flow interlocks should be checked by obstructing the air flow to each blower, making certain that the interlock "cuts out" when the flow is reduced appreciably. The mechanism may be adjusted by changing the position of the small counter-balancing weight on the air flow damper. The blowers should be started and stopped 10 or 15 times to make certain that the interlocks are functioning satisfactorily — that there is no tendency for them to stick, either at the ON or at the OFF position. The motion of the damper and the mercury switch must be absolutely free. The flexible leads from the switch should be free. The switch should be so installed in its clip that the switch contacts are aligned vertically, with the large contact in the higher position.

The habit of using grounding sticks before entering the transmitter or its enclosure is an excellent one to acquire at the time the equipment is first placed in operation.

Tubes

Install all tubes in their sockets. The handle bands of the RCA-892-R tubes should be adjusted so that, with the grid terminal of the tube which protrudes from the side of the glass envelope in the required position, the handles will be on a line parallel to the chassis supporting the socket itself. The position of the handle bands may be shifted by first loosening the three screws in the chrome-plated clamp band. After the position of the handle bands has been adjusted the clamping screws should be tightened. There are three filament terminals located on top of the tube, one of which is connected to the center point of the filament. It is important that the largest of the three filament connectors is attached to this terminal. A label illustrating the proper connections is cemented to the chassis adjacent to each filament connector terminal board for the RCA-892-R's.

The radiator fin assembly of each tube contains two drilled thermometer wells. Four thermometers are furnished with each transmitter. In case of breakage, new thermometers may be ordered from the H-B Instrument Company, 2518 N. Broad St., Philadelphia, Pa. Eight inch spirit thermometers, calibrated 50 degrees C. to 150 degrees C. should be specified. These thermometers are especially useful in checking for normal operating conditions during test periods.

Power Frequency Conversion Kits

Frequency conversion kits may be ordered as follows:

MI-7085-A	5F	60 cycles to 50 cycles
MI-7085-B	5F	50 cycles to 60 cycles
MI-7085-C	10F	60 cycles to 50 cycles
MI-7085-D	10F	50 cycles to 60 cycles

The kits contain all parts which are affected by a change in power frequency (motors, relay coils, etc.).

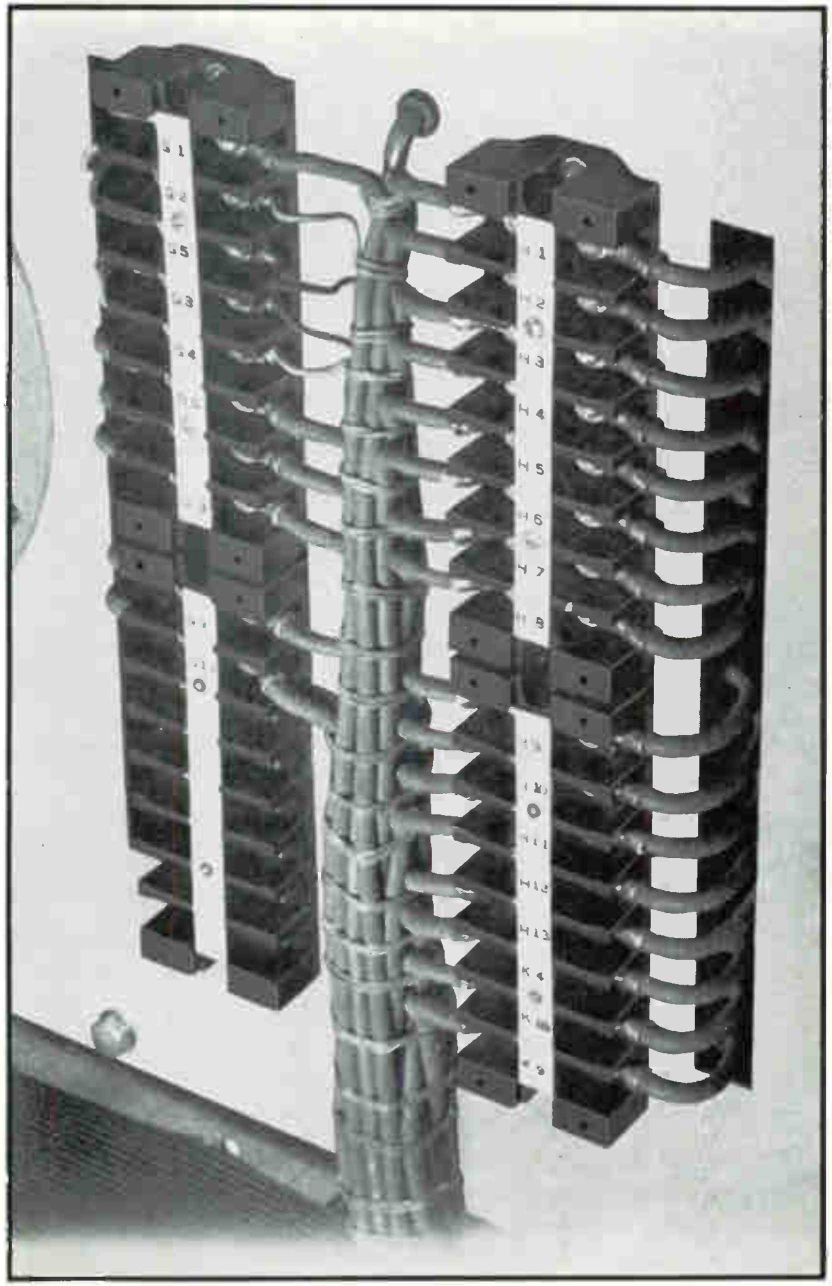


Figure 2—Interconnecting Cable Lacing

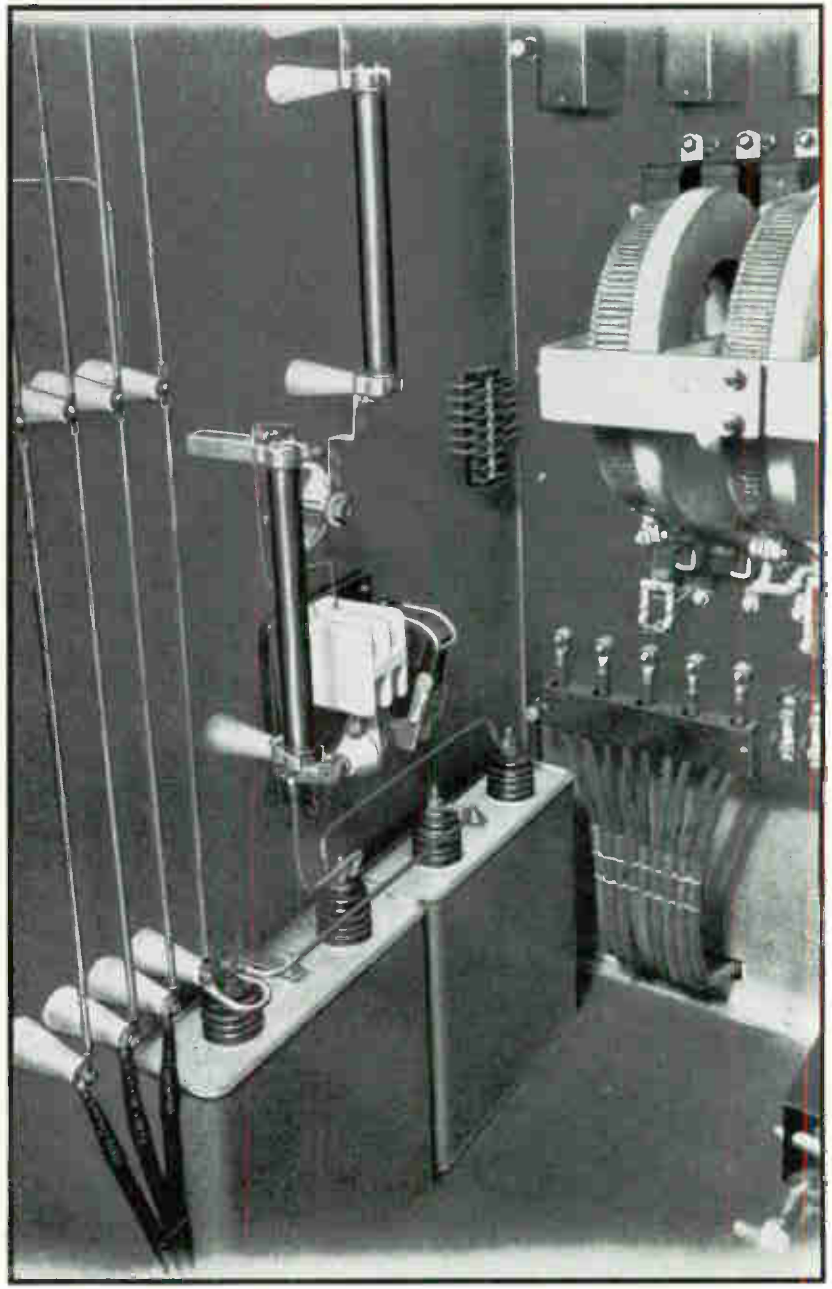


Figure 3—Power Supply Cable Lacing

SHEET #1

LIST OF CONTENTS OF MASTER ITEM 7260-C

MI-7260-C BTA-5F B/C TRANSMITTER EQUIPMENT (230 V., 3 PH., 60 CY.)

ITEM	QUAN.	DESCRIPTION	REFERENCE	PART OR GROUP
1	1	R.F. UNIT	MI-7259-E	SEE NOTE #4
2	1	L.P. RECTIFIER	MI-7253-C	
3	1	AUDIO UNIT	MI-7258-E	
4	1	MODULATOR OUTPUT UNIT	MI-7087-A	
5	1	POWER CONTROL UNIT MI-7098-E	MI-7257-A	
6	1	BASE ASSEMBLY, ETC.	MI-7255-A	
7	1	ENCLOSURE	MI-7256-A	
8	1	INTERCONNECTION JUMPERS	MI-7077	
9	1	TOOL KIT	MI-7086-B	
10	1	MISCELLANEOUS HARDWARE KIT	MI-7474	
11	1	TOUCH-UP FINISH KIT	MI-7499-A	
12	2	CRYSTAL OSCILLATOR UNIT	MI-19458	
13	2	INSTRUCTION BOOK (PACKED BY SHIPPING DEPT.)	IB-30140	
14	*	PLATE TRANSFORMER	SEE NOTE	
15	*	ANTENNA TUNING EQUIPMENT	SEE NOTE	
16	*	AUDIO CABINET (RIGHT WING)	MI-7485-E	
17	*	ANTENNA PHASING CABINET (LEFT WING)	MI-7485-F	
18	*	SUPERVISORY CONTROL CONSOLE	MI-11616	
19	*	RELAY PANEL (GRAY)	MI-4309-B	
20	*	INSTALLATION MATERIAL KIT	SEE NOTE	
21	*	CONVERSION KIT (BTA-5F TO BTA-10F)	MI-7267-A	
22	*	CONVERSION KIT (60 CY. TO 50 CY.)	MI-7085-A	
23	*	FREQUENCY DETERMINING PARTS (TRANSMITTER)	MI-19465-A	
24	*	TMV-129B CRYSTAL UNIT	MI-7467	
25	*	SET OF TUBES (TRANSMITTER)	MI-7083-A	
26	*	NAMEPLATE	MI-28180-1	
27	*	INSTALLATION NOTES	IB-30099-1	

*(NOTE) USE THE FOLLOWING INFORMATION FOR ORDERING ITEMS 14 THRU 27 ABOVE:

<u>ITEM 14</u> SUPPLY ONE. ORDER AS MI-7088-A (OIL FILLED) OR MI-7088-B (AIR COOLED).

<u>ITEM 15</u> SUPPLY ONE IF & AS REQUIRED BY CUSTOMER'S ORDER. ORDER AS MI-28902-A IF MONITORING RECTIFIER IS NOT DESIRED, OR AS MI-28902-B IF MONITORING RECTIFIER IS TO BE INCLUDED. IN LIEU OF EITHER EQUIPMENT CUSTOMER MAY ORDER SPECIAL PHASING EQUIPMENT. SEE MI-28902-A/B FOR ADDITIONAL ORDERING DATA.

(CONTINUED ON SHEET #2)

COMPILED BY	THIS MI IS USED FOR	DISTRIBUTION	REQUISITIONS	S	REQUISITIONS	S
GMP 3-11-46	B/C XMITTERS	WB PN				

0

APPROVED BY W.C. Tucker March 15, 1946

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SHEET #2

LIST OF CONTENTS OF MASTER ITEM 7260-C

MI-7260-C BTA-5F B/C TRANSMITTER EQUIPMENT (230 V., 3 PH., 60 CY.)

ITEM	QUAN.	DESCRIPTION	REFERENCE	PART OR GROUP

(NOTE FOR ITEMS 14 THRU 27 CONTINUED)

<u>ITEM 16</u> SUPPLY ONE IF & AS REQUIRED BY CUSTOMER'S ORDER.

<u>ITEM 17</u> SUPPLY ONE IF & AS REQUIRED BY CUSTOMER'S ORDER.

<u>ITEM 18</u> SUPPLY ONE, IF & AS REQUIRED BY CUSTOMER'S ORDER. ANTENNA CURRENT INDICATOR WITH 0-10 DIV. SCALE IS PROVIDED. SPECIAL SCALE MAY BE ORDERED TO MEET ANTENNA CHARACTERISTICS.

<u>ITEM 19</u> SUPPLY ONE IF & AS REQUIRED BY CUSTOMER'S ORDER.

<u>ITEM 20</u> SUPPLY ONE. ORDER AS MI-7268-A FOR EXPORT SALES OR MI-7268-E FOR DOMESTIC SALES.

<u>ITEM 21</u> SUPPLY ONE IF & AS REQUIRED BY CUSTOMER'S ORDER.

<u>ITEM 22</u> SUPPLY ONE IF & AS REQUIRED BY CUSTOMER'S ORDER.

<u>ITEM 23</u> SUPPLY ONE. ENG. DEPT. WILL DETERMINE REQUIREMENTS UPON RECEIPT FROM SALES DEPT. OF THE STATION'S OPERATING FREQUENCY & TRANSMISSION LINE IMPEDANCE. FREQUENCY DETERMINING PARTS FOR ITEM 15, IF ORDERED, WILL ALSO BE SPECIFIED BY ENG. DEPT. UPON RECEIPT FROM SALES DEPT. OF TRANSMISSION LINE & ANTENNA CHARACTERISTICS.

<u>ITEM 24</u> SUPPLY TWO (1 SPARE) IF & AS REQUIRED BY CUSTOMER'S ORDER, & SPECIFY CRYSTAL FREQUENCY AS DETERMINED FROM TRANSMITTER OUTPUT FREQUENCY.

<u>ITEM 25</u> SUPPLY QUANTITY PER CUSTOMER'S ORDER.

(CONTINUED ON SHEET #3)

COMPILED BY	THIS MI IS USED FOR	DISTRIBUTION	REQUISITIONS	S	REQUISITIONS	S
GMP 3-11-46	B/C XMITTER	WB PN				

0

APPROVED BY W.C. Tucker March 15, 1946

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Figure 4—Reproduction of MI-7260-C

Preliminary Adjustments

After the transmitter has been assembled and all the wiring is in place and before power is applied, point-to-point circuit checks should be made. An ordinary electric door-bell or buzzer and battery fitted with a pair of 10 foot leads is an excellent piece of equipment for "ringing out" circuit connections. Be sure the circuit check is direct and not being completed through some circuitous path involving a common ground or the winding of a transformer. It is wise to isolate the circuit by lifting one end of the conductor.

Relays

Before any power is applied to the transmitter the relays described in the following paragraphs should be adjusted in the manner indicated.

2E1—Bias Protective Relay, Type SG. Adjust and lock the No. 4-36 brass screw located in the center of the movable armature so that the face of the armature, upon closing, is separated from the stationary pole piece by a small air gap equal to the thickness of thin cardboard, approximately 15 mils (0.015 inch). It may be necessary to adjust the spring tension on the armature return spring. Since 2E1 is "blocked-in" for the control-circuit check its operation cannot be observed until power is being applied for the R-F tune-up procedure. Should the BIAS pilot light 5A2 fail to glow check to see if relay 2E1 is closed (this relay may be observed through the port of the low-power compartment door). If the relay fails to close stretch the armature return spring slightly to reduce its tension. This adjustment may require two or three operations to secure positive relay action.

4E6—Rectifier Plate Delay Relay, Type TK. The setting mechanism of this relay consists of (1) a gear train which provides three different time settings (50 minutes, 5 minutes and 30 seconds) and (2) a tripping mechanism consisting of a scale plate and two tripping discs. The scale plate has three scales: the 50 minute scale graduated in sub-divisions to 1 minute, the 5 minute scale graduated in sub-divisions to 0.1 minute, and the 30 second scale with sub-divisions to 1 second. The tripping discs mounted in front of the scale plate are equipped with index marking pins for setting to the scale and trip pins which perform the tripping function as they are revolved to a point where they trip the Micarta latch arms and release the contact fingers. Both the gear train and tripping mechanism are mounted on a common shaft at the top of the relay. The gear train is located behind the tripping mechanism and is movable on the shaft; it is held in place by a set screw. Before setting for a predetermined tripping time the sliding gear assembly should be shifted to the ratio desired. A square "Time Setting" plate located adjacent to the gear train is calibrated and the large gear is set opposite the time range desired. By loosening the thumbscrew on the front end of the shaft the tripping discs can now be rotated so the index pins point to the desired scale markings. The adjustment of 4E6 should be: set the large gear of the gear train opposite the arrow for 30 seconds, and rotate both tripping discs until their index pointers are set at 30 seconds on the scale dial. Be sure that the set screw on the gear train and the thumbscrew holding the tripping discs are both tightened securely. (Refer to Bulletins 43-366 and 2465E.)

4E8—Rectifier Surge Relay, Type TK. This is the same type of relay as 4E6. Set the large gear of the gear train opposite the arrow for 30 seconds and rotate both tripping discs until their index pointers are set at 3 seconds on the 30 second scale of the dial.

4E7—Auxiliary Plate Time-Delay Relay, Type CR-2820-1731-A. (Provides a by-pass circuit for relay 4E6.) This is an instantaneous-closing, time-delay-opening relay in which an escapement mechanism delays the contact opening. The time interval is determined by the position of the pin inserted through the slot in the yoke assembly. This pin is located on the right-hand side of the relay just below the solenoid. It is held in place by a nut. To change the time interval loosen the nut and move the pin down for increased time or up for decreased time. The range of adjustment is from 1 to 4 seconds. For 4E7 move the pin upward toward minimum time so that the contacts open in two seconds after the relay is de-energized. This adjustment may be made without the application of power; the action of the solenoid may be simulated by operating it by hand. Be sure to tighten the locking nut to maintain adjustment. (Refer to Bulletin GEH-1016A.)

4E11—Auxiliary Notching Relay, Type CR-2820-1731-B. (Provides a time-delay closing interlock for relay 4E10.) This is an instantaneous-opening, time-delay closing relay in which the escapement mechanism delays reclosing. The method of adjustment is the same as that of 4E7. Set the escapement for minimum time. (Refer to Bulletin GEH-1016A.)

4E20—Auxiliary Carrier-Off Relay, Type CR-2820-1731-A. (Provides a time-delay-opening interlock for relay 4E9.) This relay has the same characteristics as 4E7 and is adjusted in the same manner. Set the escapement for minimum time. (Refer to Bulletin GEH-1016-A.)

4E12 and 4E13—Main Line A-C Overload Relays, Type 12PAC13A-Z. The current at which the plunger operates to trip the contacts is predetermined by the height at which the plunger rests in the calibrating tube at the bottom of the relay. The groove in the lower end of the plunger should be set opposite to the value of amperes at which it is desired that the relay shall operate. This setting is accomplished by turning the knurled nut, located at the lower end of the calibrating tube, until the plunger groove rests opposite the desired tripping current. Set the plungers on relays 4E12 and 4E13 at minimum current (plungers up) for the first power application. When plate power is applied, the plungers should be lowered until they just fail to trip at 100 per cent tone modulation. For maximum protection during normal operation this setting should be reduced so that tripping occurs at the desired program overmodulation level. (Refer to Bulletin GEH-954A.)

4E14—Power Amplifier D-C Overload Relay, Type 12PAC13A-1. This is the same general type of relay as 4E12 and is adjusted in the same manner.

4E15—Low Power Rectifier A-C Overload Relay, Type 12PAC14A-10. This is the same general type of relay as 4E12 and is adjusted in the same manner.

Arc Gaps

The sphere gaps on the modulation transformer 6T1, should be set at approximately ⅛ to $\frac{3}{16}$ inch and this spacing should be reduced under operating conditions until flash-over occurs at the maximum modulation level which is to be encountered under normal conditions. Continuity through the arc limiting resistor 7R2 should be carefully checked.

The arc gap on the main filter reactor 7L1 should be set at ¼ inch maximum and subsequently reduced to the minimum value that will permit operation without continuous arcing on starting. A momentary arc will occur at the instant potential is applied.

The horn gap at the transmission line terminal should be set at ⅜ inch maximum.

Control Circuit Check

After the preceding adjustments have been made the operation of the control circuits should be checked.

First make certain that all switches and circuit breakers are in the OFF position and that grounding sticks are attached to the high-voltage terminals of the main and low-power rectifiers. Block Carrier Off Relay 4E9 and Bias Protective Relay 2E1 closed. This makes it possible to check all primary-power-excited control circuits, including the plate contactor, without the application of plate voltage.

1. Close the following switches on the Control Console:

FILAMENT ON	9S5
POWER CHANGE	9S2
PLATE ON	9S4

NOTE: The procedure outlined below is not intended as a discussion of the full operation of all elements of the control circuits, but merely as an outline of the obvious sights and sounds connected with their proper operation. During this checking procedure if any part fails to function as indicated, reference should be made to Control Ladder, Figure 24 and the discussion of Control Circuits in the Description section of this book for guidance in locating and correcting the defective circuit.

2. Close A-C MAIN LINE circuit breaker 4S1.
   a. A-C MAIN LINE pilot lamp 4A2 should light.
   b. A-C LINE VOLTS meter 5M16 should read 230 volts.

3. Close CONTROL CIRCUIT ON circuit breaker 4S5 and MASTER FILAMENT circuit breaker 4S6. Rotate A-C SUPPLY VOLTMETER switch 4S8 to positions 1, 2 and 3 and check the balance of the three phases of the a-c supply.

4. Close TRANSMITTER ON switch 4S4.
   a. CONTROL CIRCUIT ON pilot lamp 4A3 should light.
   b. INTERLOCKS pilot lamp 5A5 should light.
   c. BIAS pilot lamp 5A3 should light.
   d. Low power and rectifier tube filaments should light, and after a 30-second delay period,
   e. Relays 4E7, 4E20 and 7E2 should be heard closing.

5. Open and close each access door (except control panel door) to test interlocks.
   a. Parts in 4b and 4e should be de-energized when any door is opened.

6. Close all three blower motor circuit breakers (4S9, 4S10 and 4S11).
   a. All three blower motors should start.
   b. After airflow has been built up, AIRFLOW pilot lamp 5A4 should light.
   c. Filaments of high power tubes 1V7, 2V7 and 2V8 should light.

7. Press PLATE VOLTAGE ON switch 5S10.
   a. PLATE VOLTAGE-REDUCED pilot lamp 5A8 should light.
   b. Relays 4E4 and 4E19 should be heard closing.
   c. After 3 seconds delay, Surge Relay 7E1 should be heard closing with a loud report.

8. Throw POWER CHANGE switch 4S3 to HIGH.
   a. PLATE VOLTAGE-REDUCED pilot lamp 5A8 should go out.
   b. PLATE VOLTAGE-FULL pilot lamp 5A7 should light.
   c. Relays 4E3 and 4E5 should be heard closing while 4E4, 4E8 and 7E1 open.
   d. After 3 seconds delay, Surge Relay 7E1 should be heard closing (loud report).

9. Operate by hand Overload Relay 4E12.
   a. PLATE VOLTAGE-FULL pilot lamp 5S7 should go out.
   b. OVERLOAD pilot lamp 5A6 should light.
   c. Relays 4E3, 4E5, 4E8, 4E19 and 7E1 should be heard opening.

10. Press PLATE VOLTAGE ON button 5S10.
   a. PLATE VOLTAGE-FULL pilot lamp 5A7 should light.
   b. OVERLOAD pilot lamp 5A6 should go out.
   c. Relays 4E3, 4E5, and 4E19 should be heard closing.
   d. After 3 seconds Surge Relay 7E1 should be heard closing.

11. Open TRANSMITTER ON switch 4S4. Throw AUTOMATIC ON-OFF switch 4S13 to ON. Close TRANSMITTER ON switch 4S4.
   a. CONTROL CIRCUIT ON pilot lamp 4A3 should light.

b. INTERLOCKS pilot lamp 5A5 should light.

c. BIAS pilot lamp 5A3 should light.

d. Low Power and rectifier tube filaments should light.

e. Blower motors should start.

f. AIRFLOW pilot lamp 5A4 should light; and after 30 seconds delay,

g. Relays 4E7, 4E20, 7E2, 4E3, 4E5 and 4E19 should be heard closing; and after 3 seconds delay,

h. Relay 7E1 should close with a loud report.

12. Operate by hand Overload Relay 4E13.

a. PLATE VOLTAGE-FULL pilot lamp 5A7 should go out.

b. OVERLOAD pilot lamp 5A6 should light.

c. Relays 4E19, 4E3, 4E5, 4E8 and 7E1 should be heard opening; and after 250 milliseconds delay,

d. PLATE VOLTAGE-FULL pilot lamp 5A7 should light.

e. Relays 4E19, 4E3 and 4E5 should be heard closing; and after 3 seconds delay,

f. Relay 7E1 should be heard closing.

g. Note that OVERLOAD pilot lamp 5A6 remains lit.

13. Operate by hand Overload Relay 4E14.

a. Action in Paragraph 12 (except b and g) should recur.

14. Operate by hand Overload Relay 4E15.

a. Action in Paragraph 12 a and c should recur; and after 250 milliseconds delay,

b. PLATE VOLTAGE-REDUCED pilot lamp should light.

c. Relays 4E19 and 4E4 should be heard closing; and after 3 seconds delay,

d. Relay 7E1 should be heard closing.

15. Operate by hand Overload Relay 4E16.

a. PLATE VOLTAGE-REDUCED pilot lamp should go out.

b. Relays 4E19, 4E4, 4E8 and 7E1 should be heard opening.

16. Press PLATE VOLTAGE ON push-button 5S10.

a. PLATE VOLTAGE-FULL pilot lamp 5A7 should light.

b. OVERLOAD pilot lamp 5A6 should go out.

c. Relays 4E19, 4E3 and 4E5 should be heard closing; and after 3 seconds delay,

d. Relay 7E1 should be heard closing.

17. Throw POWER CHANGE switch 4S3 to LOW.

a. PLATE VOLTAGE-FULL pilot lamp 5A7 should go out.

b. PLATE VOLTAGE-REDUCED pilot lamp 5A8 should light.

c. Relays 4E3, 4E5, 4E8 and 7E1 should be heard opening while 4E4 closes; and after 3 seconds delay,

d. Relay 7E1 should be heard closing.

18. Operate by hand any one of the Overload Relays (4E12 to 4E16).

a. OVERLOAD pilot lamp 5A6 should light.

b. PLATE VOLTAGE-REDUCED pilot lamp 5A8 should go out.

c. Relays 4E19, 4E4, 4E8 and 7E1 should be heard opening. After 250 milliseconds delay,

d. PLATE VOLTAGE-REDUCED pilot lamp 5A8 should light.

e. Relays 4E19 and 4E4 should be heard closing; and after 3 seconds delay,

f. Relay 7E1 should be heard closing.

19. Repeat procedure in Paragraph 18 twice more. Result should be the same (except for 18a).

20. Repeat procedure in Paragraph 18 a third time. Action in Paragraph 18 b and c should recur.

21. Press PLATE VOLTAGE ON push-button 5S10.

a. PLATE VOLTAGE-REDUCED pilot lamp 5A7 should light.

b. OVERLOAD pilot lamp 5A6 should go out.

c. Relays 4E19 and 4E4 should be heard closing; and after 3 seconds delay,

d. Relay 7E1 should be heard closing.

22. Press PLATE VOLTAGE OFF push-button 5S11.

a. Result should be the same as in Paragraph 18 (except for 18a).

23. Open all circuit breakers on the control panel and remove the "blocks" from relay 2E1 and 4E9.

All control circuit elements (except for the "blocked" relays 2E1 and 4E9) have now been checked for proper operation.

Filament Voltage Adjustment

All filament transformer primary voltage taps should be adjusted so that the voltage measured at each tube socket does not exceed the rated potential shown in the tabulation of "Typical Meter Readings" by more than five per cent when the supply voltage is at the maximum to be encountered.

To energize the filament circuits close the AC MAIN LINE circuit breaker 4S1, and the CONTROL CIRCUITS ON circuit breaker 4S5, then throw both the TRANSMITTER ON-OFF switch, 4S4, and the FILAMENT ON switch 9S5 to the ON position. The blowers and the filaments of all low-power and rectifier tubes should now be energized; also the following pilot lights should glow: AC MAIN LINE, 4A2, CONTROL CIRCUITS ON, 4A3, on the transmitter control panel, AIRFLOW 5A4, on the transmitter control strip and FIL. ON, 9A13, on the control desk. First check the voltage of the main a-c line on the LINE voltmeter, 5M16. Rotate AC SUPPLY VOLTMETER switch, 4S8, on the transmitter control panel to positions 1, 2, and 3 to connect the voltmeter across each of the three phases. Next check the filament voltage, at the socket, of each tube in the low-power compartment using a 0-15V a-c voltmeter. This will include all tubes in the rectifiers, and the low-power r.f. and audio stages. When necessary the primary voltage taps must be adjusted to provide the voltage shown in the table of "Typical Meter Readings" on page 30 under the conditions described in the first paragraph of this subject.

Now move the 0-15V a-c voltmeter to the filament terminals of one of the main rectifier tube sockets (7X1-7X6). The primary tap on each of the main rectifier filament transformers (7T1-7T6) should be adjusted so that with the line voltage at a maximum and the FILAMENT VOLTAGE CONTROL-MAIN RECTIFIER rheostat, 4S9, located on the transmitter control panel, set at approximately ¾ full resistance, the socket voltage at each rectifier tube (7V1-7V6) is exactly 5 volts. Under this condition the AC SUPPLY VOLTMETER switch, 4S8, should be rotated to position 4 and the voltage indicated on the LINE voltmeter 5M16 noted. To insure the application of the correct filament potential, this meter indication should be maintained at all times when the transmitter is operating.

New rectifier tubes should be given an initial forming period of not less than 30 minutes during which filament power should be applied. This initial forming period is required to drive mercury globules from the filament and to distribute the vapor properly within the envelope. It is not necessary to repeat this initial warm-up unless the tubes have been replaced or otherwise disturbed. Spare rectifier tubes should be so treated every 90 days.

Lastly check and adjust the filaments of the power amplifier and modulator tubes. To energize the filament circuits of the RCA-892-R tubes close the MASTER FILAMENT circuit breaker, 4S6.

The power amplifier filament voltage is controlled by the triple-unit rheostat, FILAMENT VOLTAGE CONTROL-POWER AMPLIFIER (4R2) and is indicated on the FILAMENT VOLTS meter 5M14 when the FILAMENT VOLTMETER SWITCH (4S14) is in position 3. The filament voltage should be adjusted to the minimum value that is consistent with the desired distortion characteristic. For new tubes 14.7 to 15.0 volts should be sufficient.

