AM BROADCAST TRANSMITTERS

BTA-5G

AND

BTA-10G

RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION CAMDEN, N. J.

IB 30221-1

BTA-5G and BTA-10G

A-M BROADCAST TRANSMITTING EQUIPMENT

INSTRUCTIONS

Manufactured by
RADIO CORPORATION OF AMERICA
ENGINEERING PRODUCTS DIVISION
Camden 2, New Jersey, U.S.A.

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IB-30221-1

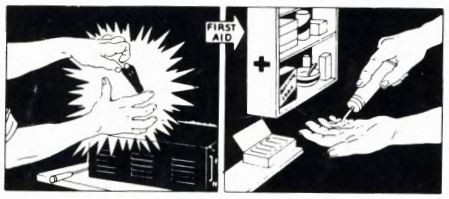
FIRST AID

WARNING!

Operation of electronic equipment involves the use of high voltages which are dangerous to life. Operating personnel must at all times observe all safety regulations. Do not change tubes or make adjustments inside the equipment with voltage supply on. Under certain conditions dangerous potentials may exist in circuits with power controls in the off position due to charges retained by capacitors, etc. To avoid casualties, ALWAYS DISCHARGE AND GROUND CIRCUITS PRIOR TO TOUCHING THEM.

ABOUT FIRST AID

Personnel engaged in the installation, operation and maintenance of this equipment or similar equipment are urged to become familiar with the following rules both in theory and in the practical application thereof. It is the duty of every radioman to be prepared to give adequate First Aid and thereby prevent avoidable loss of life.

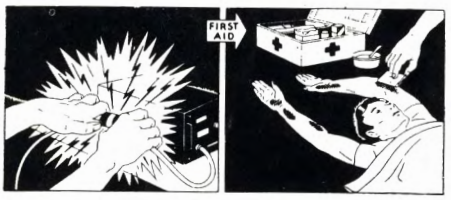


FIRST DEGREE BURN

SKIN REDDENED. Temporary treatment—Apply baking soda or Unguentine.

SECOND DEGREE BURN

SKIN BLISTERED. Temporary treatment—Apply baking soda, wet compress, white petroleum jelly, foille jelly, olive oil, or tea.



THIRD DEGREE BURN

FLESH CHARRED. Temporary treatment—Apply baking soda, wet compress, white petroleum jelly, or foille spray. Treat for severe shock.

BACK PRESSURE—ARM LIFT METHOD OF ARTIFICIAL RESPIRATION

(Courtesy of the American Red Cross)

1. Position of the subject (See Fig. 1)

Place the subject in the face down, prone position. Bend his elbows and place the hands one upon the other. Turn his fact to one side, placing the cheek upon his hands.

FIGURE 1

2. Position of the operator (See Fig. 2)

Kneel on either the right or left knee at the head of the subject facing him. Place the knee at the side of the subject's head close to the forearm. Place the opposite foot near the elbow. If it is more comfortable, kneel on both knees, one on either side of the subject's head. Place your hands upon the flat of the subject's back in such a way that the heels lie just below a line running between the armpits. With the tips of the thumbs just touching, spread the fingers downward and outward.

FIGURE 2

3. Compression phase (See Fig. 3)

Rock forward until the arms are approximately vertical and allow the weight of the upper part of your body to exert slow, steady, even pressure downward upon the hands. This forces air out of the lungs. Your elbows should be kept straight and the pressure exerted almost directly downward on the back.

4. Position for expansion phase (See Fig. 4)

Release the pressure, avoiding a final thrust, and commence to rock slowly backward. Place your hands upon the subject's arms just above his elbows.

FIGURE 3

5. Expansion phase (See Fig. 5)

Draw his arms upward and toward you. Apply just enough lift to feel resistance and tension at the subject's shoulders. Do not bend your elbows, and as you rock backward the subject's arms will be drawn toward you. Then lower the arms to the ground. This completes the full cycle. The arm lift expands the chest by pulling on the chest muscles, arching the back, and relieving the weight on the chest.

THE CYCLE SHOULD BE REPEATED 12 TIMES PER MINUTE AT A STEADY, UNIFORM RATE. THE COMPRESSION AND EXPANSION PHASES SHOULD OCCUPY ABOUT EQUAL TIME; THE RELEASE PERIODS BEING OF MINIMUM DURATION.