The filament voltage that is applied to the modulator tubes is controlled by the triple-unit rheostats FILAMENT VOLTAGE CONTROL-MODULATOR NO. 1 (4R3) and FILAMENT VOLTAGE CONTROL-MODULATOR NO. 2 (4R4). The voltage that is applied to the front modulator tube is indicated on the FILAMENT VOLTS meter 5M14 when the FILAMENT VOLTMETER SWITCH 4S14 is in position "2"; the voltage applied to the rear modulator tube is indicated when the switch is in "1." For new tubes approximately 12.8 volts should be sufficient.

Adjustment should also be made for proper filament potential at the monitoring rectifier. See IB-30168 (Type BPA-10 Antenna Tuning Unit) which is included at the back of this book.

Tuning

No attempt should be made to tune the transmitter until after the functioning of the control circuits has been checked.

Before starting the tuning procedure the following adjustments should be made:

(1) Make certain that the POWER CHANGE switch 4S3 is in the POWER CHANGE LOW position; the MANUAL AUTOMATIC switch 4S13 in the AUTOMATIC OFF position; the TRANSMITTER ON-OFF switch 4S4 in the TRANSMITTER OFF position; and that all of the other switches on the control panel are in the OFF position.

(2) Connect the high-voltage terminals (H1, H2 and H3) of the plate-power transformer (6T2) to ground.

(3) The transmitter is equipped with four grounding sticks: one in the power amplifier compartment, one in the low power compartment, one in the modulator compartment, and one at the rear of the transmitter convenient to the high-voltage d-c lines. Using the grounding sticks, connect the high-voltage lines in the power amplifier and modulator compartments to ground.

MAKE IT A HABIT TO USE THE GROUNDING STICKS EACH TIME A HIGH-VOLTAGE COMPARTMENT IS ENTERED. YOUR OWN LIFE MAY DEPEND UPON THIS. DO NOT DEPEND UPON THE INTERLOCKS TO REMOVE THE HIGH-VOLTAGE.

(4) Remove the links which connect terminals W3 and W4 on the left-hand side of the low-power rectifier chassis with terminals W3 and W4 on the low-power r-f chassis.

(5) Remove the link which connects terminal W4 on the right-hand side of the low-power rectifier chassis with terminal W4 on the low-power a-f chassis.

(6) Remove the buffer stage screen voltage dropping resistor 1R10.

WARNING—DO NOT APPLY SCREEN VOLTAGE TO THE RCA-828 TUBES WITH PLATE VOLTAGE REMOVED.

(7) Remove the modulator stage plate voltage dropping resistors 2R52 and 2R53.

Refer to the Tuning Chart and set up the r-f circuits in accordance with the values indicated for the operating frequency. The Tuning Chart is intended only as a guide in making preliminary adjustments. Each circuit must be carefully resonated and, where necessary, neutralized for proper operation. The shields of the oscillator units must be removed in order to connect the proper coil (indicated in the Tuning Chart) in the plate circuits of the oscillators. To remove the entire oscillator unit, remove the screws which fasten it to the mounting shelf, disconnect the r-f lead from the top, then pull the unit out. Power supply of the unit is through the plug-and-jack board at the rear.

Tap rotating coil 1L7 across two to four turns on each side of center of coil 1L8. Unless tuning is too slow, avoid utilizing any more turns than four because inductance shown in the tuning charts is typical only and may not apply. It is also possible to reduce the inductance to such a low value that this stage may be doubling Instead of operating at the fundamental frequency.

The particular capacitor that should be installed at a given position in the power amplifier tank and output loading circuit is indicated in the following tabulation:

POWER AMPLIFIER PLATE CIRCUIT

Frequency	Total Capacity (mmfd)	Tank Capacitors							
		1C34		1C35		1C36		1C37	
		mmfd	UC	mmfd	UC	mmfd	UC	mmfd	UC
540- 650	300	300	3334	300	3334	300	3334	300	3334
650- 750	266	200	3335	400	3333	200	3335	400	3333
750- 850	200	200	3335	200	3335	200	3335	200	3335
850-1050	150	150	3336	150	3336	150	3336	150	3336
1050-1350	120	150	3336	100	3328	150	3336	100	3328
1350-1600	100	100	3328	100	3328	100	3328	100	3328

OUTPUT-COUPLING CIRCUIT

Frequency	Total Capacitance in (mmfd)			51-ohm line				72-ohm line				230-ohm line			
				1C38		1C39		1C38		1C39		1C38		1C39	
	51-ohm line	72-ohm line	230-ohm line	mmfd	UC	mmfd	UC	mmfd	UC	mmfd	UC	mmfd	UC	mmfd	UC
540- 650	2800	2300	2000	2000	3337	800	3331	1500	3331	800	3329	1000	3330	1000	3330
650- 750	2500	2000	1800	1500	3329	1000	3330	1000	3330	1000	3330	1000	3330	800	3331
750- 850	2500	2000	1500	1500	3329	1000	3330	1000	3330	1000	3330	1000	3330	500	3332
850-1050	2000	2000	1300	1000	3330	1000	3330	1000	3330	1000	3330	800	3331	500	3332
1050-1350	2000	1600	1200	1000	3330	1000	3330	800	3331	800	3331	600	3350	600	3350
1350-1600	2000	1600	1200	1000	3330	1000	3330	800	3331	800	3331	600	3350	600	3350

INTERMEDIATE POWER AMPLIFIER

Frequency	NEUTRAL BLOCKING—1C43		TANK — 1C30, 1C31	
	Capacitance (mmfd)	Drawing Number	Capacitance (mmfd)	UC
540- 650	150	32220-647	1500	3392
650- 750	150	32220-647	1000	3344
750- 850	150	32220-647	800	3346
850-1050	100	32220-598	600	3348
1050-1350	100	32220-598	500	3351
1350-1600	100	32220-598	300	3355

Tuning Chart

OSCILLATOR		BUFFER		INTERMEDIATE POWER AMPLIFIER				POWER AMPLIFIER			
				TANK		NEUTRALIZING		TANK		OUTPUT LOADING	
Frequency (KC)	Oscillator Coil Tap (1L1)	Capacitor Connections 1C21, 1C22, 1C23	Active Turns on 1L4	Individual Capacitance of 1C30 and 1C31 (mmfd)	Active Turns (each side of center) on 1L8	Total Capacitance (mmfd) 1C26, 1C27, 1C28	Active Turns on 1L6	Total Capacitance (mmfd) 1C34, 1C35, 1C36, 1C37	Active Turns on 1L13	Total Capacitance 1C38 and 1C39 (mmfd) 230 Ohm Line	Total Capacitance 1C38 and 1C39 (mmfd) 70 ohm Line
540 to 650	1	1C21 connected in series with the parallel combination of 1C22 and 1C23. The junction of 1C21 and the combination of 1C22, 1C23 connected to the IPA grid resistors (1R14, 1R15); the other side of the 1C22, 1C23 combination connected to 1C24.	80 to 70	1500	26 *	400 1C26, 1C27 and 1C28 connected in parallel.	See Figure 5	300	See Figure 6	1800	1800
650 to 750	1 and 2		70 to 55	1000	24-26 *	300 1C27 and 1C28 connected in parallel.		266		1800	1800
750 to 850	2		55 to 41	800	22-24 *	200 1C26 and 1C27 connected in parallel.		200		1600	1800
850 to 1050	2 and 3		41 to 30	600	20-24 **	100 1C28 connected in series with the parallel combination of 1C26 and 1C27.		150		1500	1600
1050 to 1350	3 and 4	1C21, 1C22 and 1C23 connected in series. The junction of 1C22, 1C23 connected to the IPA grid resistors (1R14, 1R15); the other side of 1C23 connected to 1C24.	38 to 28	500	16-20 **			120		1400	1600
1350 to 1600	4		28 to 20	300	16-18 **	75 1C26 connected in series with the parallel combination of 1C27 and 1C28.		100		1300	1500
Station Frequency Final Values											

* Unused turns open.

** Unused turns shorted.

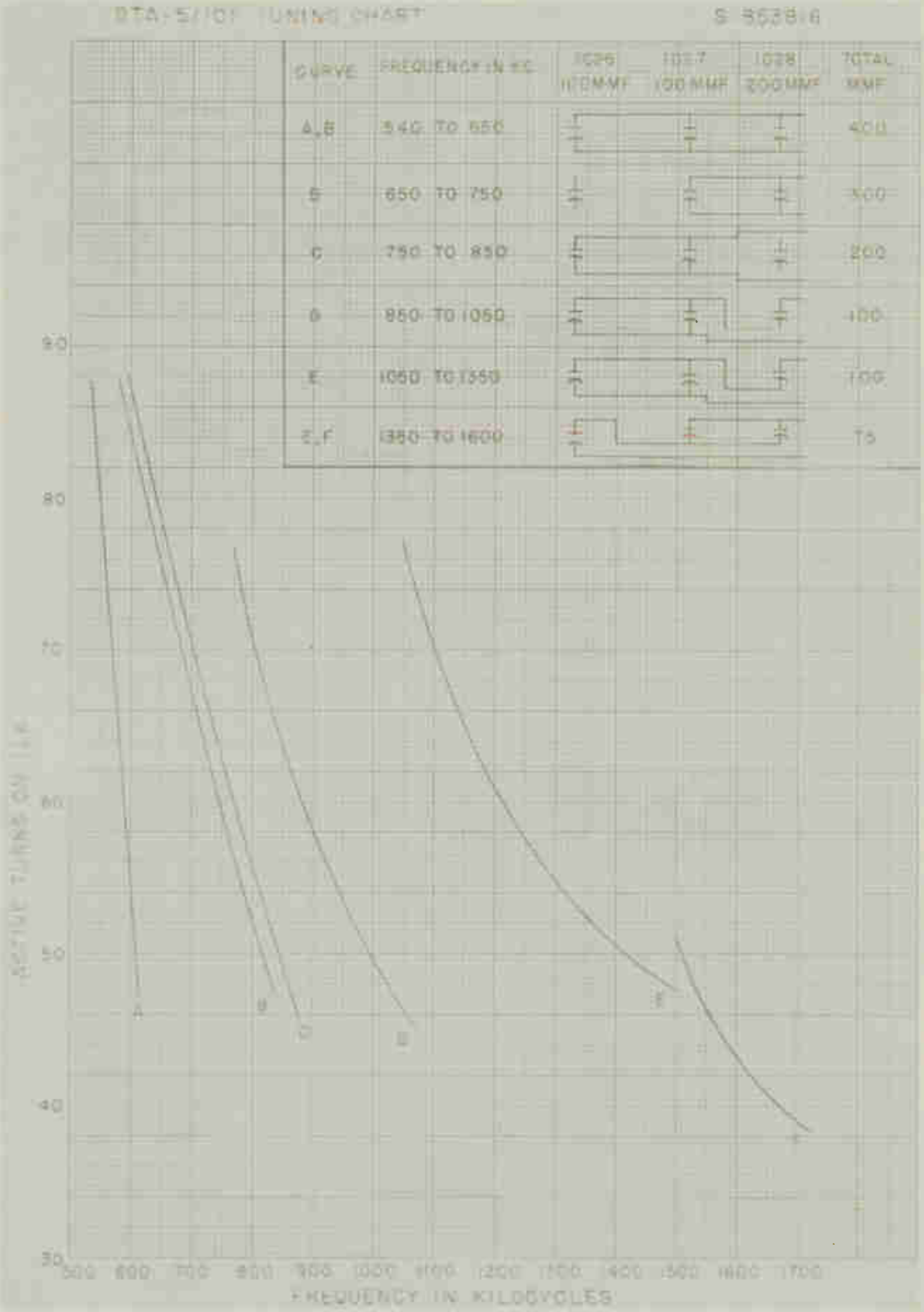


Figure 5—Tuning Chart for 1L6 (S-853816)

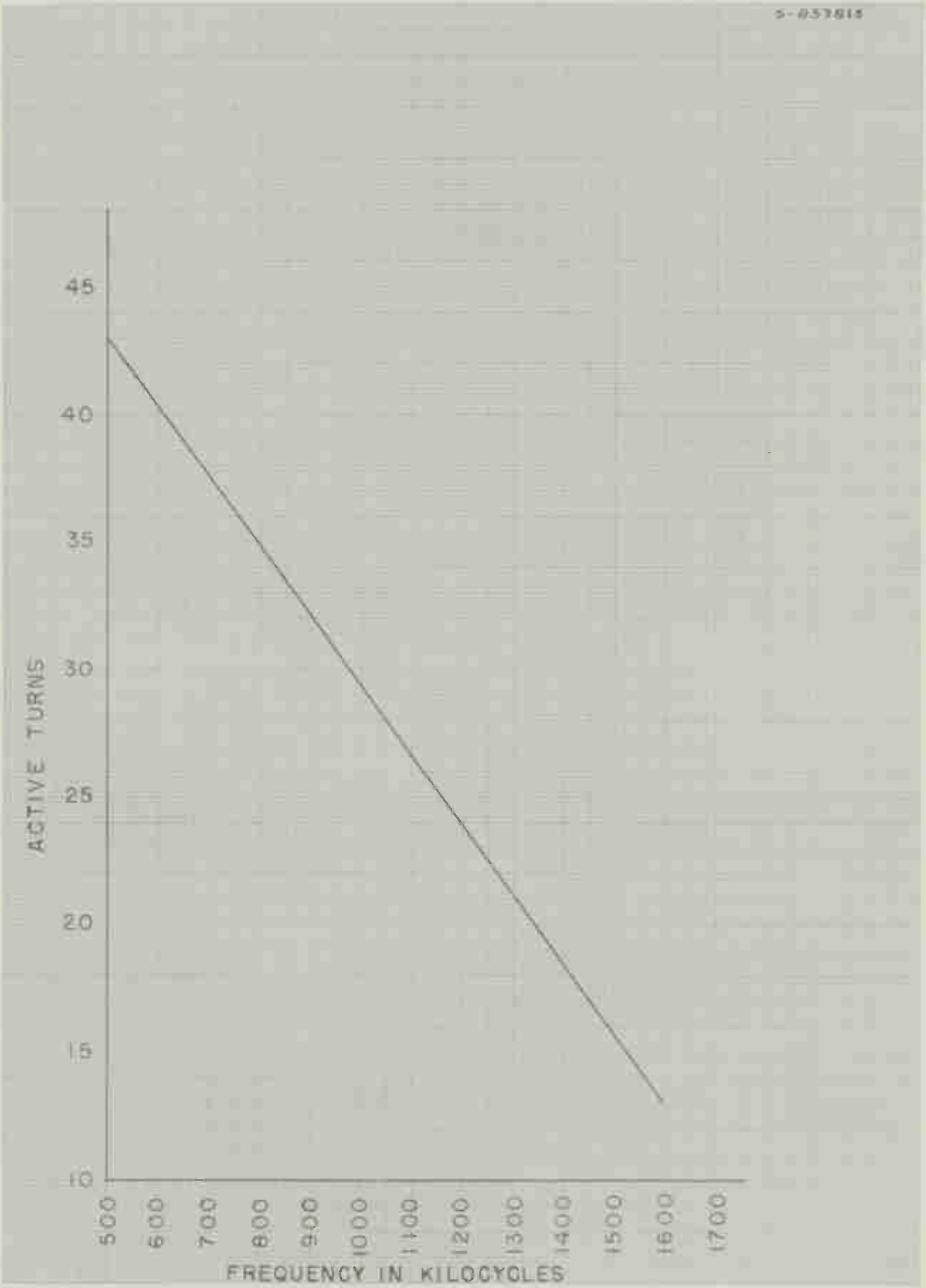


Figure 6—Tuning Chart for 1L13 (S-853815)

R-F Adjustments—Install a TMV-129B Crystal Holder containing a quartz crystal ground to the operating frequency of the transmitter in each of the oscillator units (1A2, 1A3).

Close the control desk FILAMENT ON switch 9S5 and the PLATE ON switch 9S4 then operate the control panel AC MAIN LINE circuit breaker 4S1, the CONTROL CIRCUITS circuit breaker 4S5, and the AUXILIARY RECTIFIER circuit breaker 4S7 to the ON position. Close the high power, low power, and modulator compartment access doors then operate the TRANSMITTER ON-OFF switch 4S4 to the TRANSMITTER ON position. When BIAS pilot lamp glows, press PLATE VOLTAGE ON button. Oscillator plate current should be indicated on the OSCILLATOR PLATE CURRENT meter, 5M1. Operate CRYSTAL OSCILLATOR SELECTOR switch 5S2 and check the plate current of the second oscillator.

Test the action of the interlocks by opening the access doors one at a time. Opening any access door, except that to the control compartment, should remove all plate voltage from the transmitter.

Press the PLATE VOLTAGE OFF button, replace the link between terminal W3 on the low-power r-f chassis and W3 on the low-power rectifier chassis then replace the buffer stage screen voltage dropping resistor 1R10.

NOTE—MAKE CERTAIN THAT THE PLATE CAP IS CONNECTED TO THE RCA-828 TUBE, 1V4.

Determine the oscillator plate current by removing the crystal.

The final tap setting should be the highest numbered tap (lowest inductance) which gives an oscillator plate current of 4 to 6 ma. above the normal oscillating plate current. Make certain that the tuning is adjusted so that the least number of coil turns are included in the circuit which will be on the high-frequency side of minimum oscillator plate current. Avoid tuning on the higher-inductance side because of difficulty in obtaining proper starting and stability. Also, the frequency calibration may be incorrect. The crystals are calibrated at the factory for tuning on the lower inductive side of resonance.

Oscillating currents higher than 6 ma. above the normal oscillating condition should be avoided because the crystal oscillations may become too weak to provide sufficient drive for the following stage.

After resistor 1R10 and link W3 have been replaced, press the PLATE VOLTAGE ON button and tune the buffer-amplifier stage 1V4 to resonance by rotating the plate tank coil 1L4. Resonance is indicated by minimum current indication on the BUFFER PLATE CURRENT meter 5M2 and maximum indication on the DRIVER GRID CURRENT meter 5M3.

With the grids of the intermediate power amplifier tubes (1V5, 1V6) excited, the intermediate power amplifier stage should be neutralized by rotating the neutralizing coil 1L6 to the point at which minimum deflection is obtained on the screen of a cathode-ray oscilloscope which is inductively coupled to the intermediate power amplifier plate coil 1L8 or on a 0-100 milliampere r-f meter connected between 1L8 and 1C30. If an oscilloscope or milliammeter is not available, indications of the grid milliammeter 5M3 may be used. Tune the intermediate power amplifier plate tank through resonance by operating the DRIVER RAISE-LOWER switches 5S4 and 5S5. Tuning through resonance will produce a decided rise or fall in the grid current before neutralization. When the neutralization adjustment is correct the grid current will remain constant when tuning through resonance. Recheck the Buffer plate tuning for resonance after each readjustment of the neutralizing coil 1L6.

On the very lowest frequency, improved neutralizing can sometimes be obtained by replacing the 200 mmf balancing capacitor, Item 1C53, with a 500 mmf Case 99 capacitor.

After the intermediate power amplifier stage has been neutralized reestablish the connection between terminal W4 on the low-power rectifier chassis and terminal W4 on the low-power r-f chassis. When this link has been reconnected, press the PLATE VOLTAGE ON button and then tune the intermediate power amplifier stage to resonance by manipulating the DRIVER RAISE-LOWER push-button switches 5S4 and 5S5 located on the modulator compartment door. Resonance is indicated by minimum current indications on the DRIVER PLATE CURRENT meters 5M4 and 5M5 and maximum current indication on the GRID CURRENT meter, 5M6.

When the tuning of the intermediate power amplifier stage has been completed the neutralizing adjustment should be rechecked. Complete neutralization obtains when maximum grid current occurs simultaneously with minimum plate current. To check this point tune the intermediate power amplifier plate tank through resonance two or three times by operating the DRIVER RAISE-LOWER push-button switches (5S4, 5S5) and observe the current indications on both the Driver Grid and Plate Current meters (5M3, 5M5, and 5M4). Fine adjustments in the neutralizing circuit may be secured by rotating the neutralizing coil (1L6) one-quarter turn at a time or by moving the contact one turn at a time. After this has been done press the PLATE VOLTAGE OFF button.

Now disconnect the transmission line from terminal W14, REMOVE the grounds from the high-voltage terminals of the plate-power transformer 6T2, make certain that the power change switch 4S3 is in the POWER CHANGE LOW position and that the plate caps are connected to the RCA-8008 rectifier tubes (7V1 to 7V6, inclusive) and then close the MAIN RECTIFIER PRIMARY circuit breaker 4S2. Apply reduced plate voltage to the power amplifier stage (1V7) by pressing the PLATE VOLTAGE ON push-button. Tune the power amplifier stage to resonance by manipulating the OUTPUT RAISE-LOWER push-button switches 5S6 and 5S7. Approximate resonance is indicated by minimum indication on the PLATE CURRENT meter, 5M7.

CARE SHOULD BE TAKEN NOT TO APPLY POWER TO THE TRANSMISSION LINE UNTIL THE ANTENNA TUNING UNIT HAS BEEN PROPERLY ADJUSTED. ANY MISADJUSTMENT WILL PRODUCE ABNORMALLY HIGH CURRENTS IN THE POWER AMPLIFIER PLATE TANK CIRCUIT WHICH MAY BURN OUT SOME OF THE P.A. TANK COMPONENTS, PARTICULARLY CAPACITORS

1C38 AND 1C39. ALSO SUCH MISADJUSTMENT WILL CAUSE STANDING WAVES TO OCCUR ON THE TRANSMISSION LINE. THESE STANDING WAVES MAY PRODUCE AN ARC BETWEEN THE CONDUCTORS WHICH MAY DAMAGE THE LINE. THIS IS PARTICULARLY TRUE OF THE CONCENTRIC-TUBE TYPE OF LINE WHERE THE CONDUCTORS ARE NOT WIDELY SPACED.

In some transmitters, particularly those operating at frequencies above 1,350 kc., the driver (810) tube plates may glow while the power-amplifier tube (892R) grid current is below normal. This lack of sufficient grid drive in the power amplifier stage is probably caused by low screen voltage in the buffer stage. To remedy this condition, remove all transmitter power and separate the buffer screen voltage from the oscillator plate voltage by removing the lug connection at the end of the flameproof wire at the rear of resistor 1R10. Then run a new wire from the oscillator plate to resistor 3R3. Re-apply transmitter power so that the oscillator plate voltage, as derived from 3R5, is approximately 220 volts. The buffer screen voltage at the tap on 3R5 should then be 350 volts. Adequate p-a grid drive and greater plate efficiency in the driver stage should be evidenced by lack of color on the driver plates.

Complete instructions for adjusting the Type BPA-10 Antenna Tuning Unit are contained in IB-30168 which is included at the rear of this book.

After the Antenna Tuning Unit has been adjusted in the manner described the transmission line should be reconnected to terminal W14. The transmitter should be restarted and the power amplifier tuning rechecked.

The motor-driven inductor 1L16 should be roughly at its mid-point to permit adjustment for correct load and optimum efficiency. Such a setting may be obtained by adjusting the position of the shorting strap on plate tank coil 1L13 until the roller on 1L16 rests near the mid-point on its coil when the tank circuit is tuned to resonance.

Neutralization may be checked in a number of ways. The simplest and most accurate is to connect a vacuum tube voltmeter across the output capacitors 1C38 and 1C39 and then apply drive after plate voltage has been removed from the final amplifier by operating the MAIN RECTIFIER PRIMARY circuit breaker 4S2 to the OFF position. Capacitor 1C53 should then be connected to a tap on inductor 1L8 by means of its flexible lead and this connection varied until minimum voltage indication on the vacuum tube voltmeter is obtained. Six to eight volts indicate correct neutralization. Resonance should be maintained in the intermediate power amplifier (driver) stage at all times. As an alternate method an oscilloscope may be inductively coupled to the power amplifier tank coil, 1L13 and the adjustment made for minimum band width on the screen. A third method is to substitute a 0-500 ma r-f meter for the tank thermocouple 5M8. With grid drive but no plate voltage the meter should not read more than approximately 350 ma with the output load connected to the transmitter. (Dummy load or antenna system.)

After proper neutralization the plate tank circuit should be checked for resonance. Depress the PLATE VOLTAGE OFF push-button 5S11 and close the MAIN RECTIFIER PRIMARY circuit breaker 4S2. Reapply plate voltage by pressing the PLATE VOLTAGE ON push-button 5S10. By manipulating the OUTPUT RAISE-LOWER push-button switches 5S6 and 5S7, tune for minimum P.A. plate current.

The power amplifier is now ready to be adjusted for proper loading and maximum efficiency. Remember the transmitter is operating in the "Reduced" power position and, therefore, the loading should be based upon these ratings in the "Typical Meter Reading" table. With the plate current at minimum the output load should be slightly below normal requirements. If such is not the case it will be necessary to change the values of output loading capacitors 1C38 and 1C39. To decrease the loading increase the capacity, and to increase loading decrease capacity. The capacitance suggested in the Tuning Chart for 1C38 and 1C39 serves only as a guide for preliminary adjustment. Specific requirement for the output loading capacitors will depend upon the actual impedance into which the transmitter must work.

Now proceed to adjust the plate tank circuit for maximum efficiency, that is, unity power factor. If 1L16 is rotated (clockwise) to reduce its inductance (making the tank circuit input inductive) it will be found that plate current and output increase. This occurs because the tank inductance setting for minimum plate current does not coincide with unity power factor in the tube load circuit. Maximum efficiency is achieved when the unity power factor condition is realized.

Such a condition will be found in any tank circuit similar to the one used in this transmitter where the kva to kw ratio of the tank current is less than approximately 10. For higher ratios, the two inductance settings (minimum plate current and unity power factor) become practically identical. However, as the tank kva to kw ratio decreases below 10, the separation between the inductance setting for minimum plate current and that for unity power factor increases. The separation in this case is not great and represents but a few revolutions of the variable inductor 1L16.

From the foregoing, it will be evident that the output and efficiency will increase as inductor 1L16 is rotated beyond the "dip" position to the unity power factor condition. Upon passing the latter point, the output will continue to increase but the efficiency will start to decrease. It is desirable to load the final amplifier so that plate current dip is reasonably close to the desired operating plate current. This will permit optimum grid drive efficiency.

A solution of the mathematics of this tank circuit shows that for tuning in the region of unity power factor, small variations in the setting of inductor 1L16 will produce relatively large changes of the load into which the tube looks. Consequently, it is possible to obtain a considerable variation in power output without appreciably affecting the efficiency, tuning, or modulation characteristics. This tank control, therefore, provides an excellent means of compensating for reasonably wide deviations in output circuit loading and plate supply voltage.

To determine the point of maximum efficiency hold the power amplifier input constant by maintaining a fixed plate current reading on 5M17 and with an r-f ammeter installed in the transmission line note the change in transmission line current as inductor 1L16 is adjusted. Maximum line current for a given power amplifier plate current indicates maximum efficiency.

After the plate-tank circuit adjustments have been made and if there is no indication whatever of abnormal operation, the power-change switch 4S3 should be operated to the POWER CHANGE HIGH position. Observe the value of plate current at the minimum or "dip" position as indicated upon meter 5M17. If this current is not slightly below the value given in the tabulation of "Typical Meter Readings," it may be assumed that the modulated amplifier is loaded incorrectly and that the output coupling circuit requires further adjustment.

If the power amplifier grid current is sufficient and the intermediate power amplifier plate current is above normal, connect resistor 1R16 in series with 1L23 and place the resistor at the low r-f potential end of 1L23. The normal plate current is determined after all stages of the transmitter are placed in normal operation.

The output coupling circuit is another important factor governing the power output and efficiency of the transmitter. In this circuit, the coupling capacitors 1C38 and 1C39 are furnished to satisfy a specified line (or load) impedance. Since the reactance of these units controls the loading of the transmitter, it must be calculated for each installation. If the loading is found to be insufficient, as indicated by low plate current, the reactance must be increased (capacitance decreased) to increase the tube load. Obviously, the converse also is true. Small discrepancies in loading may be corrected by shifting taps on the line-terminating inductor 8L1 in the Antenna Tuning Unit.

Tuning of the output coupling circuit to a condition of correct match with the transmission line is accomplished by the series variable inductor 1L17. Since small percentages of mismatch have no effect upon the transmission characteristics, this inductor also may be used to control the loading. This element, however, is much more effective with low load impedance than when high-impedance lines are employed. It has little effect on lines having characteristic impedances greater than 200-ohms and may be removed from the circuit in such cases if desired. The chief value of this inductor is to provide the vernier correction necessary to obtain an exact match to low-impedance lines since that condition cannot be secured with commercially available steps in capacitance.

A simple check for approximate line matching may be made by inserting an r-f ammeter in series with each end of the transmission line. The currents indicated by the two meters should both lie within 20 per cent of the value of I_L as derived by the formula:

$$I_L = \sqrt{\frac{W}{Z_o}}$$

Where: I_L = transmission line current (amperes)
W = antenna power (watts)
Z_o = characteristic impedance of line (ohms)

The antenna power (W) may be calculated from the equation: $W = I_a^2 R_a$

Where: W = antenna power (watts)
I_a = antenna current (amperes)
R_a = antenna resistance (ohms) measured at the same point as I_a

The r-f pickup coils 1L14 and 1L15 are provided to supply radio-frequency energy for the test and monitoring equipment. The number of turns on these coils should be reduced one turn at a time until the coil itself matches the impedance of the transmission line to the test equipment. Resistors 1R23 and 1R24 may be adjusted so that the output level at the test equipment will not vary with a change in power level of the transmitter. Tuned circuits should **never** be attached to the lines from coils 1L14 and 1L15 unless heavily loaded to prevent excessive selectivity. Such selectivity will clip the high frequency response and cause distortion, thus affecting the quality of the signal which would be supplied to the monitoring and test equipments.

As a final check on operation the CRYSTAL OSCILLATORS OFF push-button 5S3 should be depressed to block the carrier. If all grid currents drop to zero and no plate current becomes abnormal the circuits are stable. As a further check for spurious oscillation proceed as follows: Remove the crystal from one oscillator and throw the CRYSTAL OSCILLATOR SELECTOR switch (5S2) to the position for that oscillator. Tune an ordinary communication receiver (with the BFO on) through the broadcast and communications bands from 550 KC to 3200 KC. Any spurious oscillation will produce an audible beat note in the receiver. Press PLATE VOLTAGE OFF button 5S11 and verify whether signals are originating in the transmitter. If so, make slight adjustments on the Driver Neutralization Coil 1L6 until the indications of spurious oscillation disappear.

After all adjustments have been completed satisfactorily, the antenna current meter 9M1 installed in the console should be calibrated against the antenna ammeter 8M1 in the Antenna Tuning Unit. This check should be made at high power, setting the antenna current meter shunt 4R8 at a position where the readings of both meters are identical. Recheck this calibration at least once each week.

When the transmitter is first "put on the air" one of the several frequency measuring services which are established through the country should be contacted by telephone for the purpose of checking and directing the adjustment of the carrier frequency. Such adjustment is made by tuning the oscillators 1A2, 1A3 to zero beat at the operating frequency of the transmitter by adjusting the vernier capacitor 1C10. This is a screwdriver adjustment which may be made through the hole in the front of the oscillator unit. At the same time that the oscillator units in the transmitter are being checked the frequency monitor should also be adjusted.

It should be observed that the power output and efficiency of the transmitter are controlled by many variables. Of these, the most important are filament emission, grid excitation, plate-tank tuning, and adjustment of the output coupling circuit. The two latter items have been discussed fully within this section and require no further clarification.

Filament emission of the RCA-892-R tubes is a limiting factor on the output of the modulated amplifier stage. If the filament voltage is abnormally low, the tubes will be incapable of full output because of decreased emission. Similarly, the grid excitation must have sufficient amplitude or optimum efficiency and output will not be realized. The grid current should be within the limits specified in the tabulation of "Typical Meter Readings" to insure proper operation.

A-F Adjustments

Replace resistors 2R52 and 2R53 and the link between terminals W4 on the low-power rectifier chassis and W4 on the low-power a-f chassis, then set the power change switch 4S3 in the POWER CHANGE LOW position.