FIGURE 4

Additional related directions:

It is all important that artificial respiration, when needed, be started quickly. There should be a slight inclination of the body in such a way that fluid drains better from the respiratory passage. The head of the subject should be extended, not flexed forward, and the chin should not sag lest obstruction of the respiratory passages occur. A check should be made to ascertain that the tongue or foreign objects are not obstructing the passages. These aspects can be cared for when placing the subject into position or shortly thereafter, between cycles. A smooth rhythm in performing artificial respiration is desirable, but split-second timing is not essential. Shock should receive adequate attention, and the subject should remain recumbent after resuscitation until seen by a physician or until recovery seem assured.

FIGURE 5

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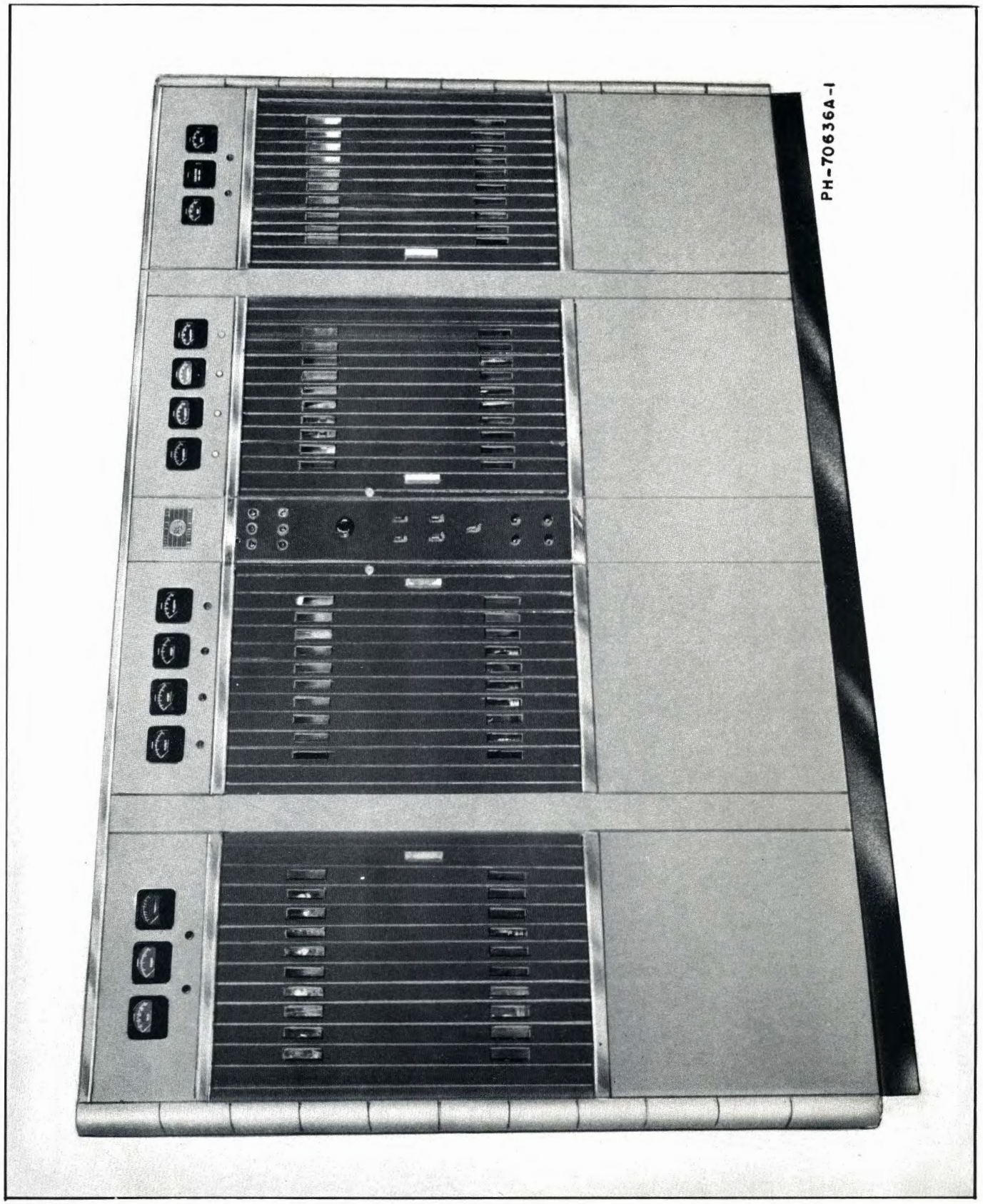