Apply plate voltage to the transmitter and note the indication of the MODULATOR PLATE CURRENT meters, 5M12, 5M13. These plate currents may rise excessively and possibly "kick-out" the DC OVERLOAD MODULATOR relay 4E16. This reaction would be caused by an oscillation created by reversed feed-back connections. Such a condition may be corrected by interchanging the terminals G2 and G5. After verifying the stability of the audio section, check the plate currents of the various stages as indicated on the FIRST AUDIO PLATE CURRENT meter, 5M9, SECOND AUDIO PLATE CURRENT meter, 5M10, the AUDIO DRIVER PLATE CURRENT meters 2M1 and 2M2, and the MODULATOR PLATE CURRENT meters 5M12 and 5M13. If these currents are not excessive (refer to table of Typical Meter Readings page 30) proceed to adjust and balance the tube voltages for the first three audio stages. Potentials for the plate, screen, and suppressor grids of the low-power audio stages are supplied from the voltage dividing network 2R20-2R26. The d-c potentials of all tube elements should be carefully checked and any necessary readjustments made in the network so that the operating values are within the limits shown in the table of Typical Meter Readings. For minimum distortion the tubes in both sides of the push-pull stages should be carefully balanced. It is important that all of these adjustments are made under static conditions, that is, while no audio signal is applied to the input, unless otherwise noted.

To determine the conditions of balance of the first audio stage measure plate voltages of both tubes **at the tubes** (with respect to ground). Should these voltages be unequal, determine whether this is a tube unbalance by reversing the tubes. If the unbalance follows the tube, substitute tubes until a matched pair is obtained. But if the unbalance is fixed it is probably caused by unequal voltages being fed back from the feed-back voltage dividers attached to the modulator sockets (see Figure 16, Main Rectifier Chassis). Although these "Feed-back ladders" are matched at the factory, field replacements of any of resistors 2R54 to 2R83, if not possessing the same tolerance as the original part, might cause some unbalance of the d-c voltage being fed back to the grids of the first audio stage. To balance this feed-back voltage shunt 2R54 or 2R83 (depending upon the ladder causing the unbalance) with a resistance in the range of 0.5-1.0 megohms. The specific value of resistance will be determined by trial.

Tubes in the second audio stage should be adjusted with special care. Here also balance may be obtained by substituting tubes until the plate voltage with respect to ground, as measured **at** the tubes, is the same value for both halves of the stage. In either of these two stages plate voltage differences are understandable in view of the variation in the plate currents drawn by vacuum tubes and also because of the commercial tolerances inherent in the large series plate resistors.

The third audio or driver stage as well as the modulators are balanced by varying the bias voltage. The output of the bias rectifier (1V3, 1V4) is fed to the audio chassis at terminals W6 (negative) and W7 (positive). Resistors 2R48, 2R49, the potentiometers 2R40, 2R41, resistors 2R42, 2R43, 2R44, 2R45 and the potentiometers 2R46, 2R47 form a voltage-dividing network and bleeder system. (See Figure 14, Low-Power A-F Chassis.) The highest negative voltage is fed to the grids of the a-f driver tubes 2V5, 2V6. The voltage-dividing network is so arranged that potentiometers 2R40, 2R41, permit a small adjustment of balance on the two sides to provide for variation in voltages required by both audio driver and modulator tubes having slightly different amplification factors. The next lower voltage, obtained from junction points 2R42, 2R43 and 2R44, 2R45 is applied to the grids of the modulator tubes 2V7 and 2V8 and to the cathodes of the a-f driver tubes 2V5, 2V6. A still lower voltage, obtained from the junctions of 2R41 with 2R42 and 2R45, is connected to the No. 3 (suppressor) grids of the driver stage tubes 2V5 and 2V6.

In making the adjustments on these last two stages of the audio system, particular attention should be paid to the balance of the audio driver stage. Since the bias adjustments are common to both stages and tube variations may produce slight unbalances in each of them, the audio driver stage should be balanced and the modulator stage permitted to assume whatever residual unbalance is present.

Since the audio driver stage operates Class B it is well to select two tubes with similar dynamic characteristics and install them before making any adjustments of the static characteristics. To check the dynamic properties of the RCA-828 remove **one** tube from one of the sockets of the audio driver stage. Remove the plate voltage from the modulators by operating the MAIN RECTIFIER PRIMARY circuit breaker, 4S2, to the OFF position. Next apply a small amount of sine-wave audio signal (1000-cycle tone) to the audio input terminals, G3 and G4, and note the rise in plate current as indicated on one of the AUDIO DRIVER PLATE CURRENT meters 2M1 or 2M2. Be particularly careful not to apply too much audio signal, otherwise excessive plate current will flow. Determine the audio level required to produce an indication of 150-200 milliamperes on 2M1 or 2M2. Now replace the single RCA-828 with another and again apply the same audio level, noting the resultant plate current swing. Repeat this procedure until two matched tubes are secured. Install them in the sockets of the audio driver stage and again close the MAIN RECTIFIER PRIMARY circuit breaker 4S2. Be sure all audio signal is removed from the audio input terminals and then proceed to statically balance the stage.

To balance the audio driver plate currents adjust potentiometers 2R40, 2R41 (which are controlled by a common shaft and knob) to the point equal currents are indicated on the AUDIO DRIVER PLATE CURRENT meters, 2M1, 2M2. Next adjust the static level of the audio driver plate currents by varying potentiometers 2R46, 2R47 (also controlled by a common shaft and knob) until the audio driver tubes have the correct value (see the table of Typical Meter Readings, Page 30). Counter-clockwise rotation of 2R46, 2R47 decreases bias and increases the static plate current.

For reduced power operation relay, 2E2 operates to move the ground point to the movable arm of 2R41 so that the negative potential on the modulator grids is reduced. At full power the ground point is shifted to the movable arm of potentiometers 2R46, 2R47, thus increasing the bias potential and permitting adjustment for individual tubes. The closer the movable arm is to 2R41, the lower the bias and the higher the static currents will be.

After any readjustment of the modulator grid bias balance or adjustment of the amplitude of the static currents, the voltages of all elements of the driver tubes (2V5, 2V6), particularly the No. 2 (screen) grid, should be readjusted to bring the potentials back to their proper value.

Full power voltage may now be applied by operating the power change switch 4S3 to the POWER CHANGE HIGH position, and an audio signal may be delivered to the audio input of the transmitter.

It should be noted that, during tests, sustained 100 per cent modulation at frequencies higher than 3000 cycles should not be permitted for periods longer than five to ten minutes without interruption. This time limit may, of course, be increased with lower percentages of modulation but should be more carefully adhered to as 10,000 cycles is approached. This precaution is necessary because certain phasing elements, which form portions of the feed-back circuit, function under a heavy load only at these higher frequencies. Normal transmission would never produce a load in any way comparable with a sustained high frequency tone.

Hum Control

Under normal 5-kw operating conditions the hum level will be from 60 to 65 db (unweighted) below 100 per cent modulation at 1000 cycles.

Any appreciable increase in hum may be caused by several factors. A defect or failure in the feed-back ladder is a possible source of difficulty, and would cause large increases in hum level. Insufficient grid-drive in the power amplifier may be a source of difficulty. Drive should not be permitted to drop below the minimum value shown in the table of Typical Meter Readings. Large unbalances of the phases of the power supply will account for several decibles increase in hum level. The hum control circuit (2L3, 2C9) in the plate circuit of the first audio stage is designed for 120-cycle resonance. Small variations of the capacitor 2C9 may be necessary to insure optimum second harmonic hum component suppression.

Defective tubes in the audio amplifier chain are always a possible source of excessive hum level.

RCA-892-R filament voltages should be reasonably well balanced. Measured at the filament terminals, the unbalance should not exceed 5 per cent. If outside to center (large terminal) is 11.0 volts the opposite leg should be no less than 10.5 and the voltage across outside to outside terminals should be close to 15.5, indicating a reasonable accurate 90° phase displacement. Filaments should always be operated so that the higher voltage does not exceed the rated 11.0 volts or serious tube life limitation will result. The No. 1 primary terminals on each transformer are provided for 50-cycle operation. In some instances the use of the No. 1 instead of the No. 2 terminal on one of the two transformers for a given tube will result in a more accurate balance of secondary voltages, particularly if the power source is somewhat unbalanced.

Distortion Control

Satisfactory distortion characteristics may be secured at installation and maintained thereafter if reasonable precautions and the following simple requirements are observed:

1. Filament Voltages — The filament voltages of the modulators and final r-f amplifier should be checked frequently and adjusted as necessary. Since increased tube life may be secured by operating at a minimum filament voltage, which must be gradually increased as the tube ages, the minimum value employed is a determining factor on distortion. It is important that the filaments be operated at a voltage slightly above the minimum value which results in increased distortion. For the power amplifier 14.7 to 15.0 will be the minimum for new tubes; for the modulators 12.8 to 13.2 should be sufficient. All filament voltages are important from the standpoint of distortion and tube life. During a normal period of operation, maximum supply line potentials should never cause a filament voltage to exceed its rated value.

2. A-F Plate Voltages—Audio tubes must be operated with proper voltages on all elements if minimum distortion is to be realized. The values given in the table of "Typical Meter Readings" should be satisfactory, although small variations may be necessary to obtain on optimum adjustment.

3. Final R-F Amplifier Grid Excitation—The limits of grid excitation for the modulated amplifier are given in the tabulation of "Typical Meter Readings." Variation of this excitation will afford a fine control of distortion.

4. Neutralization—All of the radio-frequency stages must be accurately neutralized and stable in operation to achieve minimum distortion. The proper method of neutralizing the respective circuits has been described under "Tuning."

5. In circumstances where an absolute minimum of distortion is required, two further adjustments are possible. Minimum distortion at the desired modulation frequency may be obtained by shifting the lead between the power-amplifier grid-leak by-pass capacitor 1C45 and a tap on resistor series 1R25 through 1R29. An optimum balance will be found for small reduction of both low and high audio frequencies. AS A PRECAUTIONARY NOTE, THE LEAD FROM 1C45 SHOULD NEVER BE CONNECTED BETWEEN 1L9 AND 1R25.

Secondly an increase in the intermediate power amplifier plate tank kva/kw ratio may offer some improvement and develop compensating distortion components; however, any increase adopted must not permit excessive tank currents in 1L7 and 1L8. A safe maximum is 8 amperes measured between 1L8 and 1C30 or 1C31.

SECTION V

Operation

It is assumed that the circuits of the transmitter have previously been set-up and tuned to the desired operation (carrier) frequency. If not, refer to the previous section and proceed as directed therein.

Manual Starting — For manual operation of the transmitter proceed as follows:

1. Close all circuit breakers (located on the lower half of the transmitter control panel).
2. Throw the AUTOMATIC ON-OFF switch 4S13 into the OFF position.
3. Throw the POWER CHANGE switch 4S3 located on the transmitter control panel and 9S2 on the control desk to the desired position, HIGH or REDUCED.
4. Close access doors to all compartments.
5. Throw the TRANSMITTER ON-OFF switch 4S4, on the transmitter control panel, and FIL. ON switch 9S5, on the control desk, to the ON position.
6. Wait 30 seconds until BIAS pilot light 5A3 glows.
7. Close the PLATE ON switch 9S4 on the control desk and depress the PLATE VOLTAGE ON push-button switch 5S10, located on the door to the modulator compartment.

Manual Stopping—

1. Depress the PLATE VOLTAGE OFF push-button switch 5S11, located on the door to the modulator compartment, or open the PLATE ON switch 9S4, on the control desk.
2. Throw the TRANSMITTER ON-OFF switch 4S4, on the transmitter control panel to the OFF position, or open the FIL. ON switch 9S5, on the control desk.

Automatic Starting — For automatic operation of the transmitter proceed as follows:

1. Close all circuit breakers.
2. Throw the AUTOMATIC ON-OFF switch 4S13 into the ON position.
3. Place the POWER CHANGE switches, 4S3 on the transmitter control panel, and 9S2 on the control desk, in the desired position, HIGH or REDUCED.
4. Place PLATE ON switch 9S4 in the ON position.
5. Close the access doors to all compartments.
6. Throw the TRANSMITTER ON-OFF switch 4S4, on the transmitter control panel, and the FIL. ON switch 9S5, on the control desk, to the ON position.

The transmitter will now start and automatically apply filament and plate power in correct sequence.

Automatic Stopping—

1. Open either the FIL. ON switch 9S5, on the control desk, or the TRANSMITTER ON-OFF switch 4S4, on the transmitter control panel.

When shutting the transmitter down for the night or for an extended period of time during which the equipment is left unattended it is advisable to open the AC MAIN LINE circuit breaker 4S1.

Typical Meter Readings

Circuit	Tube Element	Units	5KW	1KW
Oscillator	E_f	volts	6.3	6.3
Oscillator	E_p	volts	200-250	200-250
Oscillator	E_{scg}	volts	200-250	200-250
Oscillator	I_p	milliamperes	23-32	23-32
Buffer	E_f	volts	10	10
Buffer	E_p	volts	1150-1250	1150-1250
Buffer	E_{scg}	No. 2 grid volts	200-250	200-250
Buffer	E_{sup}	No. 3 grid volts	–10 to –13	–10 to –13
Buffer	E_g	No. 1 grid volts	–42 to –55	–42 to –55
Buffer	I_k	milliamperes	50-60	50-60
Driver	E_f	volts	10	10
Driver	E_p	volts	1400-1650	1400-1650
Driver	I_p	milliamperes	180-230	180-230
Driver	E_g	volts	–140 to –165	–140 to –165
Driver	I_g	ma. (2 tubes)	65-80	65-80
Driver	E_k	volts	–9 to –12	–9 to –12
Driver	I_k	No. 1 ma.	190-290	175-200
Driver	I_k	No. 2 ma.	190-290	175-200
Power Amplifier	E_f	volts	15.5	15.5
Power Amplifier	E_p	volts	8800-9400	3800-4000
Power Amplifier	I_p	ma.	700-820	330-360
Power Amplifier	I_g	ma.	195-230	195-260
Power Amplifier	I_{tank}	amperes	5.0-7.5	2.5-4
1st Audio	E_f	volts	6.3	6.3
1st Audio	E_p	volts	110-140	120-140
1st Audio	E_{scg}	volts	100-125	100-125
1st Audio	E_k	volts	23-28	12-20
1st Audio	I_k	ma. (2 tubes)	5-6.0	3-5.0
2nd Audio	E_f	volts	10	10
2nd Audio	E_p	volts	890 max	890 max
2nd Audio	E_g	(No. 1 grid) volts	0	0
2nd Audio	E_{scg}	(No. 2 grid) volts	840 max	840 max
2nd Audio	E_{sup}	(No. 3 grid) volts	150	150
2nd Audio	E_k	volts	90	90
2nd Audio	I_k	ma. (2 tubes)	175-190	175-190
3rd Audio	E_f	volts	10	10
3rd Audio	E_p	volts	1500-1650	1500-1650
3rd Audio	E_g	volts (No. 1 grid measured to cathode)	–120 to –130	–120 to –130
3rd Audio	E_{scg}	volts (No. 2 grid measured to cathode)	730-750*	630-710
3rd Audio	E_{sup}	volts (No. 3 grid measured to cathode)	50-65	50-65
3rd Audio	E_k	volts	–190 to –210	–110 to –180
3rd Audio	I_p	No. 1 ma. carrier	20-40	15-30
3rd Audio	I_p	No. 2 ma. carrier	20-40	15-30
3rd Audio	I_p	No. 1 ma. tone	60-90	30-60
3rd Audio	I_p	No. 2 ma. tone	60-90	30-60
Modulator	E_f	volts No. 1	15.5	15.5
Modulator	E_f	volts No. 2	15.5	15.5
Modulator	E_p	volts	8900-9200	3850-4000
Modulator	E_g	volts	–130 to –210	–100 to –180
Modulator	I_p	No. 1 amp. carrier	0.01 to 0.05	0.01 to 0.03
Modulator	I_p	No. 2 amp. carrier	0.01 to 0.05	0.01 to 0.03
Modulator	I_p	No. 1 amp. tone	0.35 to 0.65	0.16 to 0.35
Modulator	I_p	No. 2 amp. tone	0.35 to 0.65	0.16 to 0.35
Main Line Volts			230	230
Main Rectifier Filament Transformer Primary Voltage			210	210

*Readjust screen voltage after any change in bias so that screen-cathode voltage does not exceed 750 volts.

SECTION VI

Maintenance

General

The need for service will be kept at a minimum by making tight, permanent connections during the assembly of the equipment, and thereafter keeping the equipment clean and free of dust. At the end of the first six months' period, connections throughout the entire transmitter should be carefully checked and tightened when necessary. Cyclic expansion and contraction due to alternate periods of operation and shut-down tend eventually to loosen some of the connection assemblies.

Clean smoky insulators with a mild solvent such as carbontetrachloride.

Keep power tubes clean to avoid possible puncture of the glass. Tissue paper and alcohol is the most effective combination for this purpose.

Keep terminal boards clean and the terminals tight to avoid possible open or short circuits or burn-outs.

Performance Tests

Periodic performance tests will aid considerably in keeping the transmitter in the best operating condition. In order that the overall distortion may be held within the specified limits, a periodic check of the low power audio stages should be made. Unbalance in any of these stages may cause high distortion. A low emission tube may cause unbalance. Check each tube by replacing with a new tube. In making such replacements it is important that matched tubes be used in each stage. This may be checked by measuring the static or d-c plate and screen grid voltages of the replacement tube and comparing them with similar measurements made on the tube or tubes in the opposite half of the push-pull stage.

High Power Tubes

To make certain that spare tubes are suitable for immediate use, all tubes should be tested on arrival and every three or four months thereafter. Replace any tube in which there is a serious decrease in filament emission.

So far as possible, tube failure should be anticipated by keeping a log of tube life. Use of the tube hour-meter 4M2 provides a simple method of keeping an accurate record of tube life. All meter readings should be recorded and checked against readings previously taken. A ten per cent reduction in plate and cathode current usually indicates a loss of filament emission. The condition of the tube may be checked by replacing it with a tube which is known to be satisfactory and noting the difference in current.

A regular inspection of tube prongs and socket contacts is also necessary if failure is to be avoided. The large power tubes (RCA-892-R's) should be tested in the transmitter. Their filament connectors should be kept tight at all times to prevent heating which damages the seals. Before installing a tube, note whether any foreign material has fallen into the stem opening and lodged between the filament leads. These leads operate at a fairly high temperature so that any foreign material may become charred and cause a puncture of the insulation.

Occasionally one of these tubes will develop a small amount of gas in storage which can be cleaned up by proper methods. The recommended procedure for breaking in the RCA-892-R is as follows: With the tube in the power amplifier, apply low plate voltage without modulation. This is done by throwing the power change switch to the Low-Power position. After a few minutes apply 1000-cycle tone modulation, gradually increasing the percentage of modulation. If no gas flashes occur after 15 minutes of full-tone operation, remove the modulating signal, throw the power change switch into the High-Power position, and repeat.

If gas flashes occur during the process, go back to the Low-Power position with no modulation and repeat. Allow the tube to run for a considerable length of time with a low percentage of modulation, and then repeat the foregoing procedure.

When it becomes necessary to replace an RCA-892-R in the modulator, this replacement should be made with a tube that has had from 24 to 48 hours aging as a power amplifier. A spare tube should be broken in for this length of time and should be available in the tube rack.

An RCA-892-R tube that develops a small amount of gas in modulator service may usually be cleaned up by operating it in the power amplifier.

Start new RCA-892-R tubes at minimum filament voltages and increase these voltages as emission falls off. For modulator service, start RCA-892-R tubes with a filament potential of 12.8 to 13.2 volts. For power amplifier service 14.7 to 15.0 volts is the proper starting potential. These values are for full power operation.

Falling off of emission may be detected by performance tests. The symptoms are an increase in distortion, an increase in carrier shift, or both. When emission falls below that required for the maintenance of performance standards, the filament voltage should be raised. Use of the lowest filament voltage consistent with desired performance will assure maximum tube life.

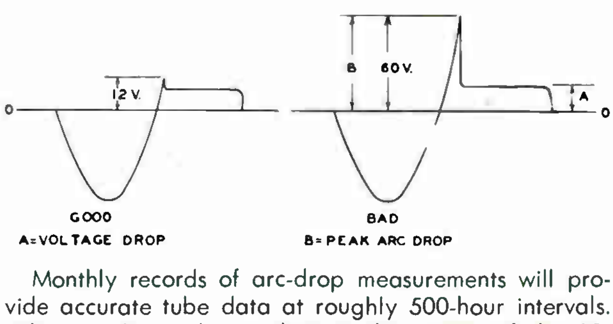
Rectifier Tubes

New rectifier tubes should be formed by operating them with the filament energized for a period of at least 30 minutes before plate voltage is applied. Spare rectifier tubes should be given a minimum of 30 minutes heat run (filament only) before being placed on the shelf. Keep tubes in an upright position and take care to avoid splashing the mercury onto the elements of the tubes. If a tube has been shaken or tipped, reheat before placing in service.

An exact determination of the condition of a mercury vapor tube can be made by inspection of its firing characteristic using a cathode-ray oscilloscope. A faulty tube will fire later and later in the first (conduction) half-cycle, and display a greater reverse-voltage transient. This oscillographic test also may be made in a low-voltage test set-up, provided the tube is loaded correctly. In making this test the oscilloscope should be connected directly across the tube and will then indicate the voltage characteristic of the tube when a-c voltage of 60 to 120 volts (rms) is applied between anode and cathode. A suitable resistance must be connected in series with the voltage source in order to limit the current through the tube during the conduction half-cycle. For a standard test potential of 115 volts, a 50-ohm resistor capable of dissipating 200 watts continuously will limit the current to approximately two amperes (based on average tube drop of ten volts). Both the oscilloscope and the applied voltage should be connected between anode and filament center-tap terminals of the rectifier tube circuit, with the anode disconnected from the main rectifier circuits. It is suggested that all the measurements be made with a standard applied voltage rather than at constant current.

The oscilloscope must be used without amplifiers and with the sweep self-synchronized with the source. The pattern will then be a reproduction of the full voltage wave across the tube, one-half being sinusoidal during the non-conducting half-cycle and the other half a trace of the instantaneous voltage drop during conduction. At the start of the conduction period, the height of the steep wave-front transient will indicate the magnitude of the peak instantaneous arc drop, which is the criterion of rectifier performance.

Excessive arc drop causes backfiring during operation, and with a little experience in making these observations, eventual failure of a tube can be predicted before excessive backfiring develops. Peak arc-drop voltages generally will range between 12 volts for a perfect tube to 60 volts for one subject to frequent backfiring. Illustrations of typical waveforms are shown in the insert.



Monthly records of arc-drop measurements will provide accurate tube data at roughly 500-hour intervals. When peak arc-drop values in the region of the 30- to 40-volts are indicated, more frequent tests may be desirable. Because the oscillographic tests reveal peak arc-drop voltages and give an accurate picture of the firing characteristic, this method of testing rectifier tubes is recommended as being much more valuable than older d-c methods of measurement. If the 115-volt source is a grounded neutral system, it will be necessary to use a 1:1-ratio isolation transformer to prevent distortion due to ground capacitance. Such a transformer should have a rating of not less than 300 volt-amperes. A standard time-interval of two minutes should be allowed for thorough heating of the tube before applying anode voltage during these tests. A d-c ammeter connected in series with the tube will indicate the average current during the conduction period.

Higher peak arc-drop voltages generally will be accompanied by lower average current readings, within certain limits, providing all measurements are made at a standard voltage. This is due to a reduction in the area under the wave as a defective tube fires later and later in the conduction half-cycle. Conduction current data should be recorded simultaneously with the peak arc-drop readings.

Air Filters

The air filter is a permanent one and requires no replacement. However, it should be cleaned at regular intervals varying from one to four months, depending upon the locale of the transmitting station. In some areas where fine dust frequently exists in the air, it will be necessary to remove any deposit which accumulates on the impeller blades of the blowers whenever the filter is cleaned. Any accumulation of such dust, either in the air filter or on the impeller blades, seriously impairs the efficiency of the air cooling system. In dusty areas, it also is advisable to clean the canvas boots and check the air flow interlock mechanism at regular intervals. The filter itself may be cleaned simply by rinsing it with hot water. When dry, the mesh should be sprayed with 10-W lubricating oil by means of an ordinary insecticide spray gun.

The filter is removable through the transmitter front. The mounting clips may be released by means of thumbscrews at the top of the filter. The plenum chamber cover must be removed for this operation.

When the air filter is kept clean, the air temperature inside the low-power and rectifier compartments will remain approximately 5° F. above the air intake temperature. This intake temperature is, in most cases, the transmitter room ambient temperature. Compartment temperatures should be taken from a thermometer placed a few inches behind a compartment window. The temperature difference should not be allowed to exceed approximately 10° F. Whenever the inside temperature exceeds the intake temperature by 10° F., the filter must be removed and cleaned.

Tuning Motor Drives

The tuning motor drive should be lubricated at three month intervals. The motors should be oiled with a good grade of light machine oil. All external gears should have an application of either Fiske Luber-plate 110 or a light cup grease. A drop or two of light machine oil should be applied to the shaft bearings on the variable inductors.

Blower Motors

These motors are equipped with wool-packed bearings and should be oiled at regular intervals with 30 to 70 drops of good light (SAE-20) or medium (SAE-30) mineral lubricating oil. They should be checked at least once every month. The impeller blades should be cleaned thoroughly at such times.

Contactors and Relays

A periodic inspection should be made of all contactors and relays. At such time each contact of every switch and relay should be cleaned. Large contactors may require dressing with a fine file. Do not use emery cloth, as abrasive granules left imbedded in the contact surfaces may raise the contact resistance and produce a tendency of the contacts to weld. Check operation manually and check contact alignment. See that pole faces are clean and seat securely. Contacts on the PAC type overload relays may become so pitted or out of adjustment that mechanical vibration will cause them to function. A sharp shock on the control panel will indicate if any such condition exists.

Replace broken arc-chutes and magnetic blow-outs. Lubricate the notching relay and synchronous timers. The door interlocks should be carefully inspected, cleaned and a small amount of petrolatum applied after cleaning.

Oil-Filled Plate Transformer

A periodic check should be made to insure that the oil used in the plate transformer, 6T2, is up to the indicated level and to make certain that this oil meets the breakdown requirements. A standard test for the oil used is described in the manufacturer's bulletin (I.B. 65-000) which is reprinted at the back of this book.

Current Transformers

WARNING: NEVER LEAVE A CURRENT TRANSFORMER SECONDARY OPEN. IF IT BECOMES NECESSARY TO REMOVE AN OVER-CURRENT RELAY ACTUATED BY A CURRENT TRANSFORMER, SHORT CIRCUIT THE TRANSFORMER SECONDARY UNTIL THE RELAY IS BACK IN THE CIRCUIT. PERSONNEL MAY BE ENDANGERED BY INDUCED VOLTAGE IF THIS IS NOT DONE.

Sphere Gaps

Protective gaps should be checked daily and kept in a polished condition. If pitted, the spheres should be polished with crocus cloth.

CAUTION: The original spacing should not be exceeded.

The resistor (6R1) connected in series with the safety gap on the modulation reactor should be periodically checked for continuity.

Routine Maintenance Schedule

The most effective method of assuring continuous satisfactory operation of the transmitting plant is to institute a regular schedule of maintenance, recording all data on previously prepared forms so that a continuous record of performance of all parts of the equipment is at hand. The station operating schedule and local operating conditions may affect the frequency of some maintenance functions; therefore, the following recommended schedule may be varied as experience dictates.

ROUTINE MAINTENANCE SCHEDULE
(Always Use Grounding Sticks)

DAILY

1. Make general inspection after shut-down.
2. Hourly check of power tube filament voltages.
3. Inspect antenna transmission line terminating equipment if there have been heavy static discharges or lightning during the day.
4. If there have been any overloads during the day examine all safety gaps for burning. Clean and reset if necessary.

WEEKLY

1. Inspect interior of the plenum chamber.
2. Inspect all relays.
3. Clean internal parts of transmitter (insulators, etc.)
4. Make general performance checkup (noise, distortion and frequency characteristics).
5. Inspect all blowers.
6. Test air-flow interlocks.
7. Test all door interlocks.
8. Check antenna monitor rectifier tubes.
9. Test operation of notching and overload relays.
10. Clean antenna tuning apparatus.
11. Check all sphere and needle gaps.
12. Test calibration of remote antenna ammeter (s) against direct antenna ammeter.

MONTHLY

1. Clean RCA-8008 tube contacts.
2. Check oil in blowers.
3. Clean all socket contacts.
4. Clean console attenuator contacts.
5. Service high speed relay contacts (PAC and PCV relays).
6. Check air filter.

QUARTERLY

1. Test all spare power tubes in circuit and clean up gassy tubes if any.

2. Operate all spare mercury vapor tubes for 30 minutes (filament only).
3. Make general detailed close inspection of every unit in transmitter with whatever tests of parts seem advisable.
4. Clean air filter, blower impellers and canvas boots.
5. Service contacts on variable inductors (1L4, 1L6, 1L7, 1L16 and 1L17).
6. Service all contactors.

SEMI-ANNUALLY

1. Test transformer oil and filter if necessary.
2. Clean transmission line insulators. Inspect all relay contacts and make replacements where required. Clean pole faces on contactors.
3. Test spare tubes and clean up gas if necessary.
4. Tighten all connections in transmitter.
5. Inspect flexible cables to door connections.
6. Service voltmeter selector switches (4S8 and 4S14).

PARTS LIST

When ordering replacement parts, please give RCA Stock Number. Symbol Number, Description, and Drawing Number will be helpful in further identifying the desired part and should be given when no Stock Number is shown in the following list.

The part which will be supplied against an order for a replacement item may not be an exact duplicate of the original part, however, it will be a satisfactory replacement, differing only in minor mechonicol or electricol characteristics. Such differences will in no way impoir the operation of the equipment.

Symbol Numbers with suffix letters may not be shown on the schematic and are used for relating the ports to the main item of which they ore components.

Symbol No.	Part of MI-	Description	Drawing No.	Stock No.	Recom-mended Spares
1A1	7259-E	Crystal Holder, TMV129B	MI-7467		
		Parts for 1A1:			
		Thermostot for crystal	708493-29	15983	
		Resistor—10 megohms, ½ wott	78727-37	30992	
		Capocitor—6,500 mmf	984006-16	71690	
1A2	7259-E	Crystal Oscillator Unit	621369-501		
1A3	7259-E	Crystal Oscillotor Unit	621369-501		
1A4	7259-E	Motor, tuning drive	428401-3	69852	
1A5	7259-E	Blower, PA tube cooling, CCW, 220 volts, 60 cycles, 1,140 rpm	428410-2		
		Motor only, with ½ inch shaft	428410-6	*44746	1
		Motor only, with 5/8 inch shaft	428410-6	*57237	1
1A5A	7259-F	Blower, PA tube cooling, CCW, 230 volts, 50 cycles, 1,425 rpm	428410-4		
		Motor only	428410-8	52924	
1A6	7259-E	Motor, tuning drive, same as 1A4			
1A7	7259-E	Outlet, convenience	185304-1	21644	
1A8	7259-E	Lamp, indicator, oscillotor selector, red, 220 volts	440312-2		
1A9	7259-E	Lamp, indicator, oscillator selector, green, 220 volts	440312-3		
		Parts for indicotor lomps 1A8 and 1A9:			
		Lamp only	440312-36	16154	6
		Cap, red	440312-31	19897	2
		Cap, green	440312-32	44136	2
		Receptacle, less cop, lamp, resistor	440312-46	44997	2
		Resistor (for receptacle)	440312-41	44570	2
1A10	7259-E	Connector, motor, male	30186-1	47594	
1A11	7259-E	Connector, motor, female	67089-2	4573	
1A12	7259-E	Fan, LP rectifier cooling, 220 volts, 50/60 cycles	727539-2	55065	
		Capacitor only, 3 mfd, 300 volts	727539-25	56156	
1A13	7259-E	Outlet, convenience	185304-1	21644	
1A14	7259-E	Connector, motor, male, same os 1A10			
1A15	7259-E	Connector, motor, female, same as 1A11			
2A1	7258-E	Blower, Modulator tube cooling, CCW, 220 volts, 60 cycles, 1,140 rpm	428410-2		
		Motor only, with ½ inch shoft	428410-6	*44746	
		Motor only, with 5/8 inch shaft	428410-6	*57237	
2A1A	7258-F	Blower, Modulator tube cooling, CCW, 230 volts, 50 cycles, 1,425 rpm	428410-4		
		Motor only	428410-8	52924	
2A2	7258-E	Blower, Modulator tube cooling, CW, 220 volts, 60 cycles, 1,140 rpm	428410-1		
		Motor only, with ½ inch shaft	428410-6	*44746	
		Motor only, with 5/8 inch shaft	428410-6	*57237	
2A2A	7258-F	Blower, Modulator tube cooling, CW, 230 volts, 50 cycles, 1,425 rpm	428410-3		
		Motor only	428410-8	52924	
4A1	7257-A	Lamp, indicotor, plate supply on, 220 volts, red	440312-2		
4A2	7257-A	Lomp, indicator, moin line on, same as 4A1			
4A3	7257-A	Lamp, indicotor, filaments on, 220 volts, green	440312-3		
		Ports for 4A1, 4A2, 4A3:			
		Green lamp cap only	440312-32	44136	
		Red lamp cop only	440312-31	19897	
		Lamp only	440312-36	16154	
		Resistor only	440312-41	44570	
		Receptacle only	440312-46	44997	
5A1	7256-A	Lamp, indicator, crystal heoter, red	440312-8		
5A2	7256-A	Lamp, indicator, crystal heater, green	440312-9		
5A3	7256-A	Lamp, indicator, bias on, red	440312-2		
5A4	7256-A	Lamp, indicator, air flow, green	440312-3		
5A5	7256-A	Lamp, indicator, interlock, red, same as 5A3			
5A6	7256-A	Lamp, indicator, overload, red, same as 5A3			
5A7	7256-A	Lamp, indicator, high voltage full, red, same as 5A3			
5A8	7256-A	Lamp, indicator, high voltoge reduced, green, same as 5A4			

PARTS LIST (Continued)

Symbol No.	Part of MI-	Description	Drawing No.	Stock No.	Recom-mended Spares
		Parts for 5A1 to 5A8:			
		Lamp only	440312-36	16154	
		Red cap only	440312-31	19897	
		Green cap only	440312-32	44136	
		Receptacle only	440312-46	44997	
		Resistor only, for 5A1 and 5A2	440312-40	16155	1
		Resistor only, for 5A3 to 5A8	440312-41	44570	
7A1 to 7A6	7258-E	Indicator, arc-back, Main Rectifier	402835-504	17207	
7A7	7258-E	Blower, main rectifier tube base, 220 volts, 50/60 cycles		**	
1C1	7259-E	Capacitor, crystal tuning, 4.5-20 mmfd	823075-3	16890	
1C2	7259-E	Capacitor, bypass, 0.01 mfd	32203-591	610003	
1C3	7259-E	Capacitor, bypass, same as 1C2			
1C4	7259-E	Capacitor, output coupling, 47 mmfd	32200-515	50358	
1C5	7259-E	Capacitor, filter, 0.002 mfd	32202-558	602002	
1C6	7259-E	Capacitor, feedback, 1 mmfd	99327-12	55331	
1C11, 1C12	7259-E	Capacitor, crystal heater bypass, 47,000 mmfd	728656-165	58645	
1C13, 1C14	7259-E	Capacitor, buffer filament bypass, 10,000 mmfd	890918-2	610004	1
1C15	7259-E	Capacitor, buffer screen grid bypass, same as 1C13			
1C16	7259-E	Capacitor, buffer suppressor bypass, same as 1C13			
1C17 to 1C20	7259-E	Capacitor, IPA filament bypass, 10,000 mmfd	32203-592	610004	1
1C21	7259-E	Capacitor, buffer plate tank, 620 mmfd	32221-629	553087	1
1C22	7259-E	Capacitor, buffer plate tank, 300 mmfd	32221-532	553109	1
1C23	7259-E	Capacitor, buffer plate tank, same as 1C22			
1C24	7259-E	Capacitor, frequency monitor bypass, 10,000 mmfd	32223-576	553004	
1C25	7259-E	Capacitor, buffer plate bypass, 20,000 mmfd	32223-647	552996	1
1C26	7259-E	Capacitor, neutralizing tank, 100 mmfd	32220-598	553127	2
1C27	7259-E	Capacitor, neutralizing tank, same as 1C26			
1C28	7259-E	Capacitor, neutralizing tank, 200 mmfd	32220-683	553115	1
1C29	7259-E	Capacitor, PA grid blocking, 0.01 mfd	DL-502337-501	553339	1
1C30, 1C31	7259-E	Capacitor, IPA plate tank, Case 99X frequency-determining part			1
1C32	7259-E	Capacitor, PA neutralizing, 28 mmfd	DL-502306-501	553360	1
1C33	7259-E	Capacitor, PA filament bypass, 0.05/0.05 mfd	DL-500473-501	553145	1
1C34 to 1C39	7259-E	Capacitor, PA, Case 111X, frequency-determining part			1
1C40	7259-E	Capacitor, PA plate blocking, 0.001 mfd	DL-502313-501	553330	1
1C41	7259-E	Capacitor, PA plate bypass, 0.0002 mfd	DL-502340-501	553378	1
1C42	7259-E	Capacitor, emergency buffer grid paralyzing, 20 mfd	418300-25	43441	
1C43	7259-E	Capacitor, IPA plate blocking, 150 mmfd	32220-647	553121	1
1C44	7259-E	Capacitor, motor tuning, 1.25 mfd	428401-2	47329	
1C45	7259-E	Capacitor, PA grid leak bypass, 0.2 mfd	DL-504559-501	552851	
1C48	7259-E	Capacitor, motor tuning, same as 1C44			
1C53	7259-E	Capacitor, IPA tank balancing, 510 mmfd	32228-626	553351	1
2C1, 2C2	7258-E	Capacitor, input transformer load, 200 mmfd	32200-597	600202	
2C3	7258-E	Capacitor, 1st AF screen grid bypass, 1 mfd, 400 volts	984688-3	56123	
2C4	7258-E	Capacitor, 1st AF phasing, 1,500 mmfd	32202-522	601502	
2C5, 2C6	7258-E	Capacitor, 1st AF blocking, 8 mfd, 600 volts	984629-7	58649	
2C7	7258-E	Capacitor, 1st AF phasing, same as 2C4			
2C8	7258-E	Capacitor, 1st AF blocking, same as 2C5			
2C9	7258-E	Capacitor, hum circuit, 51,000 mmfd	32219-509	69871	
2C10	7258-E	Capacitor, 2nd AF cathode bypass, same as 2C3			
2C11	7258-E	Capacitor, 2nd AF plate filter, 2 mfd, 2,000 volts	418141-31	58647	
2C12, 2C13	7258-E	Capacitor, 2nd AF phasing, 100,000 mmfd	32224-603	552984	
2C14, 2C15	7258-E	Capacitor, modulator grid bypass, 20 mfd, 330 volts ac	418300-25	43441	
2C16	7258-E	Capacitor, audio feedback	DL-501614-501	553263	
2C17 to 2C44	7258-E	Capacitor, audio feedback	35484-15	604001	
2C45	7258-E	Capacitor, audio feedback, same as 2C16			
	7258-E	Feedback Divider, complete; includes 2C16 to 2C30 and 2R54 to 2R68	714382-502	46348	1
	7258-E	Feedback Divider, complete; includes 2C31 to 2C45 and 2R69 to 2R83, same as preceding item			
2C46, 2C47	7258-E	Capacitor, 2nd AF blocking, 4 mfd, 2,000 volts	418141-33	58648	
2C48	7258-E	Capacitor, modulator driver phasing, 51,000 mmfd	32224-545	552990	
2C49, 2C50	7258-E	Capacitor, modulator driver phasing, same as 2C3			
2C51	7258-E	Capacitor, modulator driver phasing, same as 2C48			
2C52	7258-E	Capacitor, AF input compensating, 0.1 mfd, 400 volts	72086-168	70617	
3C1 to 3C4	7253-C	Capacitor, low power rectifier filter, 10 mfd, 2,000 volts	418141-37	19123	
3C5 to 3C8	7253-C	Capacitor, bias filter, 10 mfd, 600 volts	418141-8	18501	
6C1	7087-A	Capacitor, phasing, 0.0008 mfd	DL-502355-501	553346	
7C1, 7C2	7258-E	Capacitor, main rectifier filter, 5 mfd, 10 kv	870756-4	19865	
1E1	7259-E	Relay, oscillator selector, DPDT, 220 volts, 50/60 cycles	430809-1	69868	
1E2	7259-E	Relay, Carrier "Off," DPDT, 220 volts, 50/60 cycles	867861-2	69869	

PARTS LIST (Continued)

Symbol No.	Part of MI-	Description	Drawing No.	Stock No.	Recom-mended Spares
1E3	7259-E	Relay, power-change compensating, modulation monitor and distortion meter	427316-1	44956	
2E1	7258-E	Relay, bias interlock, DPST	430817-501	44938	
		Coil only	440489-12	44940	1
		Contacts only		44545	1
2E2	7258-E	Relay, bias change, DPDT	440489-5	44941	
		Coil only	440489-11	44556	1
		Contacts only		44942	1
4E3	7257-A	Contactor, full plate voltage, Westinghouse Type DN330, 3 poles, 100 amperes, 220 volts, 60 cycles, style 1228536; with 1-NC Pilot Contact Type L41 style No. 972914, with 1-NO Pilot Contact Type L41 style No. 972913, coil 220 volts, 60 cycles style 1039635	896935-1		
		Coil only for contactor	719410-11	57263	1
		Stationary contact only	719410-21	58654	3
		Moving contact with shunt only	719410-22	58653	3
		Pilot contact only, stationary make	719419-22	58655	1
		Pilot contact only, movable	719419-21	58657	1
		Pilot contact only, stationary break	719419-23	58656	1
4E3A	7257-B	Contactor, full plate voltage, Westinghouse Type DN330, 3 poles, 100 amperes, 220 volts, 50 cycles, style No. 897456; with 1-NC Pilot Contact Type L41 style No. 972914, with 1-NO Pilot Contact Type L41 style No. 972913, coil 220 volts, 50 cycles style No. 966739	896935-2		
		Coil only for contactor	719410-12	52926	
		Stationary contact only	719410-21	58654	
		Moving contact with shunt only	719410-22	58653	
		Pilot contact only, stationary make	719419-22	58655	
		Pilot contact only, movable	719419-21	58657	
		Pilot contact only, stationary break	719419-23	58656	
4E4	7257-A	Contactor, reduced plate voltage, same as 4E3			
4E4A	7257-B	Contactor, reduced plate voltage, same as 4E3A			
4E5	7257-A	Relay, auxiliary power change, 1 NO-1 NC contacts, 220 volts, 50/60 cycles	440489-6	44941	
		Coil only	440489-11	44556	1
		Contacts only		44545	1
4E6	7257-A	Relay, rectifier plate delay, Westinghouse Type TK, 230 volts, 60 cycles, style No. 1059963	719423-1	58329	
		Parts for 4E6:			
		Contacts, movable, left-hand		55783	
		Contacts, movable, right-hand		55784	
		Contacts, stationary, make		55779	
		Contacts, stationary, break		55780	
		Contact, stationary, motor-front break		55781	
		Contact, stationary, motor-rear break		55782	
		Coil, 230 volts, 60 cycles		55785	
4E6A	7257-B	Relay, rectifier plate delay, Westinghouse Type TK, 230 volts, 50 cycles, style No. 1059960	719423-2		
		Parts for 4E6A:			
		Contact, movable, left-hand		55783	
		Contact, movable, right-hand		55784	
		Contact, stationary, make		55779	
		Contact, stationary, break		55780	
		Contact, stationary, motor-front break		55781	
		Contact, stationary, motor-rear break		55782	
4E7*	7257-A	Relay, auxiliary timer, G. E. Type CR2820-1731A, 220 volts, 60 cycles, coil 22D2G3	440497-2		
		Coil only	440497-6	44550	1
		Contacts		49010	1
4E7*	7257-A	Relay, auxiliary timer, Square D Type ROID, class 9050, 208/220 volts, 60 cycles	449348-1		
		Coil only	449348-5	58737	1
		Switch only	449348-7	58738	1
4E7A*	7257-B	Relay, auxiliary timer, G. E. Type CR2820-1731A, 220 volts, 50 cycles, coil 22D2G8	440497-1	47263	
		Coil only	440497-5	52927	
		Contacts		49010	
4E7A*	7257-B	Relay, auxiliary timer, Square D Type ROID, class 9050, 208/220 volts, 50 cycles	449348-2		
		Coil only	449348-6		
		Switch only	449348-7		

PARTS LIST (Continued)

Symbol No.	Part of MI-	Description	Drawing No.	Stock No.	Recom-mended Spares
4E8	7257-A	Relay, rectifier surge relay timer, same as 4E6			
4E8A	7257-B	Relay, rectifier surge relay, same as 4E6A			
4E9	7257-A	Relay, carrier off, 2 NO contacts, 220 volts, 50/60 cycles	430817-502		
		Contact only		44545	
4E10	7257-A	Relay, overload reset, 230 volts, 50/60 cycles	445100-2	58658	
4E11*	7257-A	Relay, notching auxiliary, CR-2820-1731B3, 220 volts, 60 cycles, coil 22D2G3	440497-3		
		Coil only	440497-6		
4E11*	7257-A	Relay, notching auxiliary, Square D Type ROID, class 9050, 208/220 volts, 60 cycles, same as 4E7			
4E11A*	7257-B	Relay, notching auxiliary, CR-2820-1731B3, 220 volts, 50 cycles, coil 22D2G8	440497-4		
		Coil only	440497-5	52927	
4E11A*	7257-B	Relay, notching auxiliary, Square D Type ROID, class 9050, 208/220 volts, 50 cycles, same as 4E7			
4E12	7257-A	Relay, main line overload, G. E. 12PAC13A2	440326-12		
		Coil only	440326-41	45095	1
		1 Contact only, stationary	440326-50	17535	8
		1 Contact only, movable	440326-51	17537	1
4E13	7257-A	Relay, main line overload, same as 4E12			
4E14	7257-A	Relay, RF, PA plate overload, G. E. 12PAC13A1	440326-11		
		Coil only	440326-40	45092	1
		1 Contact only, stationary	440326-50	17535	
		1 Contact only, movable	440326-51	17537	
4E15	7257-A	Relay, LP rectifier and bias line overload, G. E. 12PAC14A10	440326-32		
		Coil only	440326-45	45094	
		1 Contact only, stationary	440326-50	17535	
		1 Contact only, movable	440326-51	17537	
4E16	7257-A	Relay, modulator plate overload, same as 4E14			
4E17	7257-A	Contactor, filament bus control, Westinghouse Type DN220, 2 poles, 50 amperes, 220 volts, 60 cycles, style 972863, coil 220 volts, 60 cycles	896936-1		
		Coil only	719415-13	55776	1
		Stationary contact	719415-25	55774	2
		Movable contact	719415-26	55775	2
4E17A	7257-B	Contactor, filament bus control, Westinghouse Type DN220, 2 poles, 50 amperes, 220 volts, 50 cycles, style 972863, coil 220 volts, 50 cycles	896936-2		
		Coil only	719415-14	52929	
		Stationary contact	719415-25	55774	
		Movable contact	719415-26	55775	
4E18	7257-A	Contactor, air cooled filaments, Westinghouse Type DN230, 3 poles, 50 amperes, 220 volts, 60 cycles, style 972866; with 1-NO Pilot Contact Type L41, style 974335, coil 220 volts, 60 cycles, style 974135	896936-3		
		Coil only	719415-13	55776	
		Stationary contact	719415-25	55774	
		Movable contact	719415-26	55775	
		Pilot contact only, stationary make	719419-22	58655	
		Pilot contact only, movable	719419-21	58657	
		Pilot contact only, stationary break	719419-23	58656	
4E18A	7257-B	Contactor, air cooled filaments, Westinghouse Type DN230, 3 poles, 50 amperes, 220 volts, 50 cycles, style 972866; with 1-NO Pilot Contact Type L41, style 974335, coil 220 volts, 50 cycles, style 974141	896936-4		
		Coil only	719415-14	52929	
		Stationary contact	719415-25	55774	
		Movable contact	719415-26	55775	
		Pilot contact only, stationary make	719419-22	58655	
		Pilot contact only, movable	719419-21	58657	
		Pilot contact only, stationary break	719419-23	58656	
4E19	7257-A	Contactor, low-power rectifier plate primary, Westinghouse Type DN220, 2 poles, 50 amperes, 220 volts, 60 cycles, style 972863; with 2-NO Pilot Contacts, Type L41, style 974335, coil 220 volts, 60 cycles, style 974135	896936-5		
		Coil only	719415-13	55776	
		Stationary contact	719415-25	55774	
		Movable contact	719415-26	55775	
		Pilot contact only, stationary make	719419-22	58655	
		Pilot contact only, movable	719419-21	58657	
		Pilot contact only, stationary break	719419-23	58656	

PARTS LIST (Continued)

Symbol No.	Part of MI-	Description	Drawing No.	Stock No.	Recom-mended Spares
4E19A	7257-B	Contactor, low-power rectifier plate primary, Westinghouse Type DN220, 2 poles, 50 amperes, 220 volts, 50 cycles, style 972863; with 2-NO Pilot Contacts, Type L41, style 974335, coil 220 volts, 50 cycles, style 974141	896936-6		
		Coil only	719415-14	52929	
		Stationary contact	719415-25	55774	
		Movable contact	719415-26	55775	
		Pilot contact only, stationary make	719419-22	58655	
		Pilot contact only, movable	719419-21	58657	
		Pilot contact only, stationary break	719419-23	58656	
4E20*	7257-A	Relay, carrier off auxiliary, G. E. Type CR-2820-1731A, same as 4E7			
4E20*	7257-A	Relay, carrier off auxiliary, Square D Type ROID, class 9050, same as 4E7			
4E20A*	7257-B	Relay, carrier off auxiliary, G. E. Type CR-2820-1731A, same as 4E7A			
4E20*	7257-B	Relay, carrier off auxiliary, Square D Type ROID, class 9050, same as 4E7A			
7E1	7258-E	Relay, main rectifier surge suppressor, 220 volts, 60 cycles	427397-3	52575	
		Coil only	427397-16	47788	1
		Stationary contact only	427397-29	44717	4
		Movable contact only	427397-30		4
7E1A	7258-F	Relay, main rectifier surge suppressor, 220 volts, 50 cycles	427397-1		
		Coil only	427397-14	52925	
		Stationary contact only	427397-29	44717	
		Movable contact only	427397-30		
7E2	7258-E	Switch, capacitor grounding, 220 volts, 60 cycles	618475-502	45145	
		Interlock only	722712-501	19868	1
		Solenoid only	882342-1	45147	1
		Contact only	802756-1		
7E2A	7258-F	Switch, capacitor grounding, 220 volts, 50 cycles	618475-503	45164	
		Interlock only	722712-501	19868	
		Solenoid only	882342-2	19867	
		Contact only	802756-1		
1F1, 1F2	7259-E	Fuse, crystal heater, 1 ampere, 250 volts	890152-1	22301	
4F1, 4F2	7257-A	Fuse, supply voltmeter, 250 volts, 6 amperes, Bryant No. 7054	99108-2	52691	
4F3, 4F4	7257-A	Fuse, filament voltmeter, same as 4F1			
4F5, 4F6	7257-A	Fuse, monitor rectifier supply, same as 4F1			
4F7	7257-A	Fuse Links, for 4F1 to 4F6	99108-32	58883	
1J1	7259-E	Plug, power, 8-prong	842766-1	47317	
1J2, 1J3	7259-E	Socket, for oscillator	860899-1	19656	
1L1	7259-E	Inductor, Plate Tank (including 1L1A through 1L1H)	429932-501	50360	
1L4	7259-E	Coil, buffer plate tank, variable	727510-501	51769	
1L5	7259-E	Coil, IPA grid choke	412784-503	16892	
1L6	7259-E	Coil, IPA neutralizing tank, same as 1L4			
1L7	7259-E	Coil, IPA plate tank, variable	621387-501		
		Parts for 1L7:			
		Porcelain end plate		50488	
		Contact wheel		50525	
		Contact wheel spring		50495	
		Guide roller for contact wheel		50496	
1L8	7259-E	Coil, IPA plate tank	713400-502	17038	
1L9	7259-E	Coil, PA grid choke	727273-501	50667	
1L10	7259-E	Coil, PA grid suppressor choke	863480-501	44934	
1L11	7259-E	Coil, PA plate parasitic suppressor	415740-501	17230	
1L12	7259-E	Coil, PA plate choke	738512-501	56193	
1L13	7259-E	Coil, PA plate tank	611280-502	17231	
1L14	7259-E	Coil, modulation monitor pick-up	415745-503	19337	
1L15	7259-E	Coil, distortion meter pick-up, same as 1L14			
1L16	7259-E	Coil, PA plate tank variable	613847-501	50664	1
		Parts for coil 1L16:			
		Rubber coupling		45369	
		Contact assembly		57400	
1L17	7259-E	Coil, PA loading, same as 1L16			
1L23	7259-E	Coil, IPA plate choke, same as 1L5			
2L1	7258-E	Coil, AF input compensating	61243-501	19657	
2L2	7258-E	Reactor, 2nd AF	901064-501	43868	1
2L3	7258-E	Reactor, hum circuit	901117-501	44754	
3L1, 3L2	7253-C	Reactor, low-power rectifier filter	900501-501	43785	
3L3	7253-C	Reactor, bias rectifier filter	901007-501	43869	
6L1 to 6L3	7087-A	Reactor, line series, part of 6T2			
6L4	7087-A	Reactor, phasing	900374-501	17264	
7L1	7258-E	Reactor, main rectifier filter	900431-502	44404	

PARTS LIST (Continued)

Symbol No.	Part of MI-	Description	Drawing No.	Stock No.	Recommended Spares
1M1	7259-E	Thermocouple, part of 5M8	440398-16	55459	
2M1, 2M2	7258-E	Meter, modulator driver plate current, 0-200 ma	426714-124	69511	
4M1	7257-A	Meter, tube hours, G. E. Type 94X931, RCA case, 220 volts, 60 cycles	438074-1	MI-19434-1	
4M1A	7257-B	Meter, tube hours, G. E. Type 94X931, RCA case, 220 volts, 50 cycles	438074-2	52930	
5M1	7256-A	Meter, oscillator plate current, 0-50 ma, dc	440398-5	45908	
5M2	7256-A	Meter, buffer plate current, 0-250 ma, dc	440398-6	45909	
5M3	7256-A	Meter, IPA grid current, same as 5M2			
5M4, 5M5	7256-A	Meter, IPA plate current, 0-500 ma, dc	440398-7	17233	
5M6	7256-A	Meter, PA grid current, same as 5M4			
5M7	7256-A	Meter, PA plate current, 0-1.5 amperes, dc	440398-1	17234	
5M8	7256-A	Meter, output tank current, 0-15 amperes, rf	440398-10	45910	
5M9	7256-A	Meter, 1st AF plate current, 0-15 ma, dc	440398-4	45912	
5M10	7256-A	Meter, 2nd AF plate current, same as 5M4			
5M11	7256-A	Meter, low-power plate voltage, 0-2 kv, dc	440398-9	45911	
5M12, 5M13	7256-A	Meter, modulator plate current, 0-2 amperes, dc	440398-8	45913	
5M14	7256-A	Meter, filament voltage, 0-20 volts, ac	440398-11	58650	
5M15	7256-A	Meter, main plate voltage, 0-12 kv, dc	440398-2	17211	
5M16	7256-A	Meter, AC line voltage, 0-300 volts, ac	440398-12	58651	
5M17	7256-A	Meter, PA plate current, 0-3 amperes, dc	440398-3	19910	
7M1	7258-E	Multiplier, main rectifier voltmeter (used with 5M15)	843435-1	17211	
1R1	7259-E	Resistor, grid leak, 150,000 ohms, 1 watt	722337-211	50361	
1R2	7259-E	Resistor, cathode, 680 ohms, 2 watts	722357-155	50362	
1R3	7259-E	Resistor, parasitic suppressor, 12 ohms, 1 watt	727836-39	28973	
1R9	7259-E	Resistor, buffer grid, 22,000 ohms, 2 watts	722357-78	72629	
1R10	7259-E	Resistor, buffer screen grid, 2,500 ohms, 25 watts	99027-35	43425	1
1R11	7259-E	Resistor, frequency monitor potentiometer, 1,000 ohms	415457-14	19203	
1R12	7259-E	Resistor, IPA grid leak, 2,500 ohms, 45 watts	99029-35	19205	1
1R13	7259-E	Resistor, buffer cathode bias, 200 ohms, 25 watts	99027-24	43783	1
1R14, 1R15	7259-E	Resistor, IPA grid suppressor, 68 ohms, 2 watt	722357-48	52213	
1R16	7259-E	Resistor, IPA plate dropping, 200 ohms, 200 watts	99037-24	45914	1
1R18	7259-E	Resistor, PA grid suppressor, 100 ohms	890145-1	17217	2
1R19, 1R20	7259-E	Resistor, IPA cathode bias, 50 ohms, 25 watts	99027-18	19659	1
1R21	7259-E	Resistor, PA filament, 50 ohms, center-tapped, 45 watts	863101-1	43780	1
1R22	7259-E	Resistor, buffer emergency grid paralyzing, 10,000 ohms, 2 watts	722357-74	44294	
1R23	7259-E	Resistor, modulation monitor pick-up potentiometer, 800 ohms, 55 watts	863102-1	44935	
1R24	7259-E	Resistor, distortion meter pick-up potentiometer, same as 1R23			
1R25	7259-E	Resistor, PA grid leak, 800 ohms, tapped, 150 watts	890014-7	43779	2
1R26 to 1R29	7259-E	Resistor, PA grid leak, 800 ohms, 150 watts	99035-30	53801	
1R38	7259-E	Resistor, IPA grid parasitic suppressor, 220 ohms, 2 watts	99126-54	53005	
2R1, 2R2	7258-E	Resistor, input transformer load, 24,000 ohms, 1 watt	722337-192	48661	
2R3	7258-E	Resistor, 1st AF cathode, 4,700 ohms, 2 watts	722357-175	39156	
2R4, 2R5	7258-E	Resistor, 1st AF grid, 100 ohms, 2 watts	722352-50	48927	
2R6	7258-E	Resistor, 1st AF screen grid voltage divider, 6,800 ohms, 2 watts	722357-179	45892	
2R7	7258-E	Resistor, 1st AF screen grid voltage divider, 39,000 ohms, 2 watts	722357-197	69743	
2R8	7258-E	Resistor, relay shunt (2E1), 40 ohms, 25 watts	99027-17	45917	
2R11	7258-E	Resistor, 1st AF plate, 10,000 ohms, 2 watts	722357-183	69744	
2R12	7258-E	Resistor, 1st AF phasing, 4,700 ohms, 2 watts	722357-175	39156	
2R13	7258-E	Resistor, 1st AF plate, same as 2R11			
2R14	7258-E	Resistor, 1st AF phasing, same as 2R12			
2R15, 2R16	7258-E	Resistor, 2nd AF grid, 200,000 ohms, 2 watts	722357-214	50703	
2R17, 2R18	7258-E	Resistor, 2nd AF grid suppressor, 470 ohms, 1 watt	722333-58	37278	
2R19	7258-E	Resistor, 2nd AF cathode, 480 ohms, 45 watts	99029-53	46107	1
2R20	7258-E	Resistor, voltage divider, 380 ohms, tapped, 200 watts	863100-2	44748	1
2R21, 2R22	7258-E	Resistor, voltage divider, 565 ohms, tapped, 200 watts	863100-3	44749	1
2R23	7258-E	Resistor, voltage divider, 565 ohms $\pm 10\%$, 200 watts	99037-56	45918	
2R24 to 2R26	7258-E	Resistor, voltage divider, 400 ohms $\pm 10\%$, 200 watts	99037-27	54655	1
2R27, 2R28	7258-E	Resistor, 2nd AF plate, 12,500 ohms $\pm 10\%$, 95 watts	99033-42	44751	1
2R29, 2R30	7258-E	Resistor, 2nd AF phasing, 16,000 ohms $\pm 10\%$, 95 watts	99033-43	43854	1
2R31, 2R32	7258-E	Resistor, 2nd AF plate, same as 2R27			
2R33	7258-E	Resistor, multiplier, part of 5M11	99114-6	50886	
2R34	7258-E	Resistor, modulator driver phasing, 1 megohm, 2 watts	722357-231	36745	
2R35, 2R36	7258-E	Resistor, modulator driver grid, 47,000 ohms, 2 watts	722357-199	44211	
2R37	7258-E	Resistor, modulator driver phasing, same as 2R34			
2R38, 2R39	7258-E	Resistor, modulator driver grid suppressor, same as 2R17			
2R40	7258-E	Resistor, variable, bias divider, 500 ohms	418840-1	43856	
2R41	7258-E	Resistor, variable, bias divider, 658 ohms, in tandem with 2R40	418840-1	43857	
2R42	7258-E	Resistor, bias divider, 630 ohms $\pm 10\%$, 95 watts	99033-29	44945	1
2R43	7258-E	Resistor, bias divider, 360 ohms $\pm 10\%$, 45 watts	863101-2	44946	1
2R44	7258-E	Resistor, bias divider, same as 2R42			
2R45	7258-E	Resistor, bias divider, same as 2R43			

PARTS LIST (Continued)