Figure 1. RCA Type BTA-5G or BTA-10G Transmitter

TECHNICAL SUMMARY

ELECTRICAL SPECIFICATIONS

	BTA-5G	BTA-10G
Type of Emission	A3 (telephone)	A3 (telephone)
Power Output, Maximum	5,500 watts	10,600 watts
Output Impedance	40 to 250 ohms	40 to 250 ohms
Frequency Range	535 to 1620 kc	535 to 1620 kc
Frequency Stability	±5 cycles	±5 cycles
A-F Input Level (100% mod.)	+10 ±2 dbm	+10 ±2 dbm
A-F Input Impedance	150/600 ohms	150/600 ohms
A-F Response:		
50 to 7500 cycles	±1.0 db	±1.0 db
30 to 10,000 cycles	±1.5 db	±1.5 db
A-F Distortion (95% mod.)		
50 to 10,000 cps	2.5% max.	2.5% max.
Type of Modulation	High level, class B	High level, class B
Carrier Shift, 0 to 100% modulation	Less than 5%	Less than 5%
Noise, Unweighted, below 100% modulation	60 db	60 db
R-F Voltage for Frequency and Modulation Monitoring	10 v. rms, 75 ohms	10 v. rms, 75 ohms
Main Power Supply	208/230 v., 3 phase, *50 or 60 cycles	208/230 v., 3 phase, *50 or 60 cycles
Power Consumption, Approx.:		
0% modulation	12 kw	20 kw
30% modulation	14 kw	24 kw
100% modulation	18 kw	33 kw
Power Factor	85%	85%
Permissible Combined Line Voltage Variation and Regulation	±5%	±5%
Auxiliary Power Supply (Crystal Heater, Lights, Convenience Outlets)	117 v., 1 phase, 50/60 cycles	117 v., 1 phase, 50/60 cycles
Crystal Heater Power Consumption	30 watts	30 watts
Filament Voltages	Regulated	Regulated
Ambient Operating Temperature, Max.	+45°C (+114°F)	+45°C (+114°F)
Altitude Range	0 to 5000 feet	0 to 5000 feet

MECHANICAL SPECIFICATIONS

DIMENSIONS AND WEIGHTS

Equipment	Uncrated Dimensions (inches)			Approx. Uncrated Weight (pounds)
	Height	Width	Depth	
Transmitter (less plate transformer)	84-1/4	130	32-9/16	4500
Plate Transformer:				
MI-28063	36-5/8	22-3/4	22-1/8	645
MI-28063-A	45	31-1/2	22	800
Building Entrance Requirements, Minimum	40	30	-	-

*Transmitter requires accessory kit for 50-cycle operation.

TUBE COMPLEMENT

RCA TYPE	BTA-5G	BTA-10G
807	6	6
813	2	4
828	2	2
833-A	1	1
5563-A	4	4
5762	4	5
8008	4	4
2D21	1	1
Total	24	27

EQUIPMENT LIST

The RCA Type BTA-5G and BTA-10G A-M Broadcast Transmitting Equipments are identified by the following RCA reference numbers:

BTA-5G - ES-28938

BTA-10G - ES-28940

Items comprising and associated with each equipment are as follows:

QUANTITY	DESCRIPTION	RCA REFERENCE	
		BTA-5G	BTA-10G
1	Modulator Unit	MI-28056	MI-28056
1	Power Amplifier Unit	MI-28057	MI-28057
1	Exciter Unit	MI-28058	MI-28058
1	Rectifier and Control Unit	MI-28059	MI-28059
1	Control Panel and Installation Material Kit	MI-28060	MI-28060
1	Set of End Shields	MI-28061	MI-28061
1	Plate Transformer	MI-28063 or MI-28063-A	MI-28063 or MI-28063-A
1	Conversion Kit, 5 KW to 10 KW		MI-28062
*	TMV-129B Crystal Oscillator Units including crystals, for customer's frequency	MI-7467	MI-7467
*	Set of Operating Tubes	ES-28941	ES-28941
*	Set of Operating Conversion Tubes, 5 KW to 10 KW		ES-28943
1	Set of Frequency-Determining Parts, to suit customer's frequency	MI-28090-freq	MI-28091-freq
1	Miscellaneous Hardware Kit (spares)	MI-7474	MI-7474
1	Finish Touch-Up Kit	MI-7499-A	MI-7499-A
1	Nameplate	MI-28180-1	MI-28180-1