Symbol No.	Part of MI-	Description	Drawing No.	Stock No.	Recom-mended Spares
2R46	7258-E	Resistor, variable, bias divider, 1,000 ohms, 50 watts	418841-1	43861	
2R47	7258-E	Resistor, variable, bias divider, 400 ohms, 100 watts, in tandem with 2R46	418841-1	43862	
2R48, 2R49	7258-E	Resistor, bias divider, 200 ohms ±10%, 95 watts	99033-24	43860	1
2R50, 2R51	7258-E	Resistor, modulator grid suppressor, 100 ohms	890145-1	17217	
2R52, 2R53	7258-E	Resistor, modulator plate, 25 ohms, 45 watts	99029-15	69849	2
2R54	7258-E	Resistor, audio feedback, 82,000 ohms ±5%, 2 watts	891769-2	46349	
2R55 to 2R82	7258-E	Resistor, audio feedback, 2.2 megohms ±5%, 2 watts	891769-1	18006	
2R83	7258-E	Resistor, audio feedback, same as 2R54			
2R84, 2R85	7258-E	Resistor, modulator driver grid, same as 2R35			
2R86, 2R87	7258-E	Resistor, modulator driver grid suppressor, same as 2R17			
2R88, 2R89	7258-E	Resistor, modulator filament C.T., 50 ohms, center-tapped, 45 watt	863101-1	43780	
2R90	7258-E	Resistor, AF input compensating, 270 ohms, 1 watt	722337-55	43006	
2R91	7258-E	Resistor, AF input compensating, 560 ohms, 1 watt	722337-59	38884	
2R92	7258-E	Resistor, AF input compensating, 1,000 ohms, 1 watt	722337-62	71916	
2R93 to 2R96	7258-E	Resistor, modulator driver plate suppressor, 10 ohms, 2 watts	867972-338	58652	
3R1, 3R2	7253-C	Resistor, low-power rectifier divider, 630 ohms, 150 watts	99035-29	43782	1
3R3,3R4	7253-C	Resistor, low-power rectifier divider, 1,600 ohms, 150 watts	99035-33	43784	1
3R5	7253-C	Resistor, low-power rectifier divider, 1,600 ohms, 150 watts, (tapped at 300, 400, 500, 700 ohms)	890014-12	53829	1
4R1	7257-A	Rheostat, HP rectifier filament, Ohmite Model R, 500 watts, 25 ohms	714680-7	56564	
4R2	7257-A	Rheostat, RF, PA filaments, Ohmite Model R, 500 watts, consisting of 3—8 inch, 6-ohm plates mounted in tandem (less knob)	714680-9	56563	
4R3, 4R4	7257-A	Rheostat, modulator filaments, Ohmite Model N, 300 watts, consisting of 3—6 inch, 12-ohm plates close mounted in tandem (less knob)	429694-12	56174	
4R5	7257-A	Resistor, 4E14 coil shunt, Ward Leonard, 14 ohms, 45 watts	890163-3	45756	
4R6	7257-A	Resistor, 4E16 coil shunt, Ward Leonard, 3.84 ohms, 45 watts	890163-2	45757	
4R7	7257-A	Resistor, 4E9 coil shunt, Ward Leonard, 500 ohms, 5 watts	890162-1	46589	1
4R8	7257-A	Resistor, meter shunt, 3 ohms, 55 watts	441154-1	45758	
4R9	7257-A	Resistor, 4E15 coil shunt, Ward Leonard, 0.5 ohms, 45 watts	890163-1	46590	
5R1	7256-A	Multiplier, part of 5M16			
6R1	7087-A	Resistor, arc limiting, 200 ohms	890144-7	47183	
7R1	7258-E	Resistor, main rectifier surge suppressor, 10,000 ohms	99037-41	43662	1
7R2	7258-E	Resistor, main rectifier surge suppressor, 20 ohms	99037-14	44936	1
1S1	7259-E	Switch, PA air flow interlock	834127-1	17219	
2S1, 2S2	7258-E	Switch, modulator air flow interlock	834127-1	17219	
4S1	7257-A	Switch, main line breaker, Westinghouse De-Ion type A8, 3 poles with thermal overload, 25 kw at 80% P.F. Trip set for 1,500 amperes. Similar to style 999139	442302-2	54334	
4S2	7257-A	Switch, plate primary breaker, same as 4S1			
4S3	7257-A	Switch, power change, DPST tumbler switch	8890126-1	55472	
4S4	7257-A	Switch, transmitter on, same as 4S3			
4S5	7257-A	Switch, filament bus breaker, Westinghouse De-Ion Type A8, 2 poles, 50 amperes, for 250 volts, with 25 ampere trip, De-Ion style 1,222,004	442309-3	58880	
4S6	7257-A	Switch, air cooled filament breaker, Westinghouse De-Ion type A8, 3 poles, 50 amperes, 250 volts, with 35 ampere trip, style 1,222,015	442304-2	54334	
4S7	7257-A	Switch, LP rectifier plate primary breaker, similar to 4S5 except for studs and tubes	442309-2	58880	
4S8*	7257-A	Switch, supply voltmeter, Westinghouse Type W, style 519115	721918-1		
4S8*	7257-A	Switch, supply voltmeter, G. E. Type SB-1	440487-7		
4S9	7257-A	Switch, modulator blower breaker, Westinghouse Type DN-W, class 10-100, size 0, 2 pole, Motor Watchman style 967337 with heater A.K. 1.9 style 966474	896937-1		
		Parts for 4S9:			
		Switch only		58881	
		Heater only		58882	
4S10	7257-A	Switch, modulator blower breaker, same as 4S9			
4S11	7257-A	Switch, PA blower breaker, same as 4S9			
4S12	7257-A	Switch, bias rectifier breaker, Westinghouse Type DN-W, class 10-100, size 0, 2 pole, Motor Watchman style 967337 with heater AT-4.8 style 966482	896937-3		
		Parts for 4S12:			
		Switch only		58881	
		Heater only		58894	
4S13	7257-A	Switch, automatic operation, same as 4S3			
4S14*	7257-A	Switch, filament voltmeter, same as 4S8	721918-1		
4S14*	7257-A	Switch, filament voltmeter, same as 4S8	440487-7		
5S1	7256-A	Door Interlock	439530-2	51047	2
5S2	7256-A	Push Button, oscillator changeover	440316-4	44958	

PARTS LIST (Continued)

Symbol No.	Part of MI-	Description	Drawing No.	Stock No.	Recom-mended Spares
5S3	7256-A	Push Button, oscillator off	440316-5	44957	
5S4	7256-A	Push Button, driver tuning, same as 5S2			
5S5	7256-A	Push Button, driver tuning	440316-2	44957	
5S6	7256-A	Push Button, PA tuning, same as 5S2			
5S7	7256-A	Push Button, PA tuning, same as 5S5			
5S8	7256-A	Door Interlock, same as 5S1			
5S9	7256-A	Door Interlock	439530-3	51047	
5S10	7256-A	Push Button, rectifier on, same as 5S2			
5S11	7256-A	Push Button, rectifier off, same as 5S3			
5S12	7256-A	Push Button, overload reset, same as 5S2			
1T1	7259-E	Transformer, oscillator and buffer filaments	900993-501	43802	
1T2	7259-E	Transformer, IPA filaments	900992-501	47791	
1T3, 1T4	7259-E	Transformer, PA filament	428404-1	44753	
2T1	7258-E	Transformer, AF input	900764-501	19198	1
2T2	7258-E	Transformer, 1st and 2nd AF filaments	900993-501	43802	
2T3	7258-E	Transformer, modulator driver filaments	900992-501	47791	
2T4 to 2T7	7258-E	Transformer, modulator filament	428404-1	44753	
2T8	7258-E	Transformer, modulator driver cathode follower	901065-501	46398	1
3T1	7253-C	Transformer, low-power rectifier plate	900435-501	17553	
3T2	7253-C	Transformer, low-power rectifier filament	900991-501	43801	
3T3	7253-C	Transformer, bias rectifier plate	901005-501	43867	
3T4	7253-C	Transformer, bias rectifier filament, same as 3T2			
4T1	7257-A	Transformer, current, for 4E12, Westinghouse Type KO-200/5, style 651913	438071-1	54337	
4T2	7257-A	Transformer, current, for 4E13, same as 4T1			
6T1	7087-A	Transformer, modulation	901029-501	46394	
6T2	7087-A	Transformer, plate power	443478-2	57631	
7T1 to 7T6	7258-E	Transformer, main rectifier filament	900078-502	17224	
4V1 to 4V3	7257-A	Fuse Block, double, Westinghouse style 822310	896221-1		
1X1	7259-E	Socket, oscillator tube	843314-2	9920	
1X2	7259-E	Socket, crystal unit	409582-501	16889	
1X3	7259-E	Block, fuse, crystal heater	881388-1	47166	
1X4	7259-E	Socket, buffer	843314-2	9920	
1X5, 1X6	7259-E	Socket, IPA	842105-1	45684	
1X7, 1X8	7259-E	Socket, PA tube	433765-1	17239	
2X1, 2X2	7258-E	Socket, tube, 1st AF	843314-6	9924	
2X3, 2X4	7258-E	Socket, tube, 2nd AF	843314-2	9920	
2X5, 2X6	7258-E	Socket, tube, modulator driver, same as 2X1, 2X2			
2X7, 2X8	7258-E	Socket, tube, modulator	433765-1	17239	
2X9, 2X10	7258-E	Socket, tube, modulator driver, same as 2X1, 2X2			
3X1, 3X2	7253-C	Socket, tube, low-power rectifier	429151-1	9917	
3X3, 3X4	7253-C	Socket, tube, bias rectifier, same as 3X1, 3X2			
7X1 to 7X6	7258-E	Socket, tube, main rectifier	429151-1	9917	
		Miscellaneous Parts:			
		Insulator supporting filament terminal board assembly for 892R's	426768-17	55151	
		Insulator for supporting modulator control wires	426769-11	50607	
		Insulator for supporting arc-back indicator	426773-11	92427	
		Insulator for supporting tube sockets (H.V. rect.)	426762-8	51782	
		Insulator, bus support (bias and aux. rect.)	426762-5	51781	
		Insulator, support for IPA grid and plate chokes	426766-5	52681	
		Insulator, modulation transformer terminals	849834-2	55828	

*Note: Order the unit the description of which corresponds to that of the unit originally supplied with the transmitter.

**Different blowers were supplied. Order replacement blower or motor by description and nameplate data.

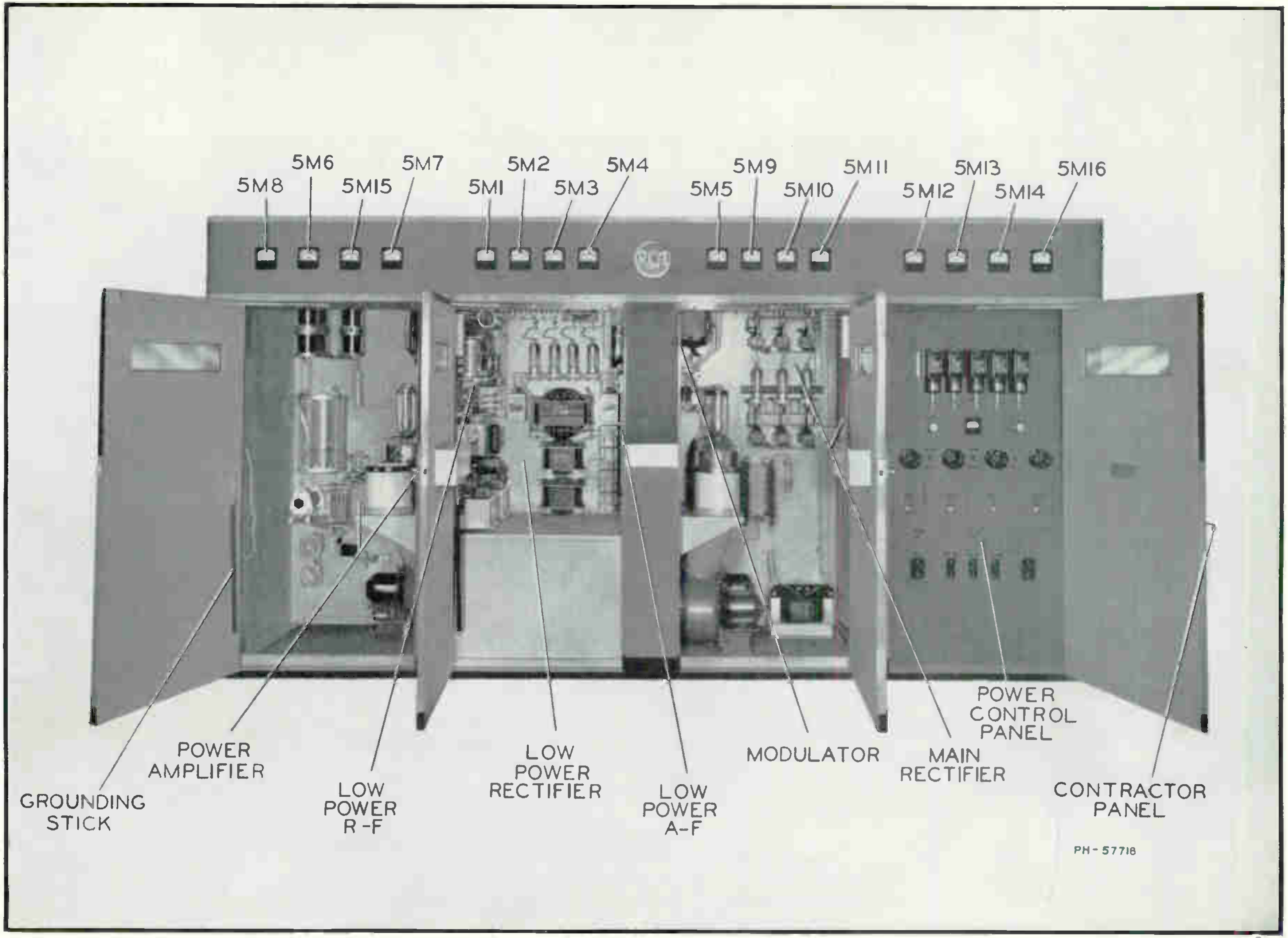


Figure 7—Type BTA-5F Broadcast Transmitter (Front View, Doors Open)

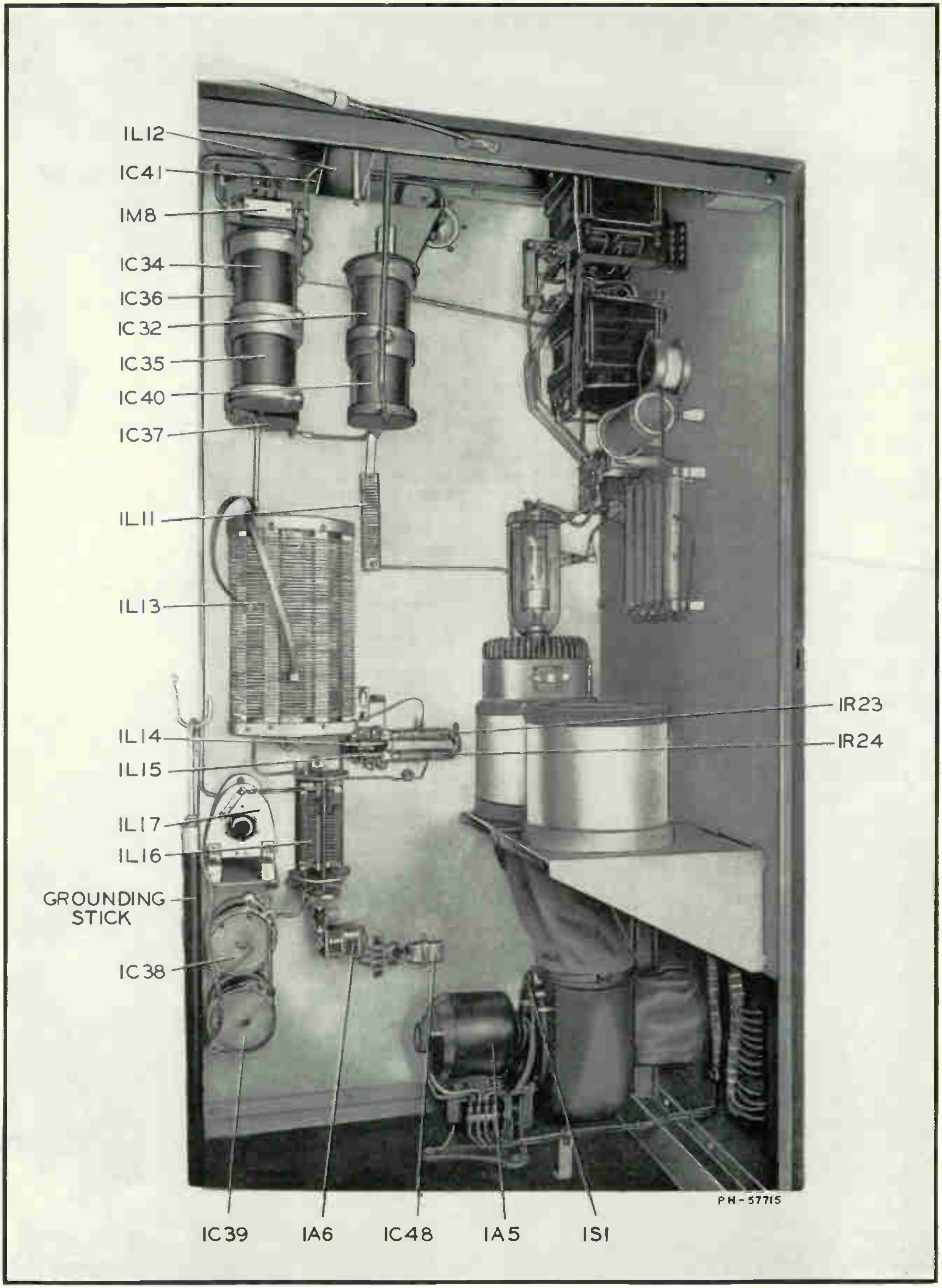


Figure 8—R-F Output Tank Chassis

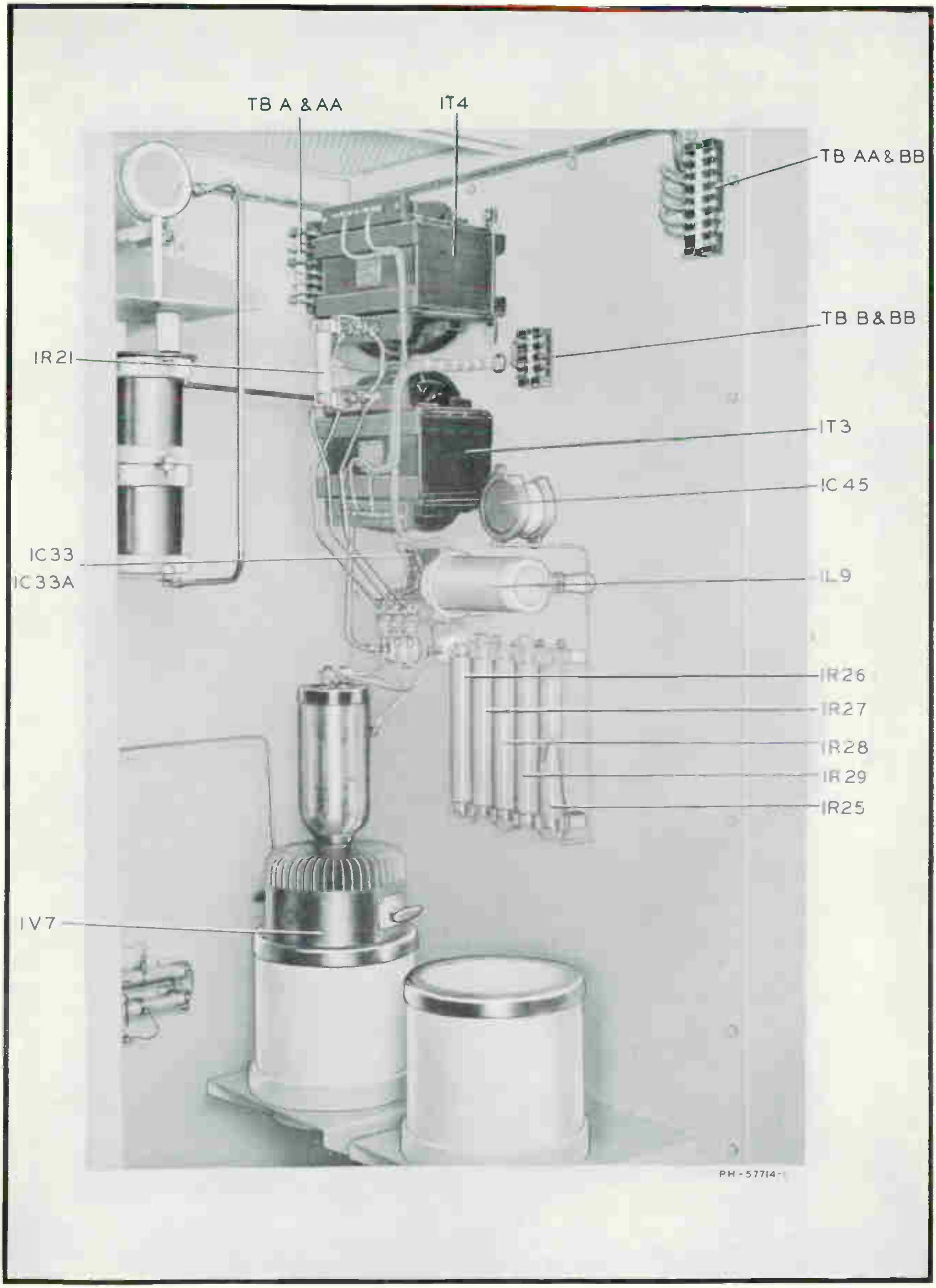


Figure 9—R-F Output Chassis

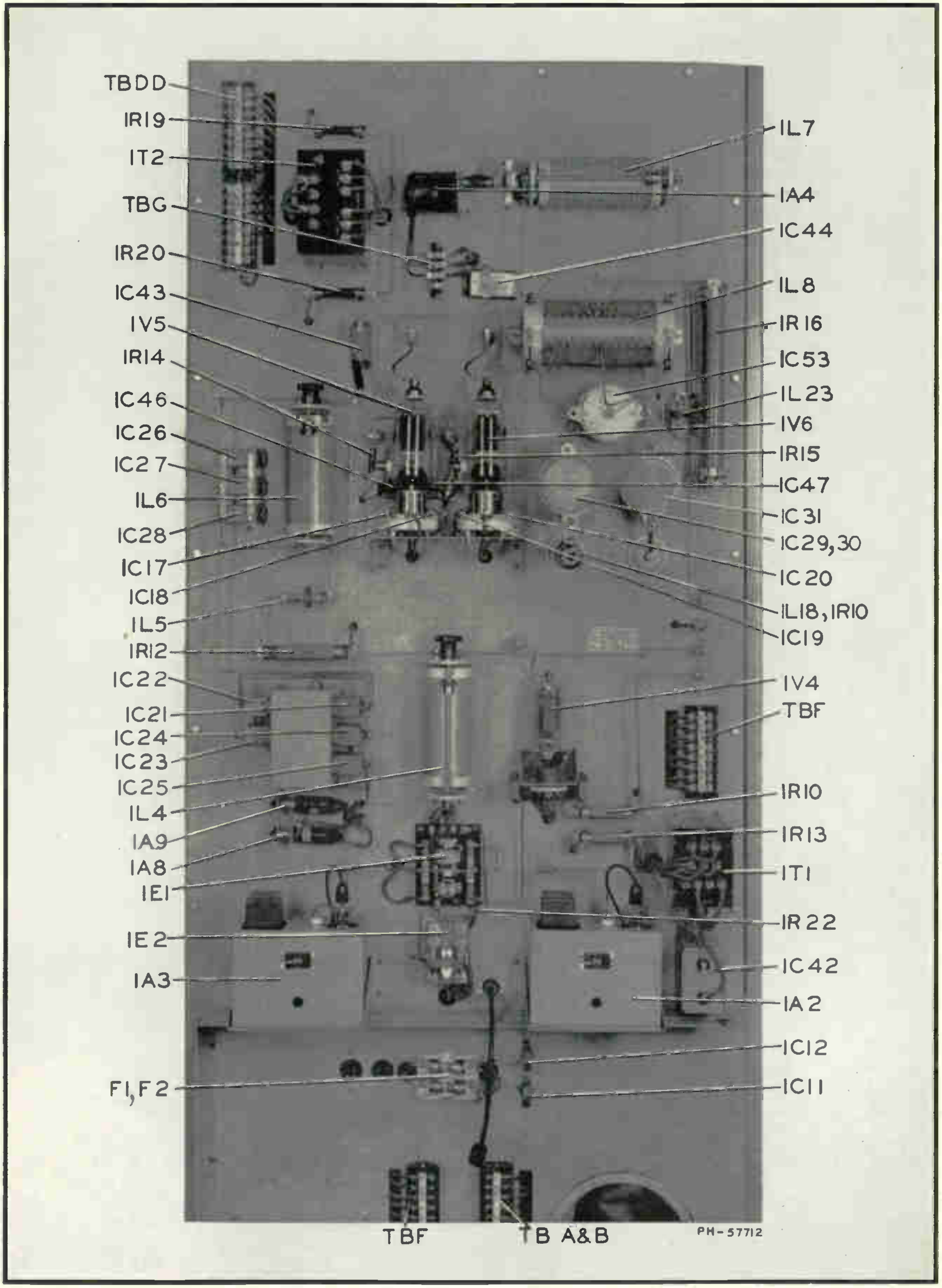


Figure 10—Low-Power R-F Chassis

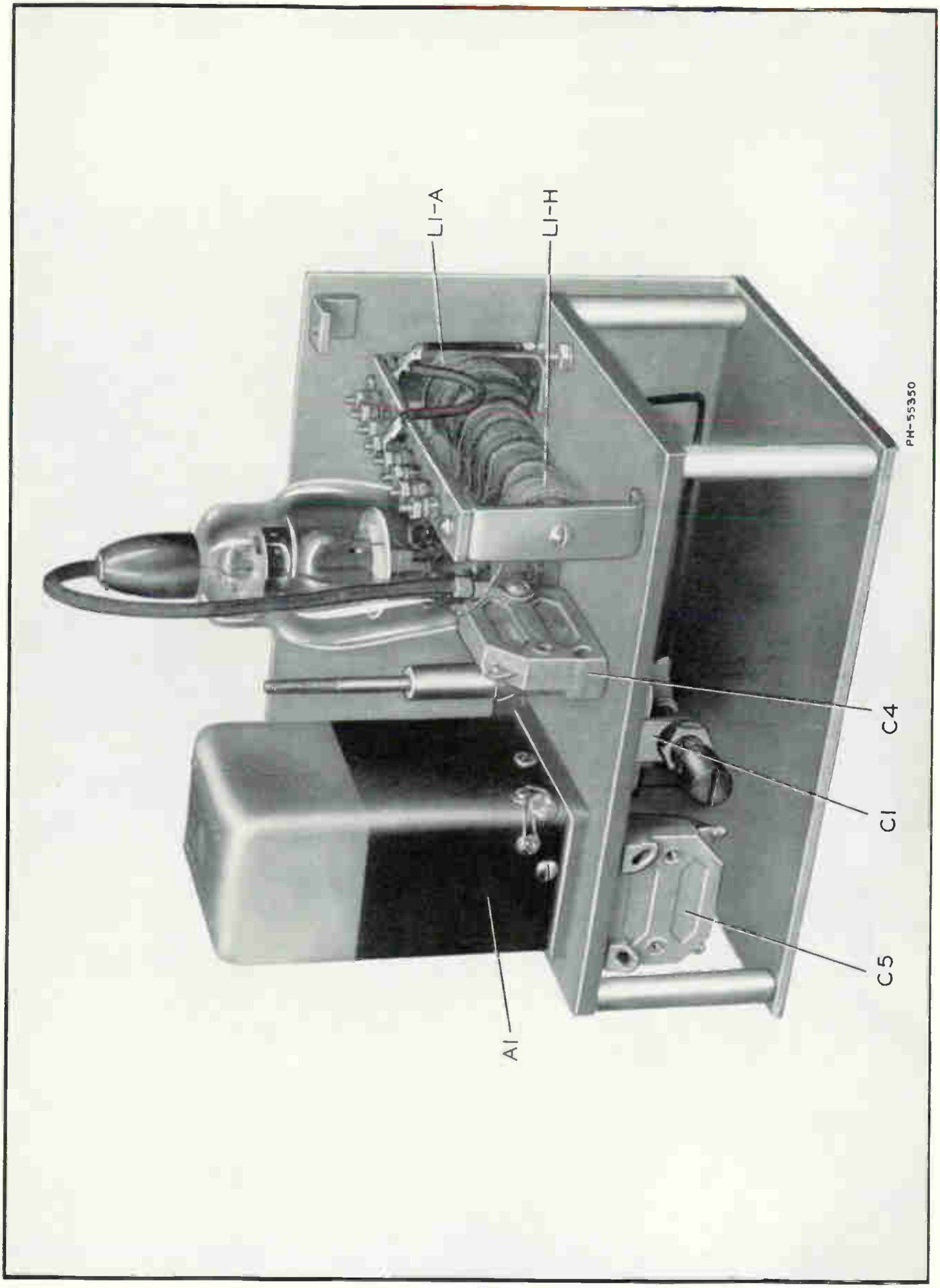


Figure 11—R-F Oscillator Unit (Front Oblique View, Covers Removed)

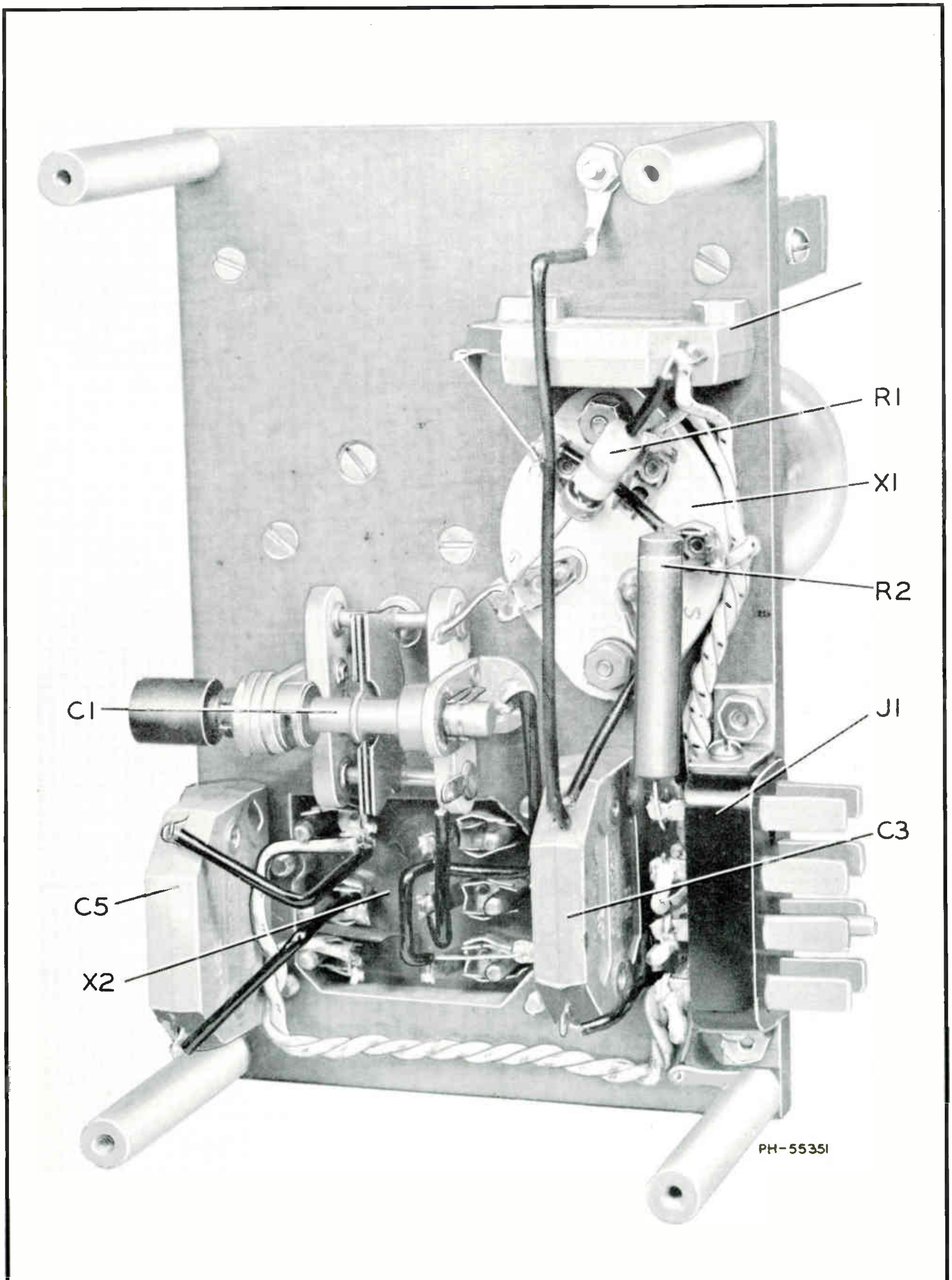


Figure 12—R-F Oscillator Unit (Bottom View, Covers Removed)

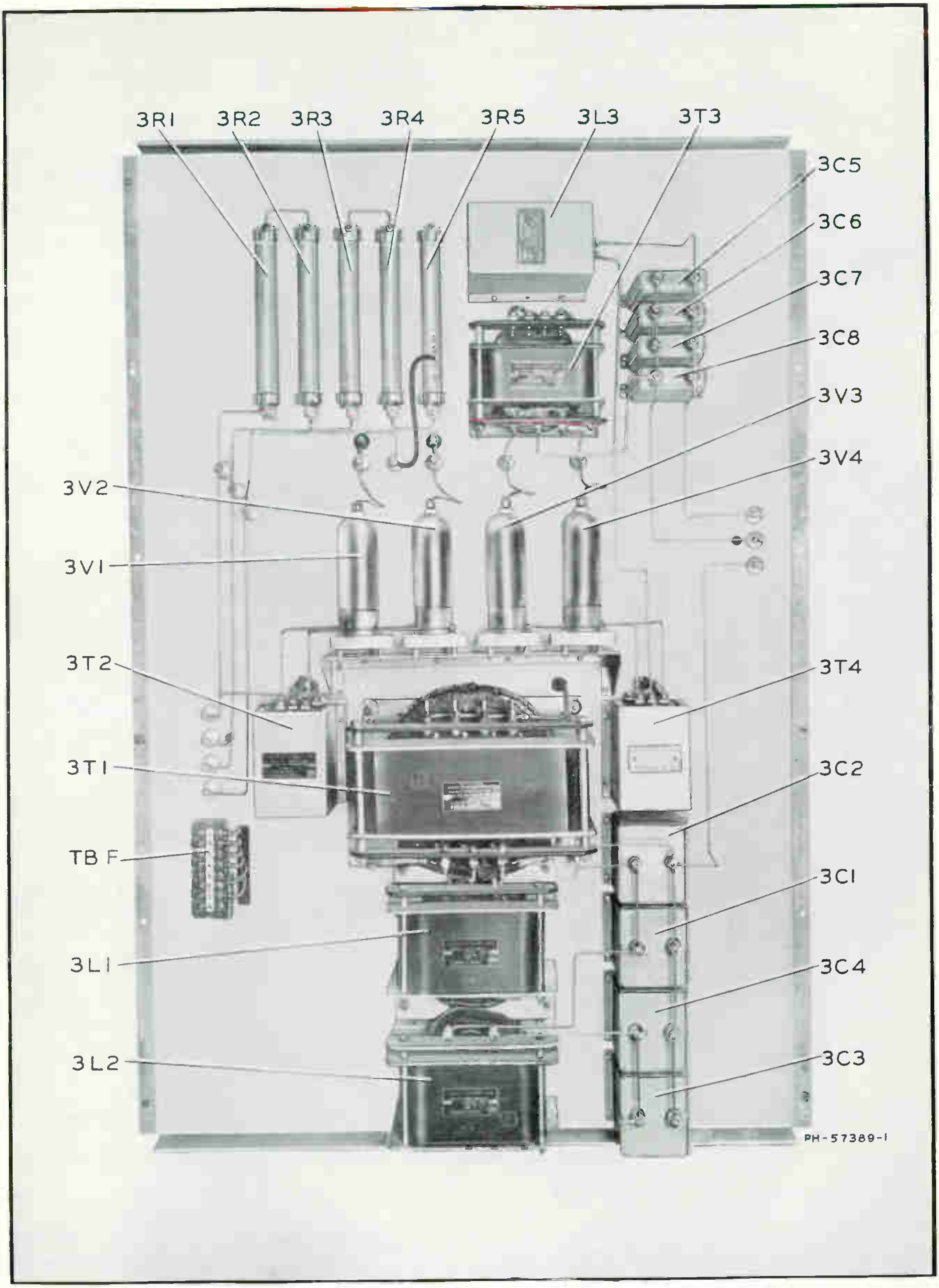


Figure 13—Bias and Auxiliary Rectifier Chassis

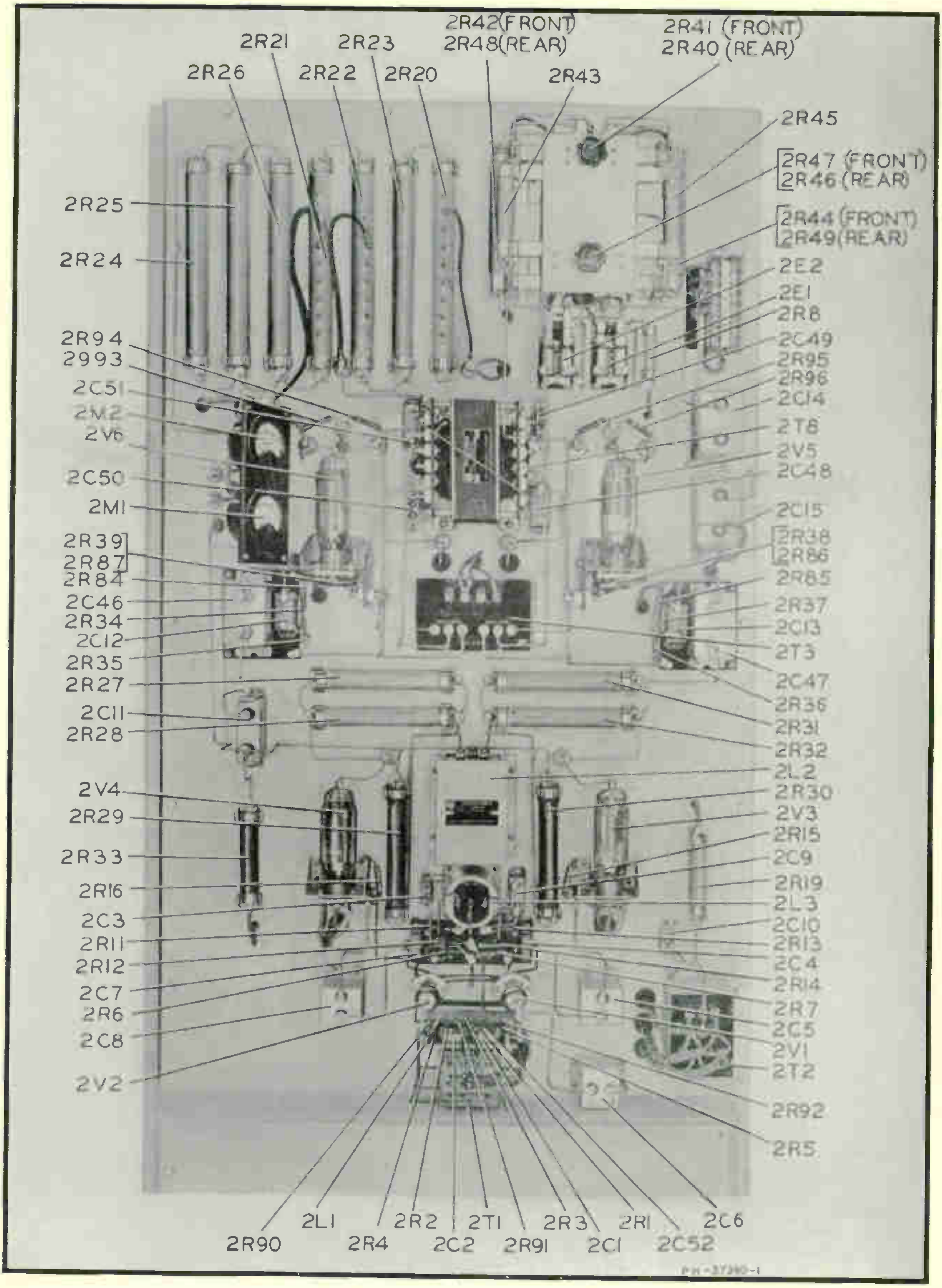


Figure 14—Low-Power A-F Chassis

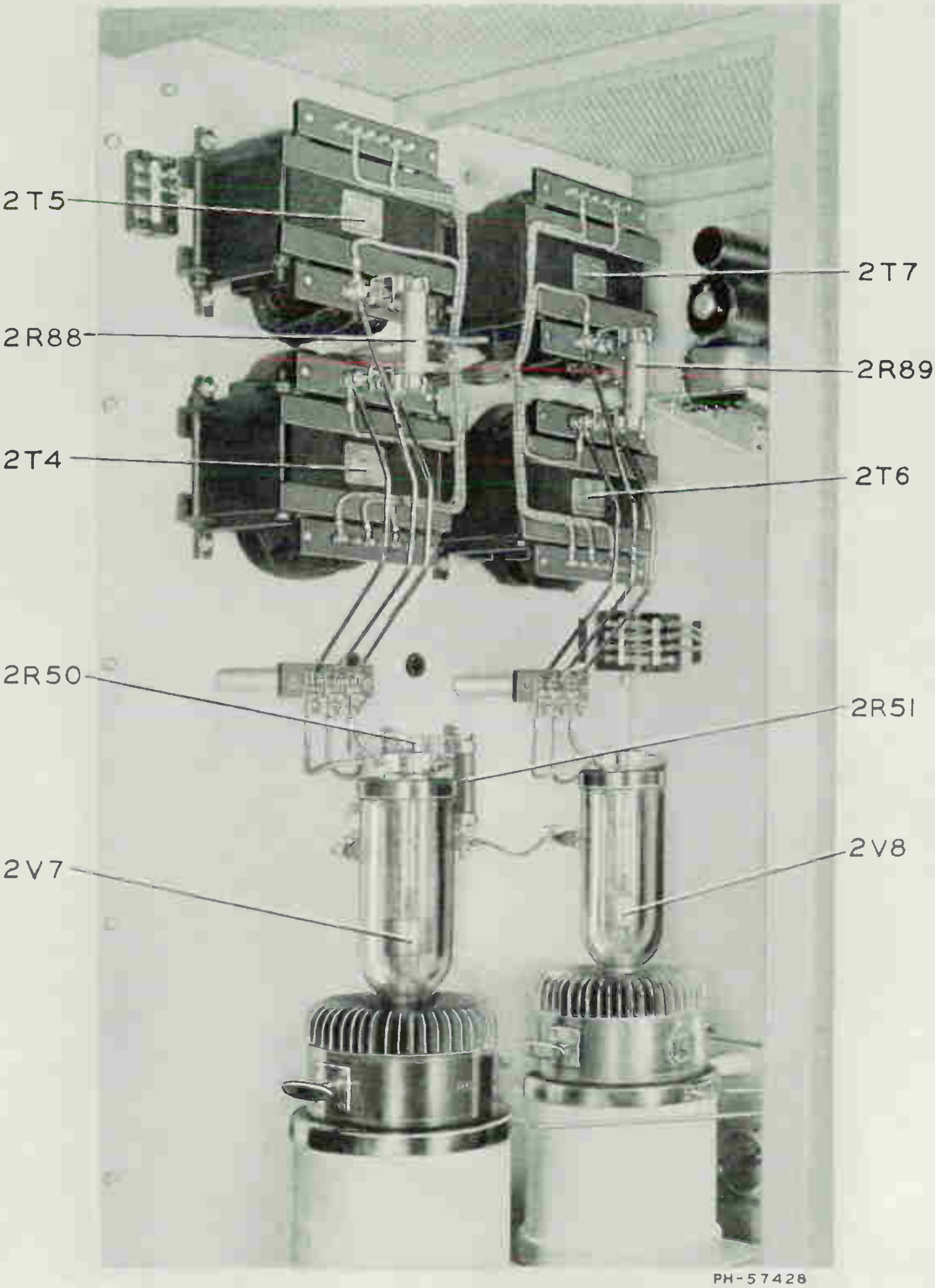


Figure 15—Modulator Chassis

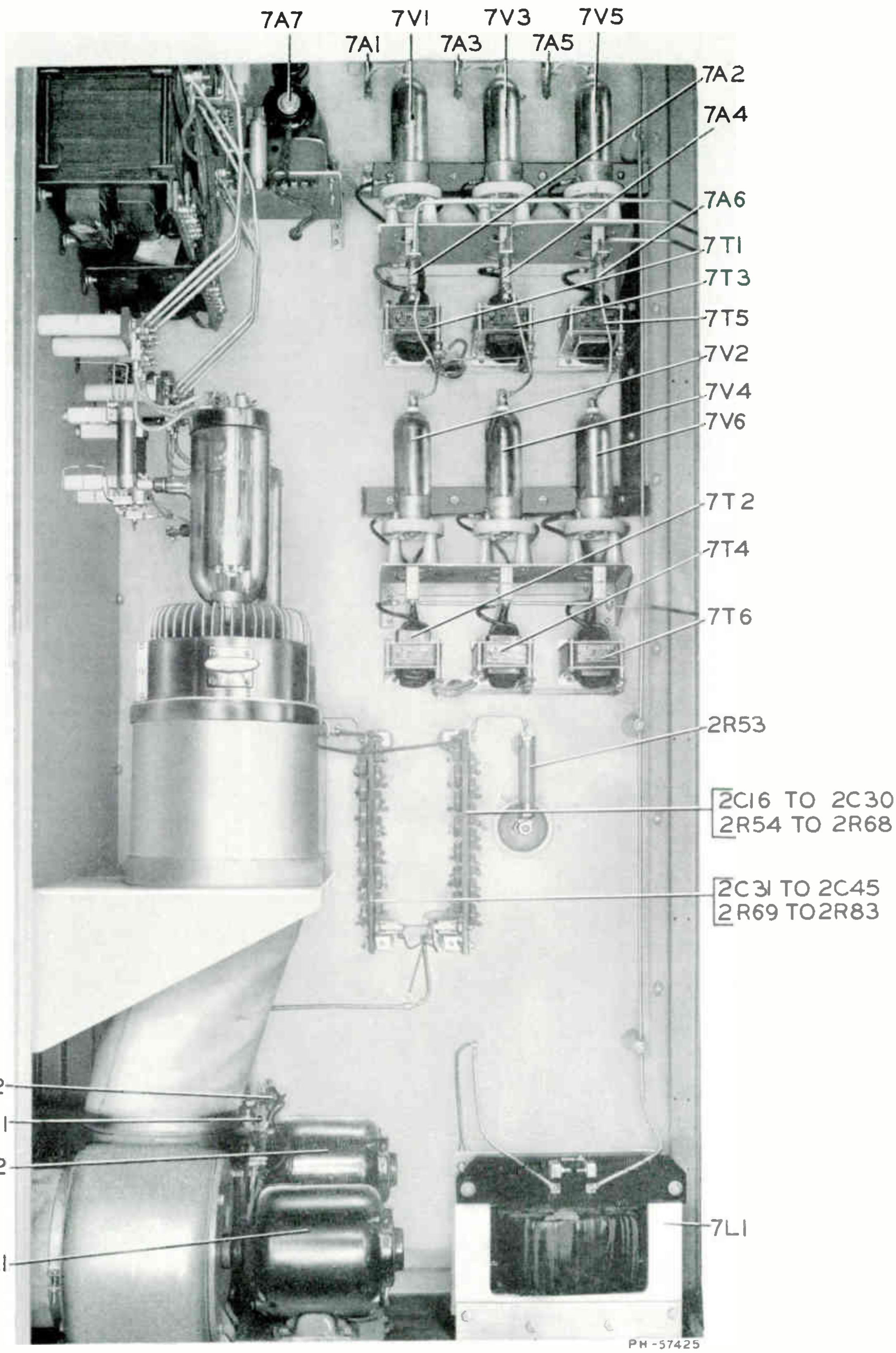


Figure 16—Main Rectifier Chassis

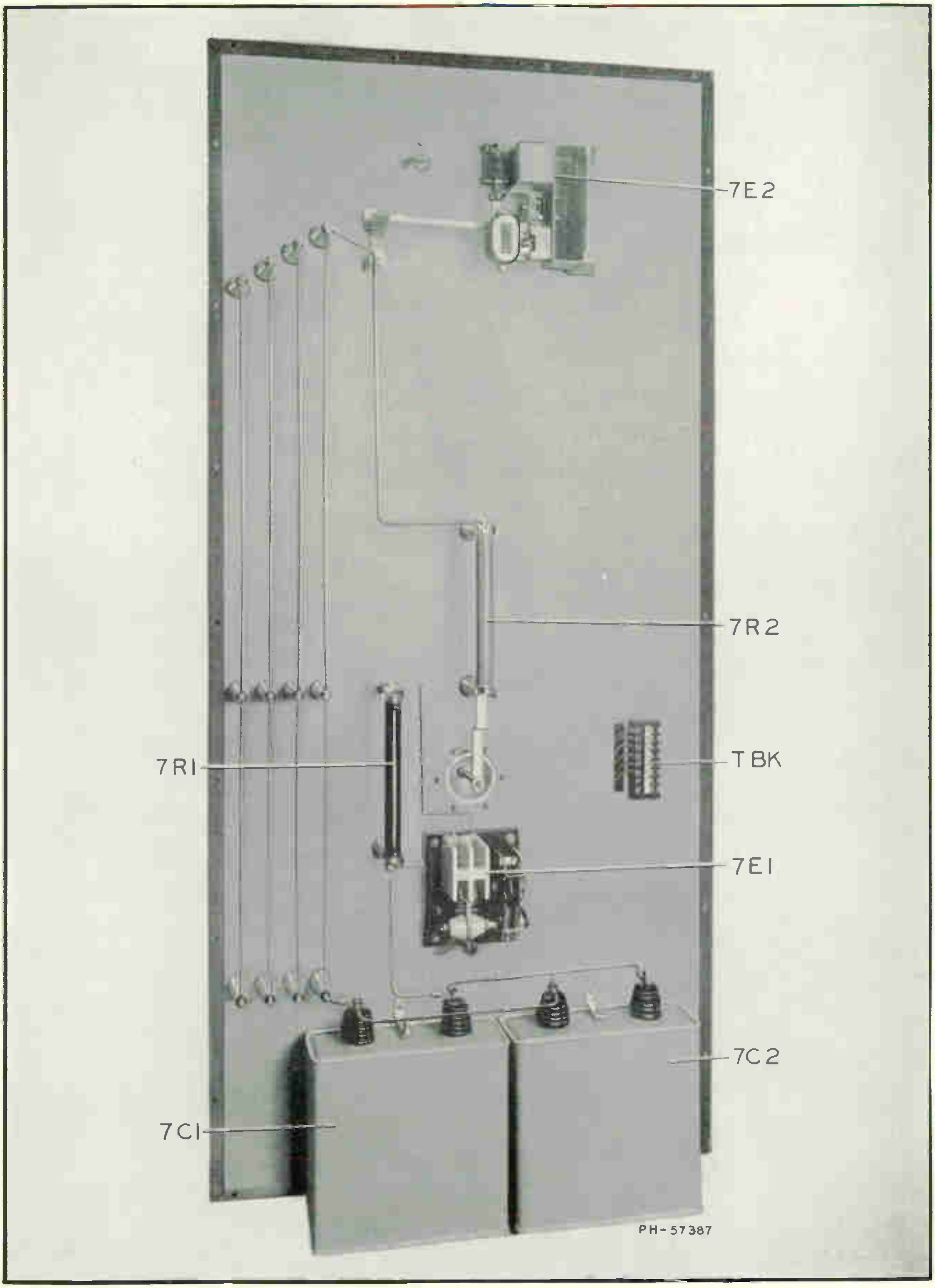


Figure 17—Rectifier Auxiliary Chassis

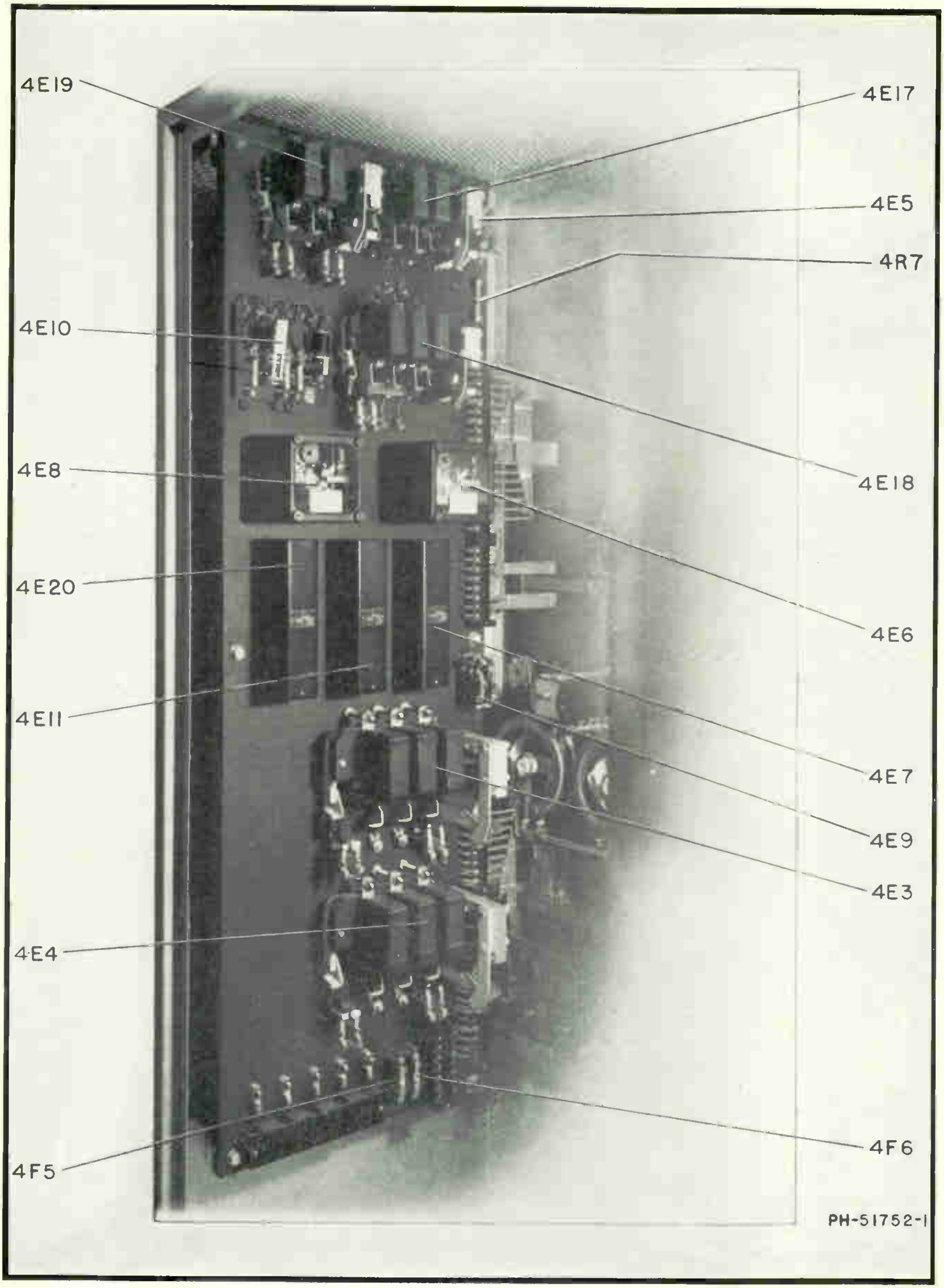


Figure 18—Contactor Panel

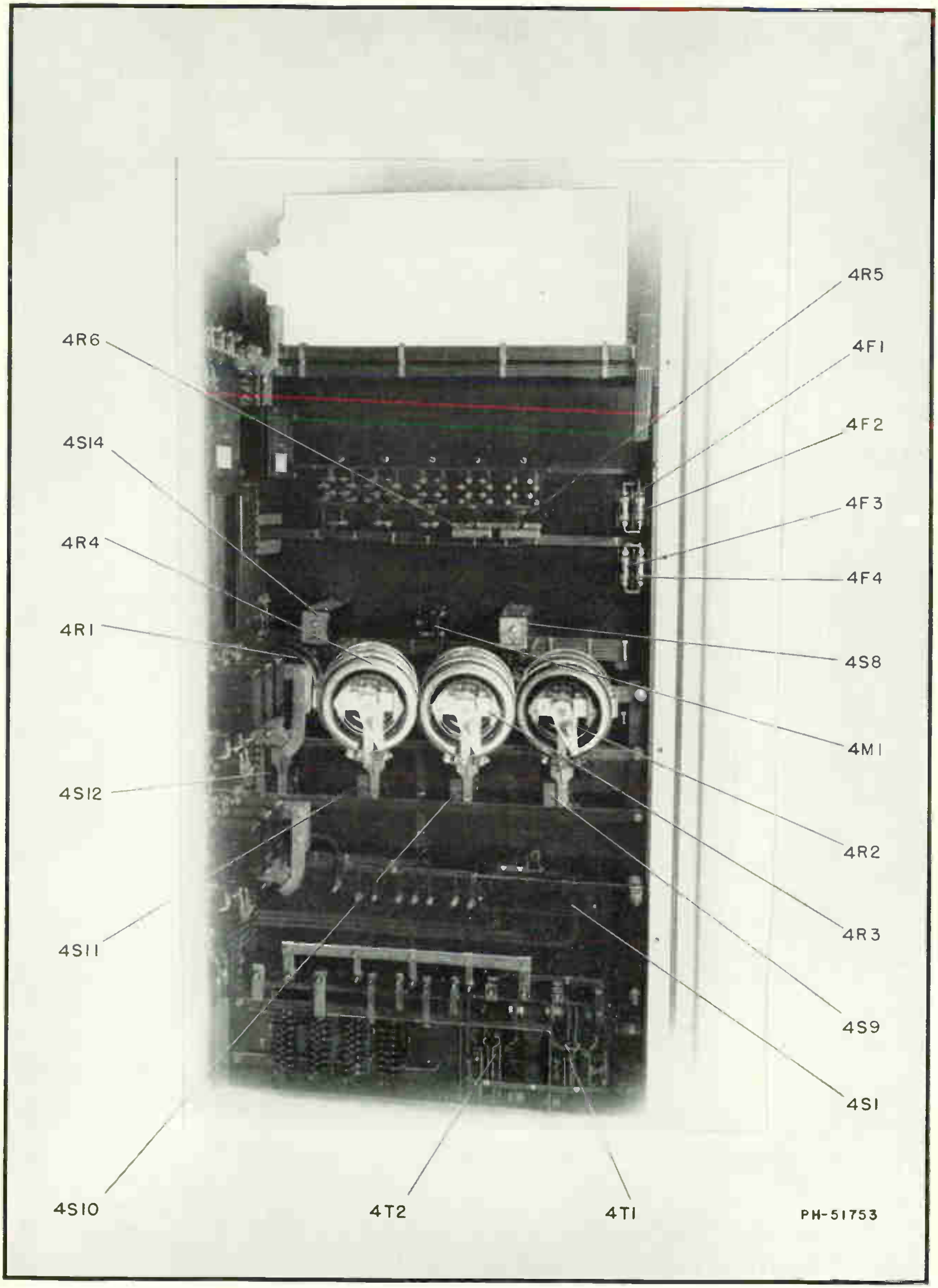


Figure 19—Power Control Panel (Rear View)

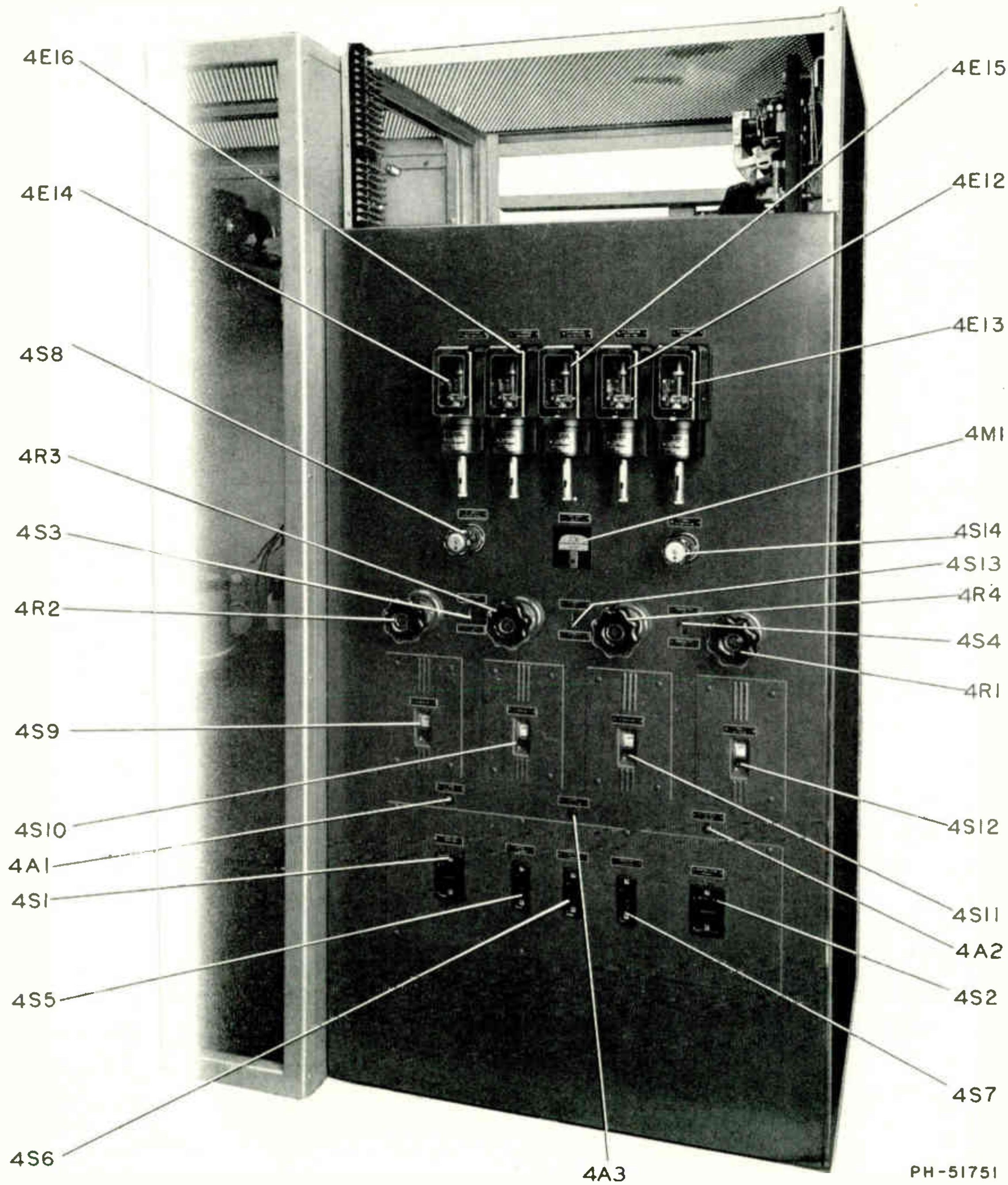


Figure 20—Power Control Panel (Front View)