QUANTITY	DESCRIPTION	RCA REFERENCE	
		BTA-5G	BTA-10G
*	Type BTC-1B Control Console ---------	MI-28950-A	MI-28950-A
*	Type BPA-10 Antenna Tuning Equipment including Monitor Rectifier ---------	MI-28902-B	MI-28902-B
*	R-F Output Meter, to suit customer's frequency and antenna ----------	MI-7157-F	MI-7157-F
*	Remote Antenna Ammeter, to suit customer's antenna ----------	MI-28037	MI-28037
*	Conversion Kit, 60 to 50 cycles ---------	MI-28055	MI-28055
*	Conversion Kit, 60 to 50 cycles ---------		MI-28074
*	Power Change Kit, 10 KW to 5 KW -----		MI-28092
*	Power Change Kit, 5 KW to 1 KW -----	MI-28092-A	
*	Set of Spare Tubes, FCC Requirements ---	ES-28942	ES-28942
*	Set of Spare Conversion Tubes, FCC Requirements, 5 KW to 10 KW -----		MI-28086
*	Installation Instruction Book ---------	IB-30226	IB-30226
2	Instruction Book ----------	IB-30221-1	IB-30221-1

* Supplied if and as specified by sales order.

RECOMMENDED TEST EQUIPMENT

The following items, or equivalents, are necessary for adjustment, tune-up, and maintenance of the BTA-5G and BTA-10G transmitters:

RCA REFERENCE	ITEM
WA-28A	Audio Oscillator
WM-71A	Distortion and Noise Meter
WV-97A	VoltOhmyst
WO-88A	Oscilloscope