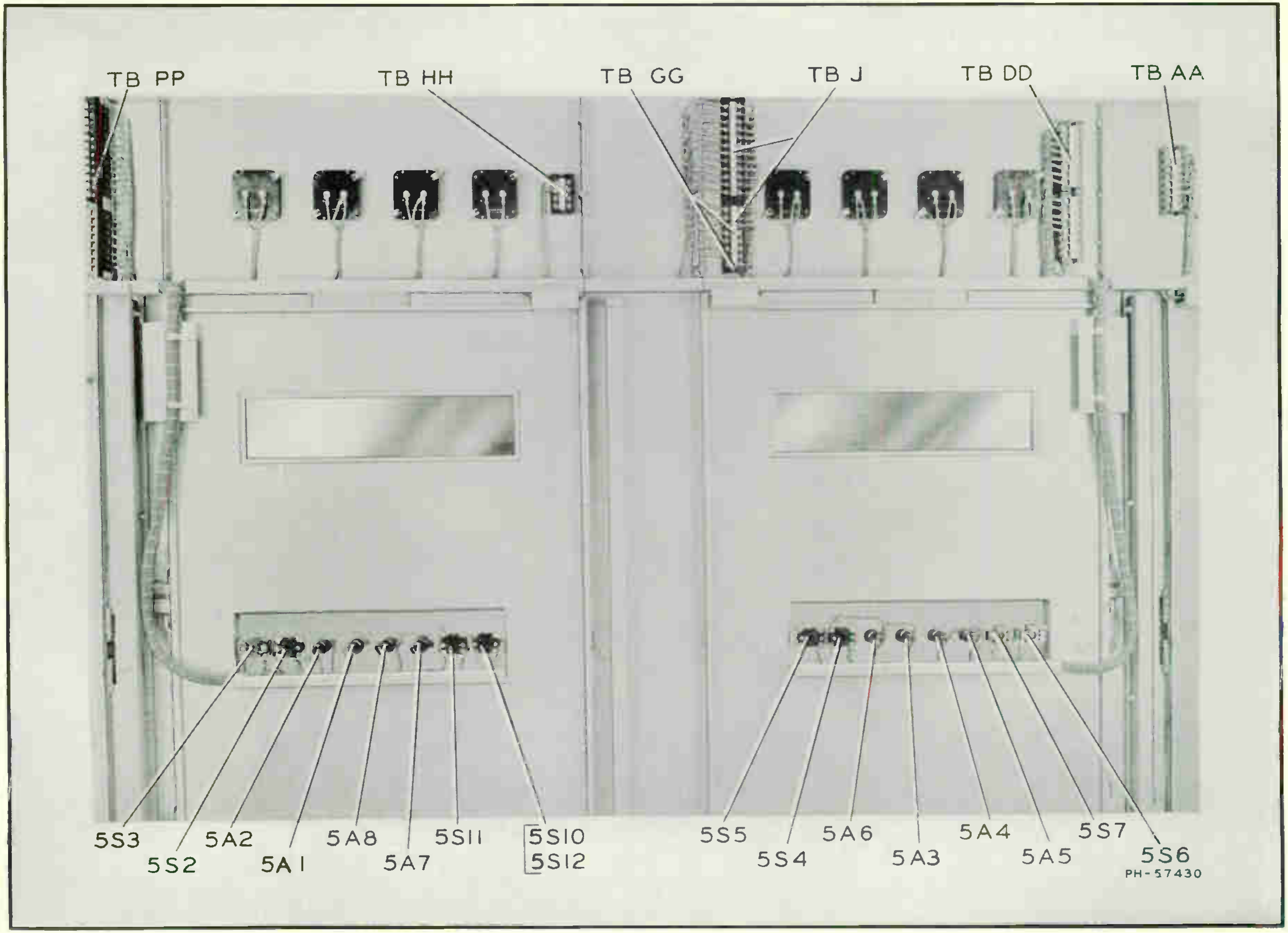


Figure 21—Enclosure (Partial Rear View)

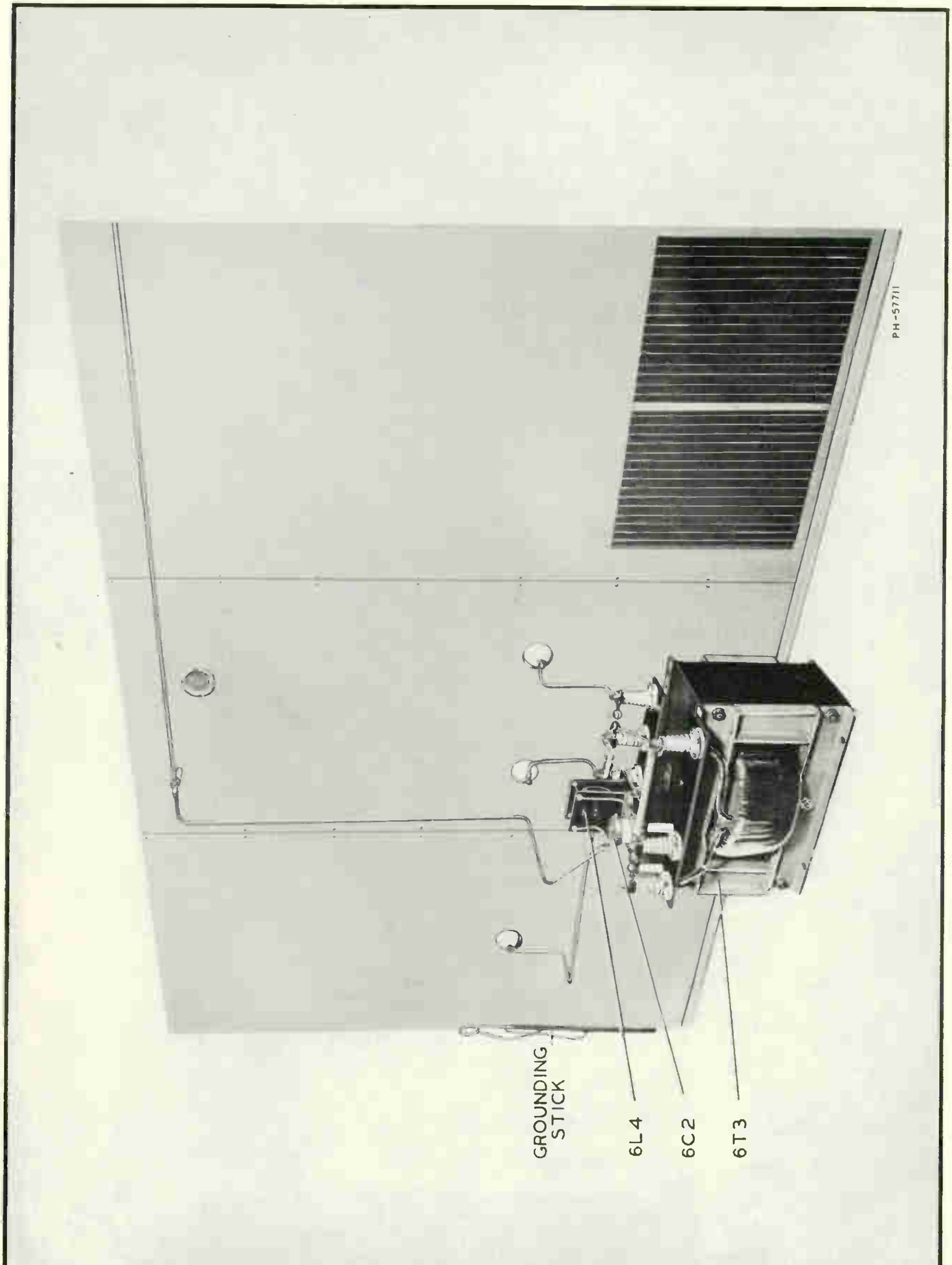
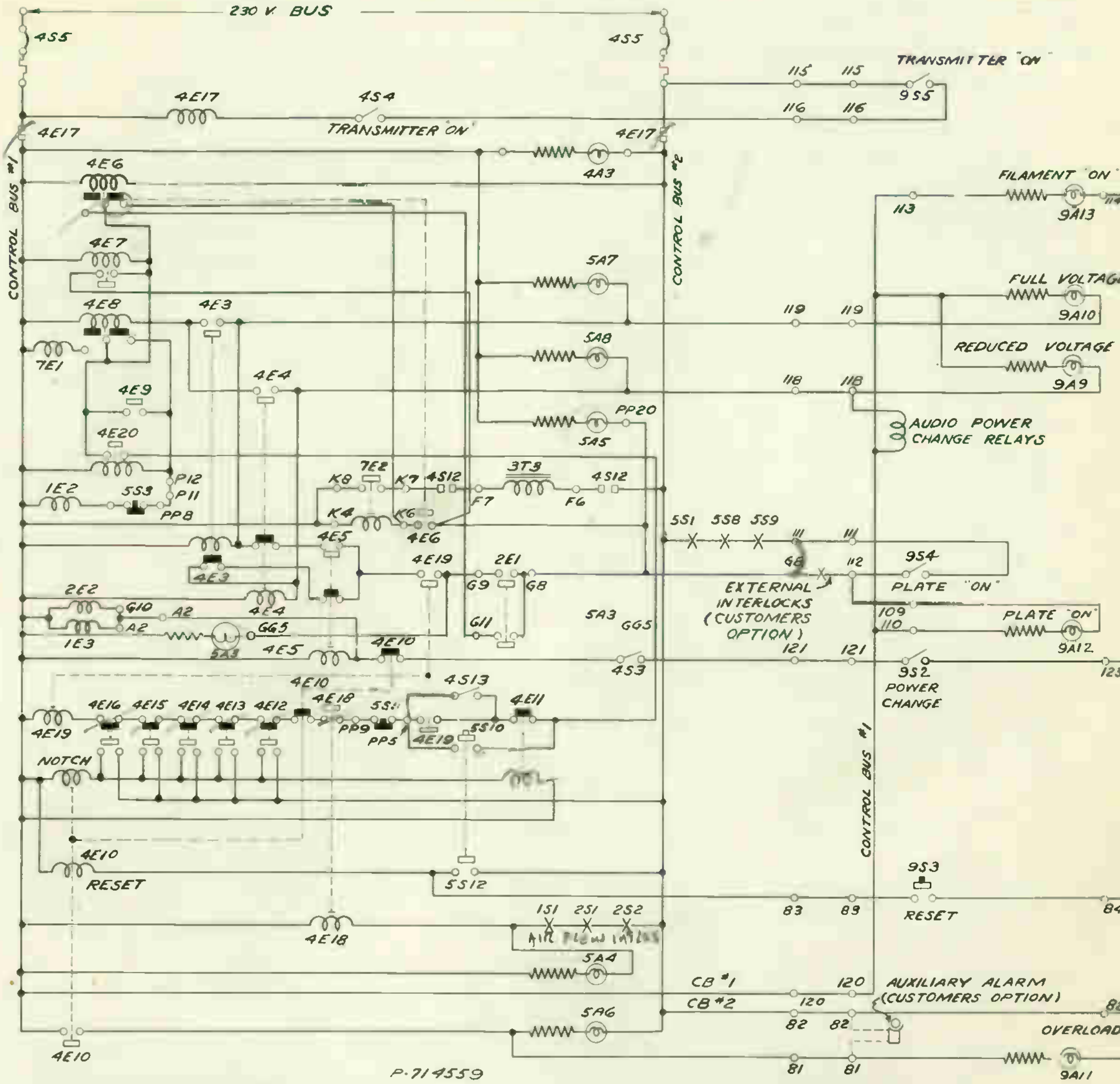


Figure 22—Modulator Output Unit (Partial Rear View of Transmitter)



R.F.

- 1E2 CARRIER "BLOCKING" RELAY
- 1E3 POWER CHANGE COMPENSATING RELAY
- 1S1 AIR FLOW INTERLOCK

AUDIO

- 2E1 BIAS PROTECTIVE RELAY
- 2E2 BIAS CHANGE RELAY
- 2S1 AIR FLOW INTERLOCK
- 2S2 AIR FLOW INTERLOCK

BIAS & LOW POWER RECTIFIER

- 3T3 BIAS RECTIFIER PLATE TRANSFORMER

POWER CONTROL PANEL

- 4E3 FULL VOLTAGE PLATE CONTACTOR
- 4E4 REDUCED VOLTAGE PLATE CONTACTOR
- 4E5 POWER CHANGE AUX RELAY
- 4E6 RECTIFIER PLATE DELAY RELAY
- 4E7 HESITATING RELAY TIMER AUX.
- 4E8 RECTIFIER SURGE RELAY TIMER
- 4E9 CARRIER "OFF" RELAY
- 4E10 OVERLOAD RATCHET RELAY
- 4E11 HESITATING RELAY, NOTCHING AUX.
- 4E12 OVERLOAD RELAY, MAIN LINE
- 4E13 OVERLOAD RELAY, MAIN LINE
- 4E14 OVERLOAD RELAY, POWER AMPLIFIER
- 4E15 OVERLOAD RELAY, AUX. RECTIFIER
- 4E16 OVERLOAD RELAY, MODULATOR PLATE
- 4E17 FIL. BUS-CONTROL BUS CONTACTOR
- 4E18 AIR COOLED FILAMENT CONTACTOR
- 4E19 LOW POWER RECT. PLATE PRI. CONTACTOR
- 4E20 HESITATING CARRIER "OFF" AUX.
- 4S3 POWER CHANGE
- 4S4 TRANSMITTER "ON"
- 4S5 FIL. BUS-CONTROL BUS BREAKER
- 4S12 BIAS RECTIFIER PRI. BREAKER
- 4S13 AUTOMATIC OPERATION
- 4A3 FIL. "ON" PILOT LIGHT

FRONT PANEL

- 5A3 INDICATOR LAMP "BIAS ON"
- 5A4 INDICATOR LAMP "AIR FLOW"
- 5A5 INDICATOR LAMP "INTERLOCKS"
- 5A6 INDICATOR LAMP "OVERLOAD"
- 5A7 INDICATOR LAMP "PLATE VOLTAGE-FULL"
- 5A8 INDICATOR LAMP "PLATE VOLTAGE-REDUCED"
- 5S3 PUSH BUTTON "CRYSTAL OSCILLATORS OFF"
- 5S10 PUSH BUTTON "PLATE VOLTAGE ON"
- 5S11 PUSH BUTTON "PLATE VOLTAGE OFF"
- 5S12 PUSH BUTTON "OVERLOAD"

RECTIFIER

- 7E1 SURGE RELAY
- 7E2 CONDENSER GROUNDING SWITCH

CONTROL CONSOLE

- 9A13 INDICATOR LAMP FIL. "ON"
- 9A12 INDICATOR LAMP PLATE "ON"
- 9A9 INDICATOR LAMP "HIGH VOLTAGE REDUCED"
- 9A10 INDICATOR LAMP "HIGH VOLTAGE FULL"
- 9A11 INDICATOR LAMP "OVERLOAD"
- 9S5 TRANSMITTER "ON"
- 9S2 POWER CHANGE - ENERGIZE FOR FULL POWER
- 9S4 CARRIER "ON"
- 9S3 OVERLOAD RESET

Figure 24—Control Circuits Ladder (P-714559)

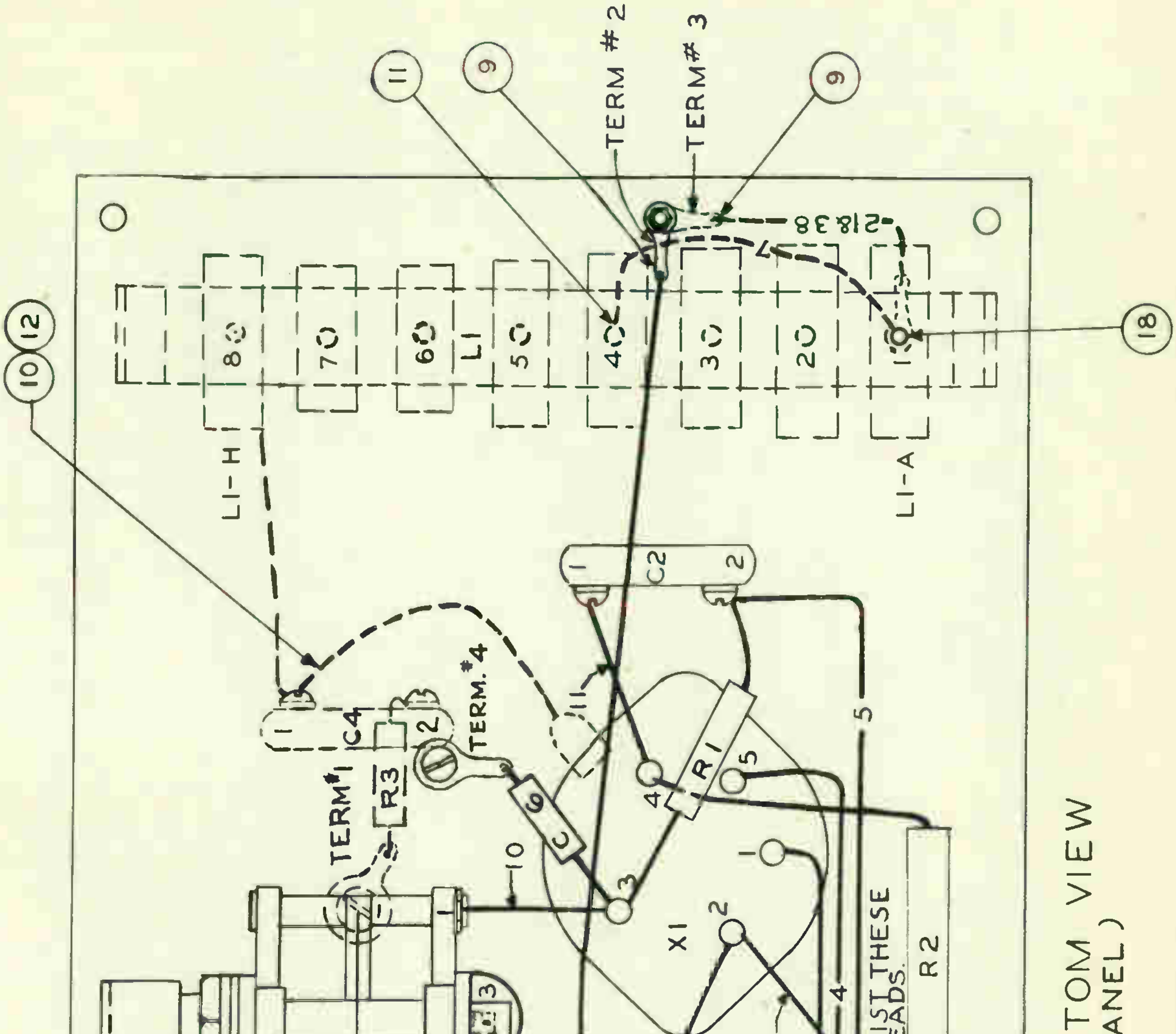
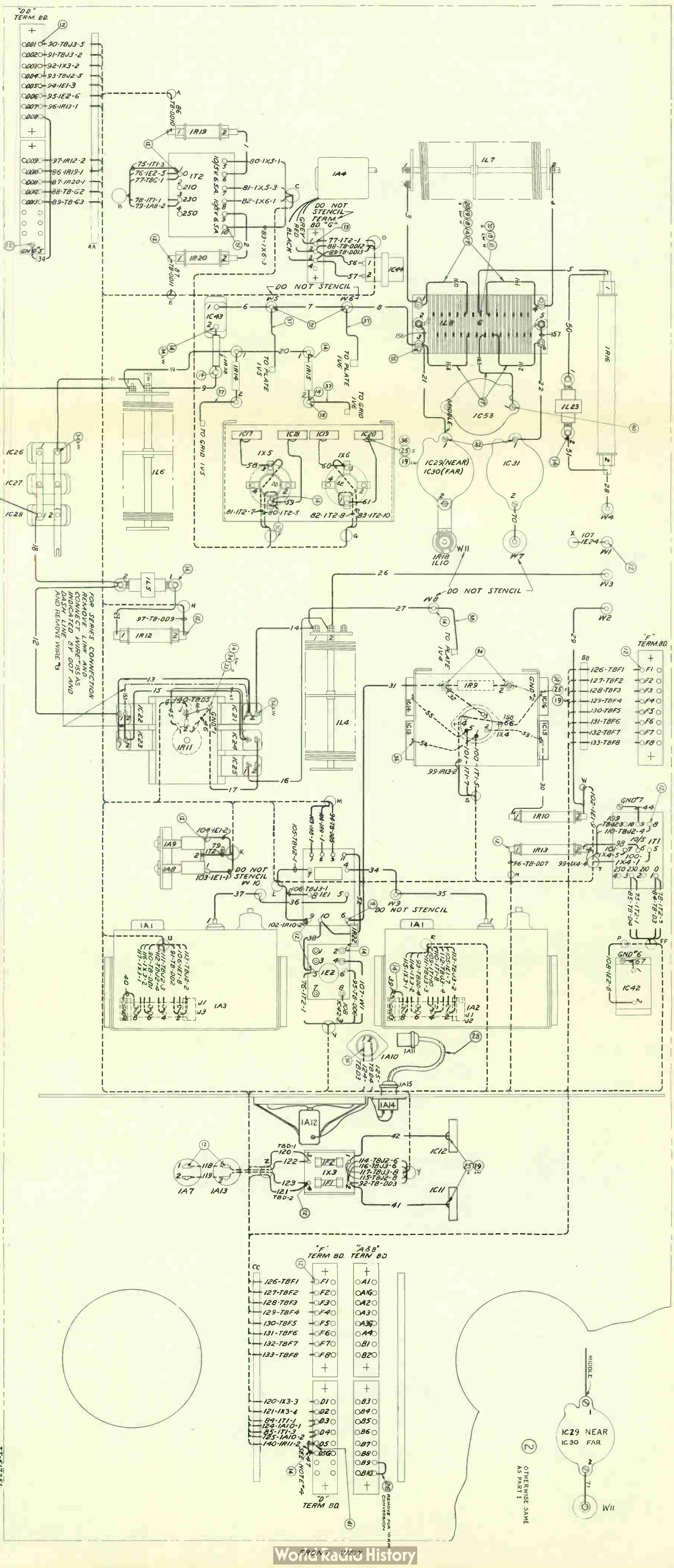


Figure 27—R-F Oscillator Connections (M-429907)



TT-617251

Figure 26—Low-Power R-F Chassis Connections (TT-617251)

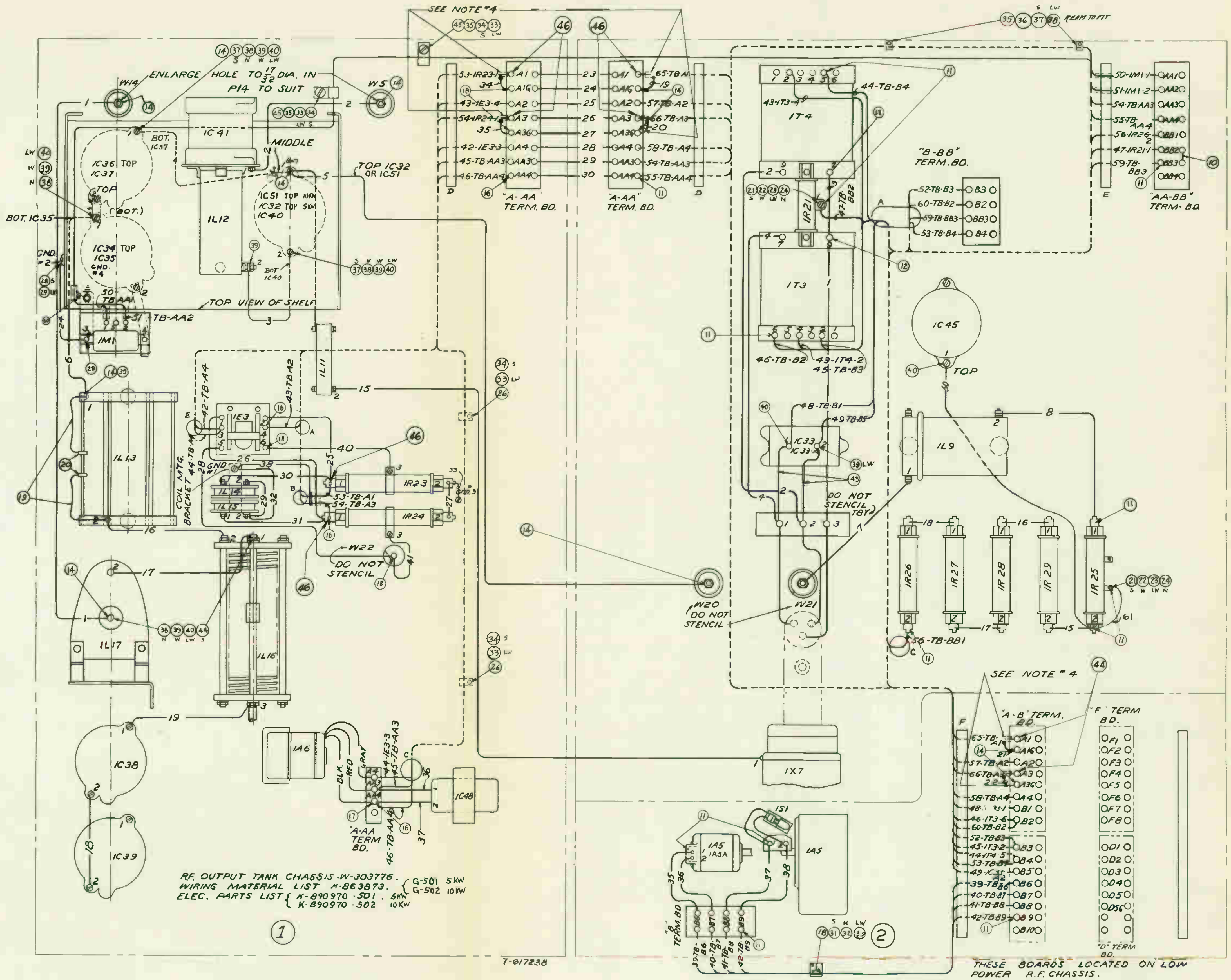
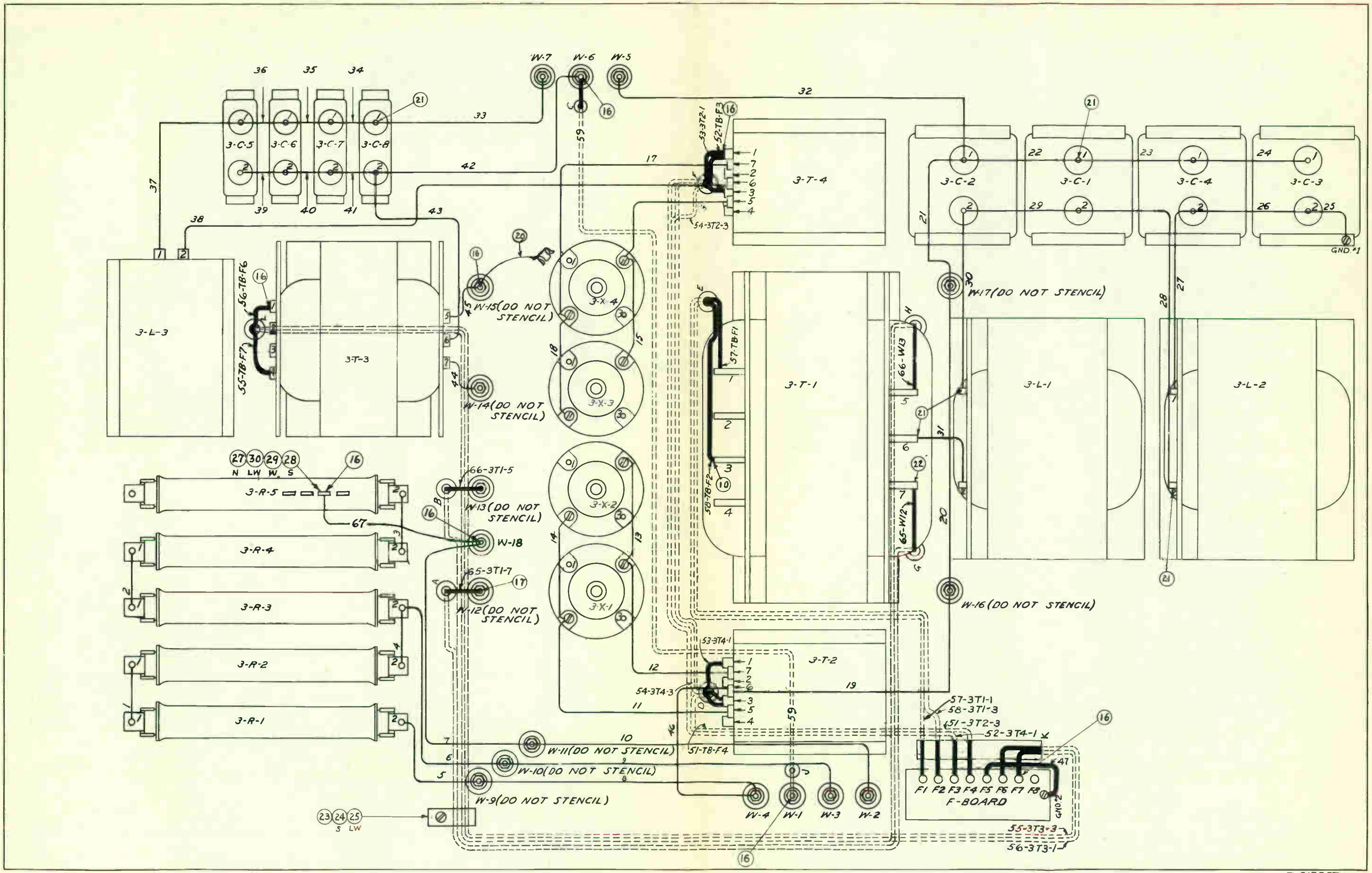


Figure 25—R-F Output Tank and R-F Output Chassis (T-617238)



T-617257

Figure 28—Bias and Auxiliary Rectifier Chassis Connections
(T-617257, Sub. 8)

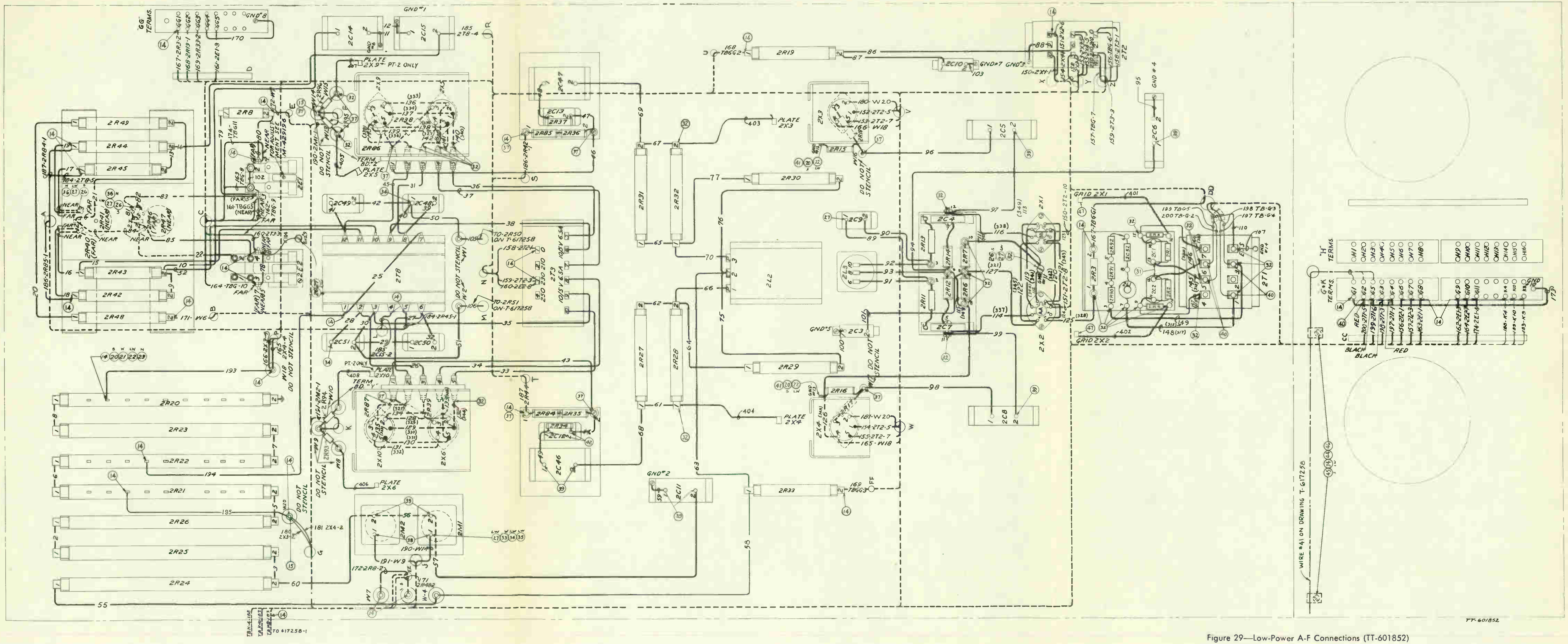


Figure 29—Low-Power A-F Connections (TT-601852)

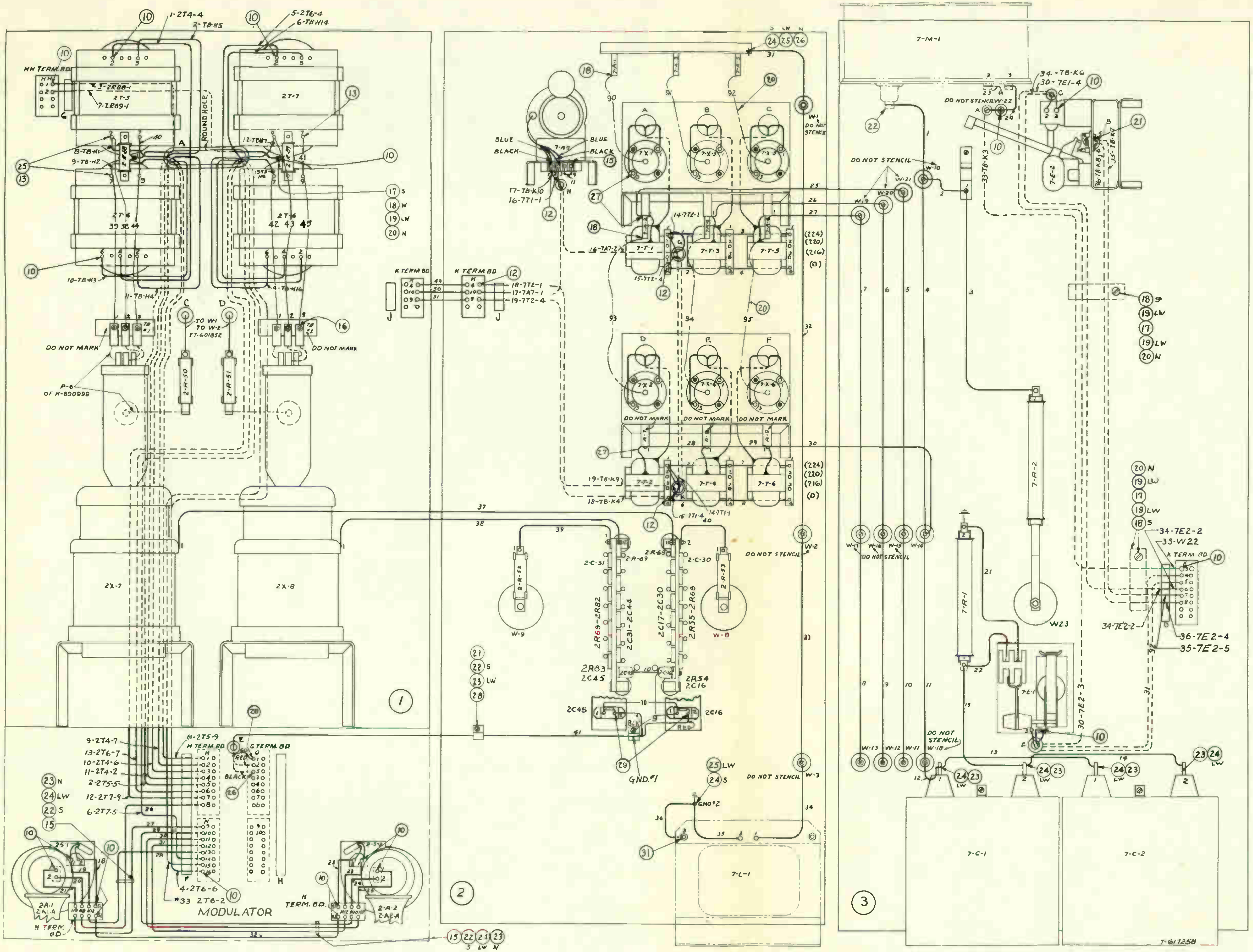
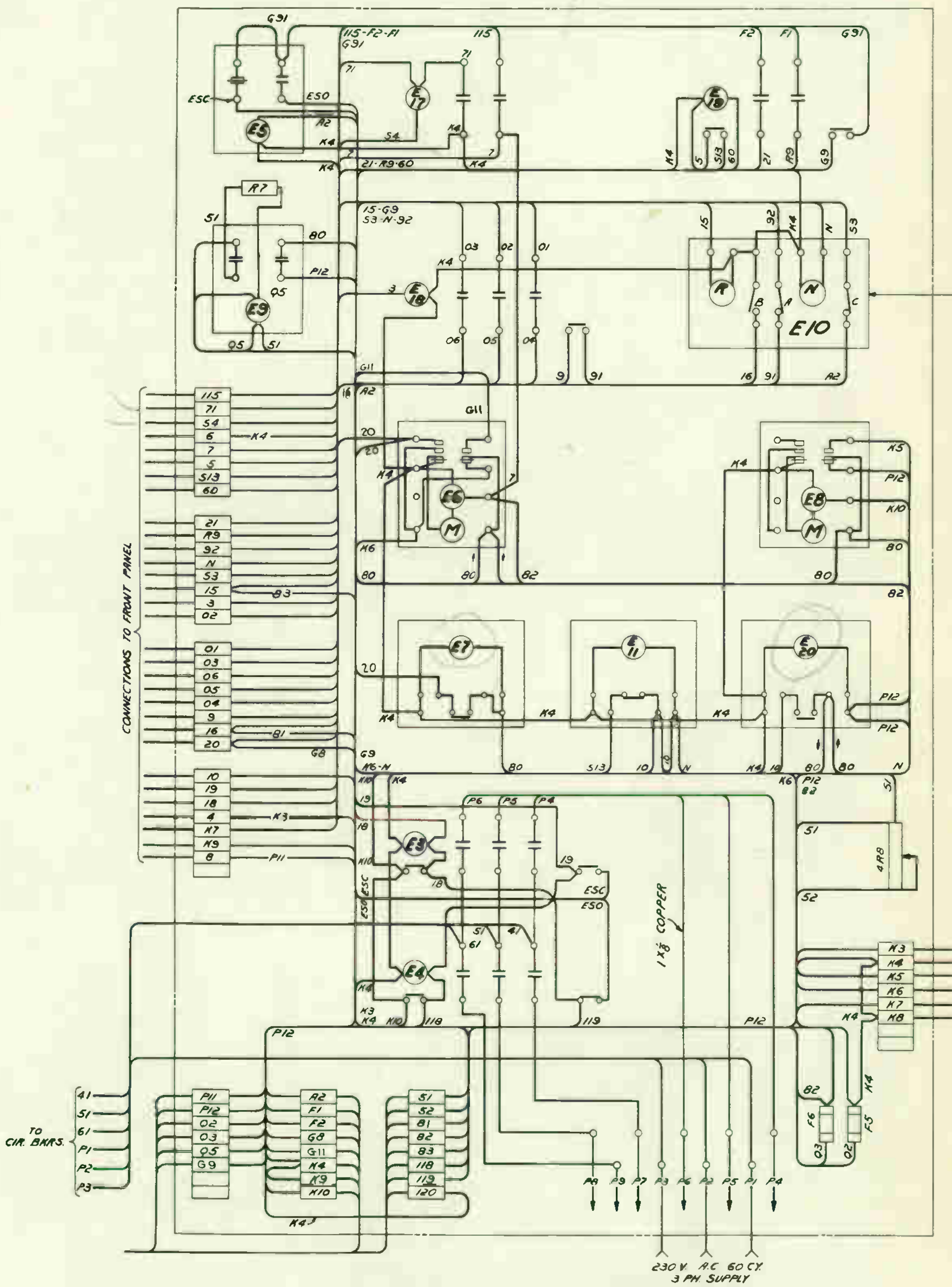
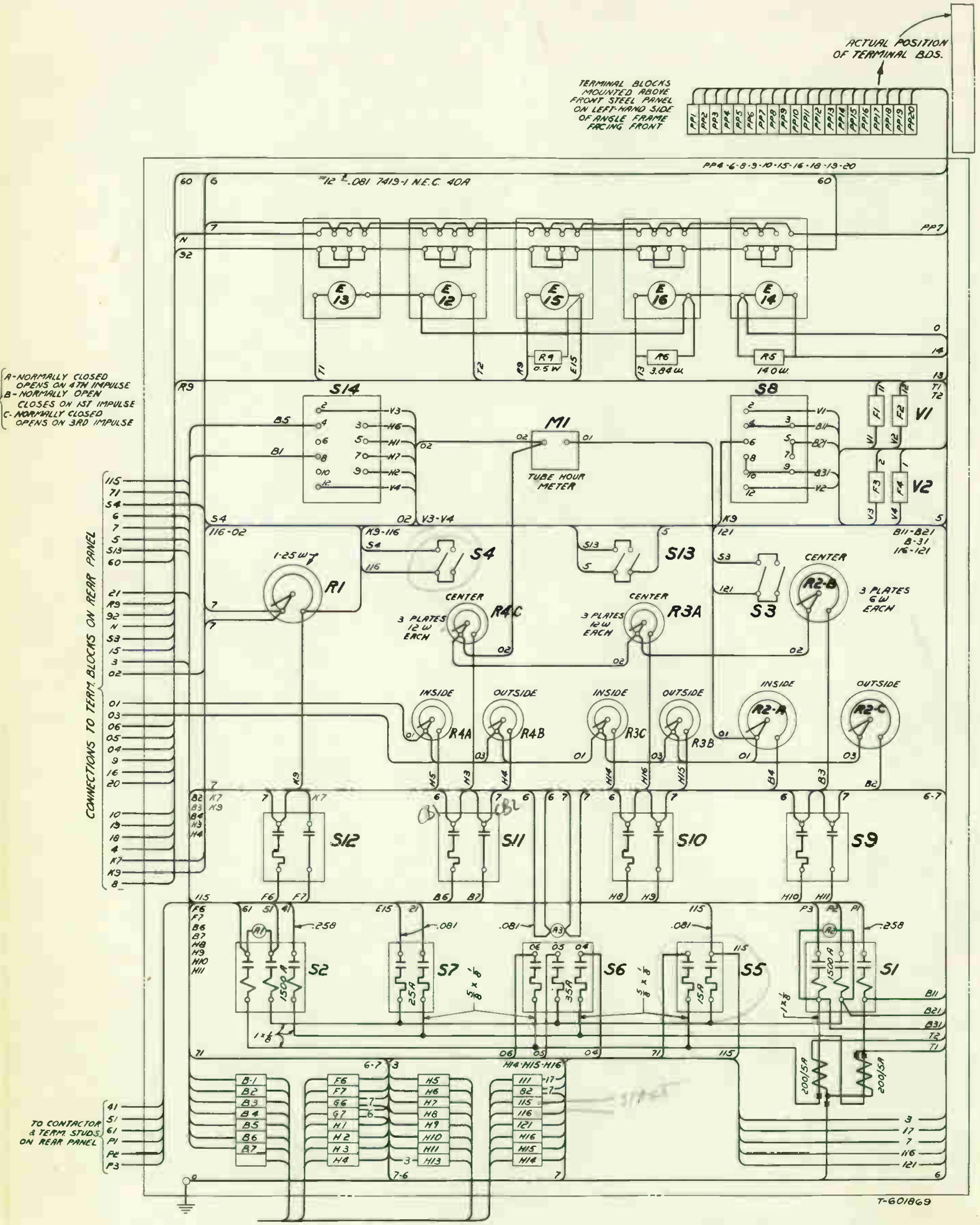


Figure 30—Modulator, Main Rectifier and Rectifier Auxiliary Chassis Connections (T-617258)



CONTACTOR PANEL CONNECTIONS



POWER CONTROL PANEL CONNECTIONS

Figure 31—Power Control and Contactor Panel Connections (T-601869)

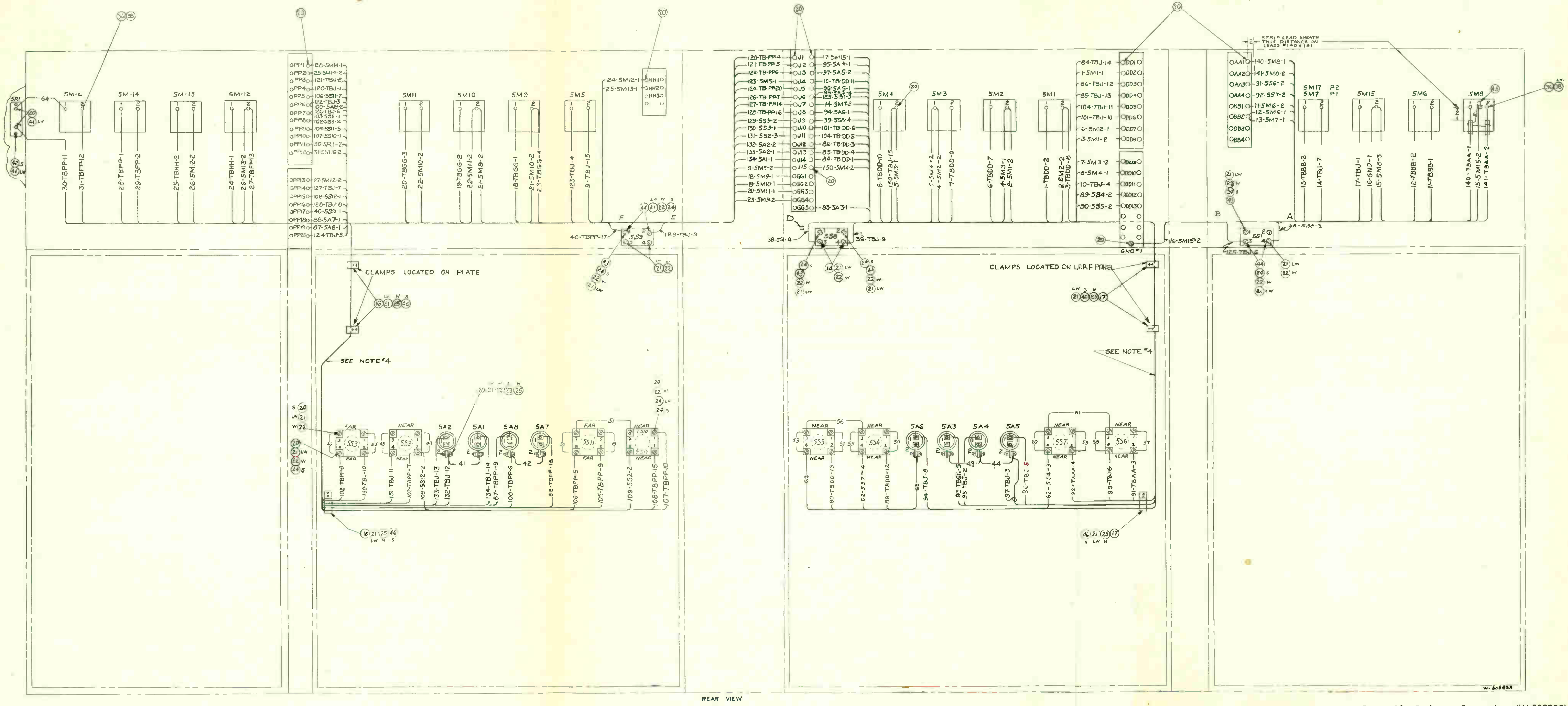


Figure 32—Enclosure Connections (W-303938)

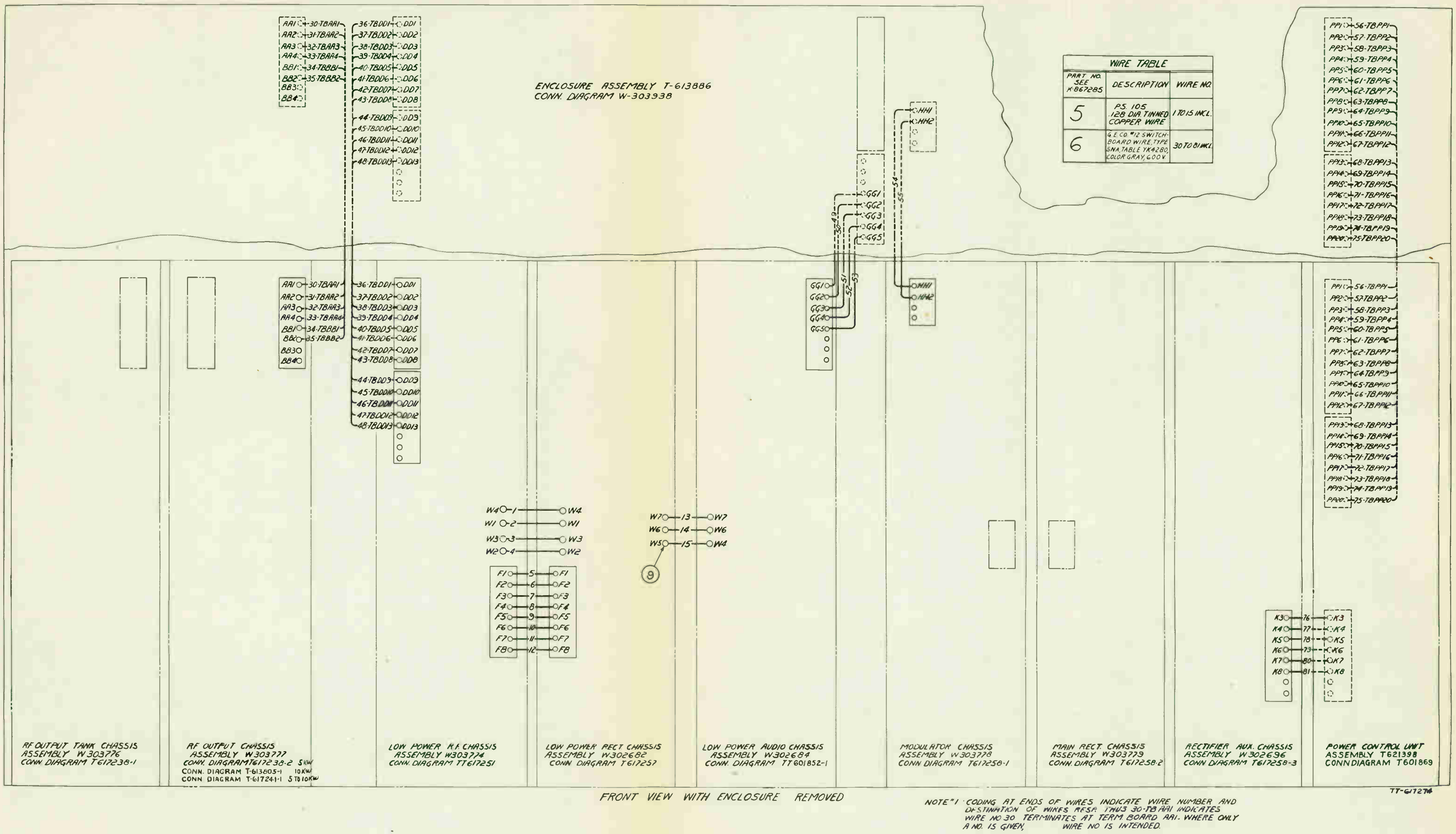


Figure 33—Interconnections (TT-617274, Sub. 5)

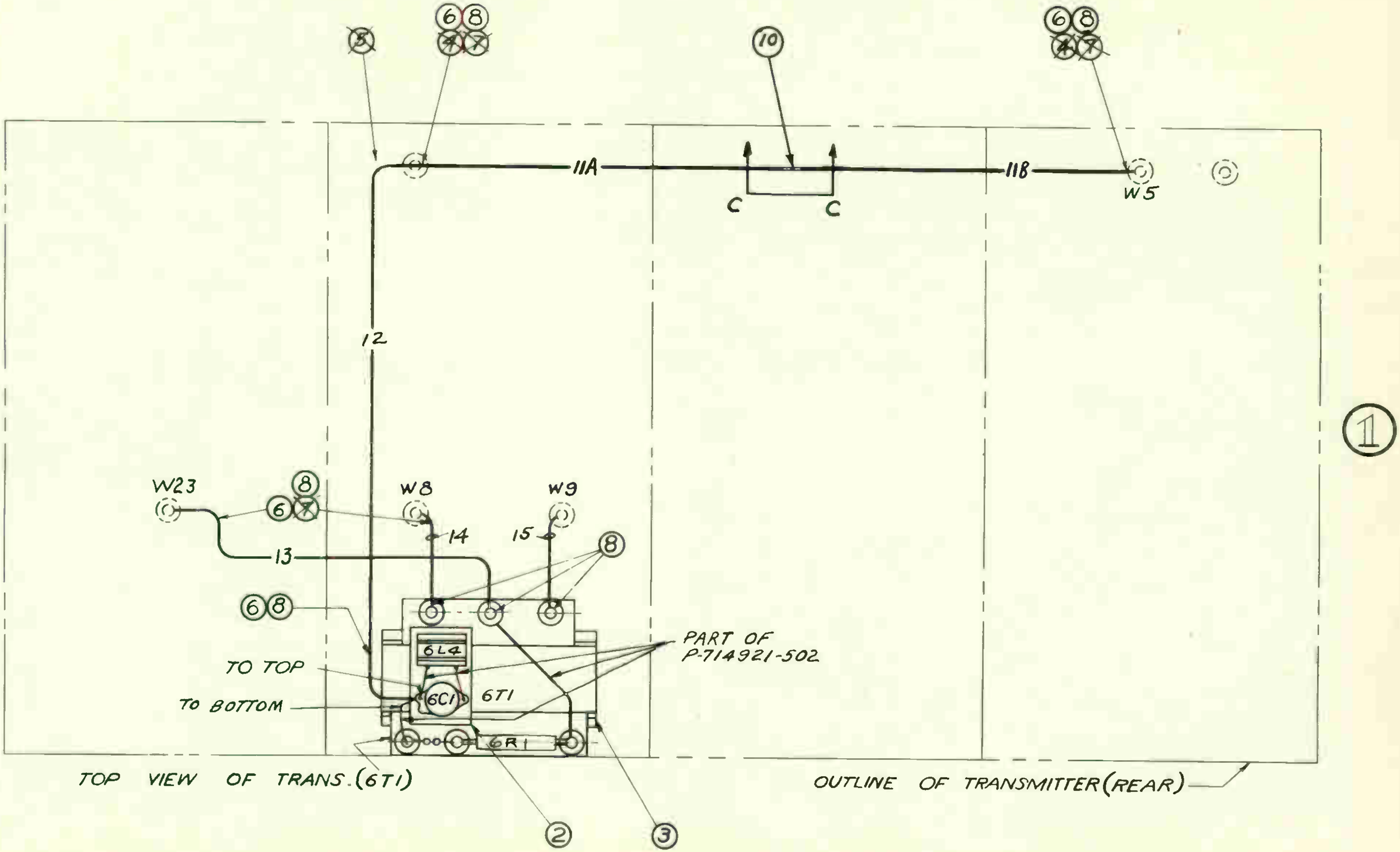


Figure 34—Modulator Output Unit Connections (P-714929)

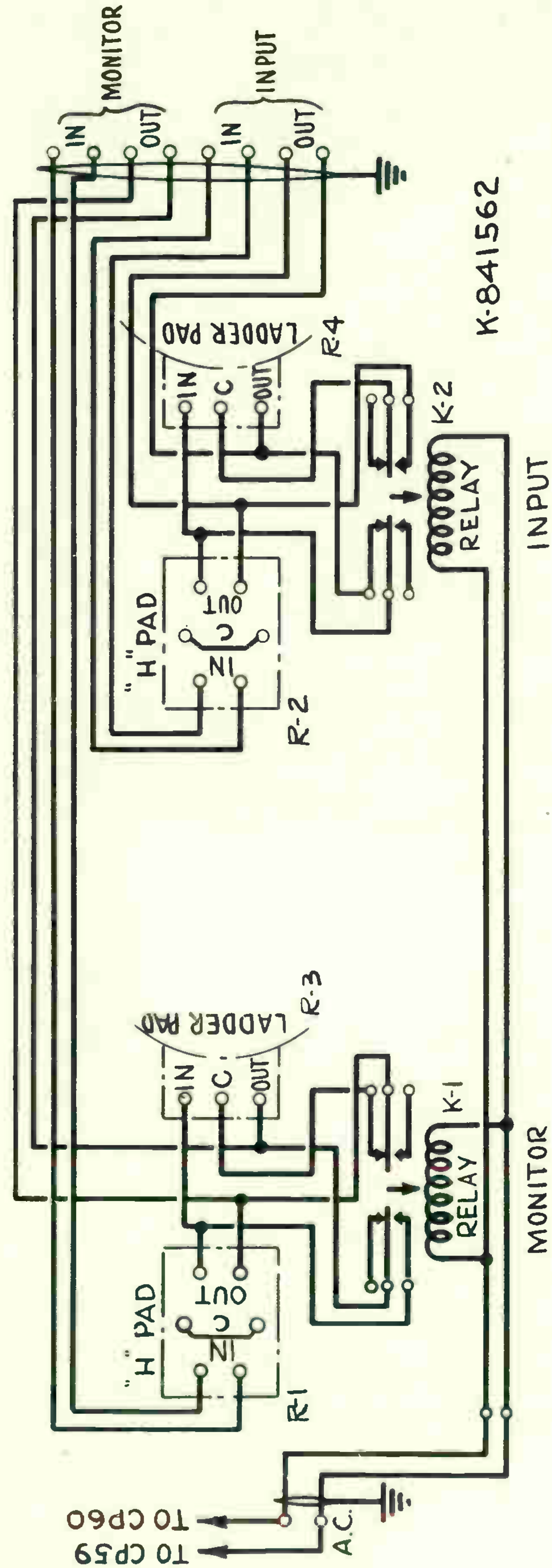
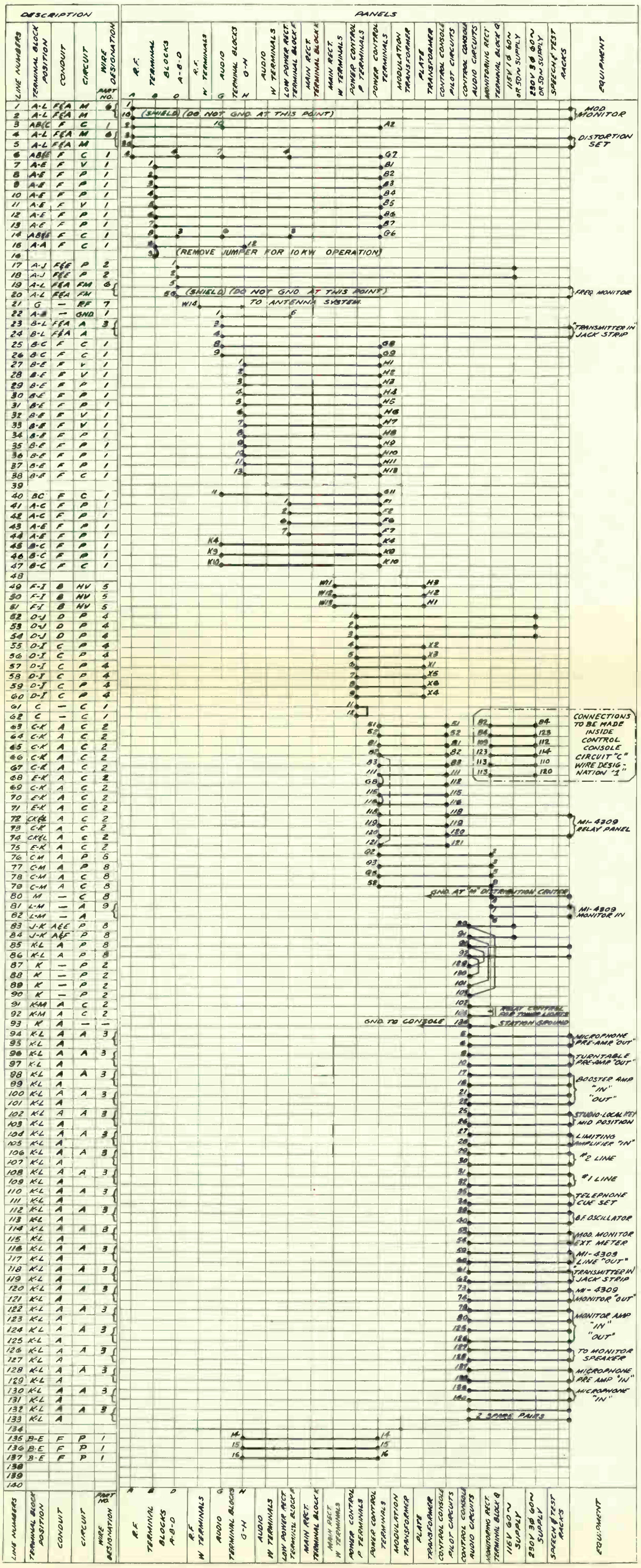


Figure 35—Audio Relay Panel Schematic (K-841562)



TERMINAL BLOCK POSITION	
A	PLENUM CHAMBER - LEFT GROUP
B	PLENUM CHAMBER - RIGHT GROUP
C	CONTACTOR PANEL LOWER RIGHT CORNER
D	CONTACTOR PANEL - LOWER LEFT CORNER
E	POWER CONTROL PANEL - BOTTOM REAR
F	RECT. AUX. CHASSIS - LOWER LEFT
G	TRANSMITTER - FRAME - EXTERNAL REAR
H	MODULATION TRANSFORMER
I	PLATE TRANSFORMER
J	POWER DISTRIBUTION CENTER
K	CONTROL DESK
L	EQUIPMENT RACKS
M	ANTENNA CONTROL DISTRIBUTION CENTER

WIRE DESIGNATION

PT. NO.	SIZE OF WIRE	MI 7268-E	LENGTH FURNISHED
1	#12-600V SOLID GRAY F.P.	ITEM 4	800 FT.
2	#12-600V V.C.L.C. SOLID	ITEM 2	500 FT.
3	#10-200V A.C.L.C. TW. PR.	ITEM 7	650 FT.
4	#0-600V V.C.L.C. STRANDED	ITEM 5	150 FT.
5	#6-10,000V V.C.L.C. STRANDED	ITEM 6	60 FT.
6	R.F. CO AXIAL CABLE	ITEM 3	100 FT.
7	½ COPPER TUBING		
8	#12 600V. V.C.L.C. SOLID		SEE NOTE #1
9	#16 600V V.C.L.C. TW. PR.		SEE NOTE #1

NOTE #1
WIRE TO BE SUPPLIED BY CUSTOMER

CIRCUIT LEGEND	
A	AUDIO
C	CONTROL
M	MODULATION MONITOR
FM	FREQUENCY MONITOR
P	POWER
HV	HIGH POTENTIAL
V	FILAMENT VOLTMETER
RF	RADIO FREQUENCY

CONDUIT	CONDUIT SIZE	NUMBER OF CABLES	SIZE & DESCRIPTION OF CONDUCTORS
A	—	—	FLOOR CHANNEL
B	2	3	PART 5 (#6-10,000V)
C	5"	6	PART 4 (#0-600V)
D	2"	3	PART 4 (#0-600V)
E	¾"	4	PART 2 (#14-600V)
F	—	—	TRANSMITTER BASE CHANNEL

NOTE #2: 5KW
USE IN CONJUNCTION WITH DWG. #TT-617275 FOR CONDUITS
DWG. #M-429173 FOR TERMINAL LOCATION

10KW
USE IN CONJUNCTION WITH DWG. #TT-601845 FOR CONDUITS
DWG. #M-429173 FOR TERMINAL LOCATION

T-617280

CONTROL CONSOLE
AUDIO TERMINAL BLOCK JUMPERS
USE P-3

1-33, 2-34	63-65-71, 64-66-72
3-23, 4-24	67-77, 68-78
7-15, 8-16	69-31, 70-32
9-13, 10-14	75-29, 76-30
11-19, 12-20	

Figure 36—Wire Chart (T-617280)