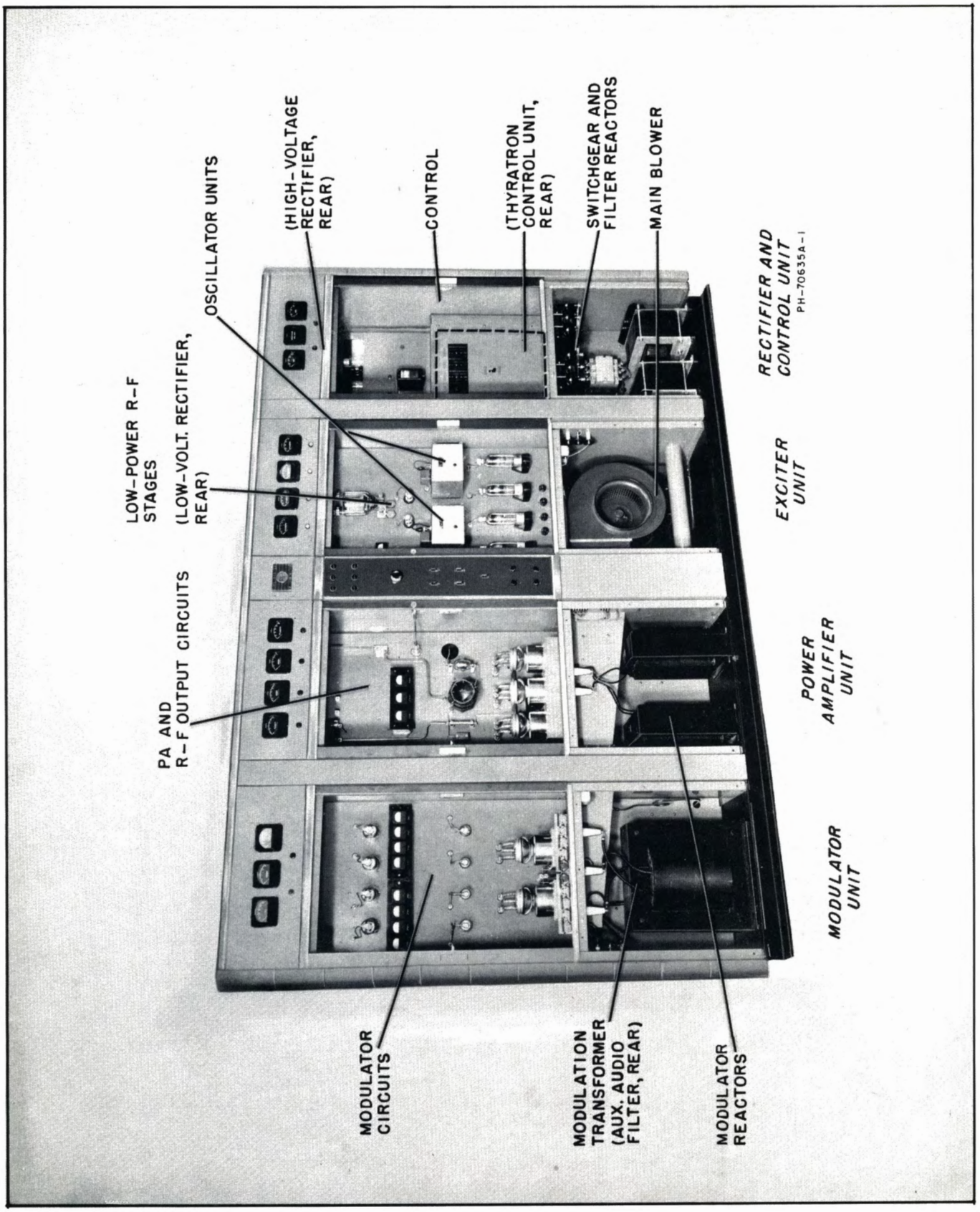


Figure 2. Unit and Chassis Locations, Front View

DESCRIPTION

GENERAL

The RCA Types BTA-5G and BTA-10G transmitters are designed for high-fidelity a-m broadcasting on any frequency from 535 kc to 1620 kc. The BTA-5G transmitter has a nominal rated power output of 5,000 watts, while the BTA-10G equipment provides 10,000 watts nominal output. Maximum power outputs, to compensate for losses in the transmission line and antenna tuning equipment, are 5,500 watts and 10,600 watts for the BTA-5G and BTA-10G units, respectively.

Illustrated in Figure 1, the transmitters employ air-cooled tubes throughout and are supplied with two crystal units so that one unit is always available as a spare. An input power source of 208/230 volts, 60 cycles, 3-phase, is required for transmitter operation; the crystal heaters utilize 117 volts, 50/60 cycles, 1-phase power.

Items associated with the transmitters, but supplied only as indicated under EQUIPMENT LIST, include the BTC-1B Universal Control Console, the BPA-10 Antenna Tuning Equipment, an r-f output meter, a remote antenna ammeter, and speech input and monitoring equipment.

Optional items utilized in connection with the BTA-5G and BTA-10G transmitters include several kits which serve to extend the useful function of the equipment. Thus, the MI-28062 Conversion Kit enables the BTA-5G equipment to be converted at any time into the BTA-10G transmitter, for 10-kw power output. A power change kit provides means for reducing output power from 10 kw to 5 kw or from 5 kw to 1 kw, where day-night broadcasting conditions dictate a power change.

CONSTRUCTION

The transmitter proper is housed in four metal cabinets with an 8-inch control panel at the center of the cabinet group. Sliding-type doors are utilized at the front and rear of each cabinet, conserving floor space and facilitating adjustments. The cabinets rest on metal wiring ducts, front and rear, on which removable plates provide for easy access to the interconnecting wiring. All interconnections between cabinets are made through a preformed cable supplied.

Vertical panel construction is utilized throughout to provide maximum accessibility to components for maintenance or servicing. All tubes are visible through the window in the sliding doors to permit observation of operating conditions. With the exception of the front door on the rectifier and control unit, all sliding doors and lower access panels are interlocked so as to open high-voltage supply lines and automatically ground the high-voltage circuits. Compartment lights and a-c convenience outlets are mounted inside the cabinets.

The main blower, mounted in the lower part of the exciter cabinet, serves to cool the entire transmitter through flexible interconnecting ducts. A differential type air interlock protects the equipment in the event of reduced or lack of air pressure. An auxiliary blower cools the high-voltage rectifier tubes.

The air-cooled high-voltage plate transformer, generally mounted near the transmitter, is completely enclosed in a metal shield and does not require a separate fireproof vault.

COMPONENTS IDENTIFICATION

Each circuit component in the BTA-5G/10G transmitters carries a symbol prefix number which designates the chassis or cabinet in which it is located. Table 1 lists the transmitter items; Figure 2 shows the chassis locations.

TABLE 1. COMPONENT SYMBOL PREFIX NUMBERS

ITEM	COMPONENT SYMBOL PREFIX	EXAMPLE
Crystal oscillators	none	C29
Modulator	1	1R16
Power amplifier	2	2L5
Exciter	3	3V2
Rectifier and control	4	4K9
Control panel (in center)	5	5S7
High-voltage plate transformer	6	6T1
Thyratron rectifier	10	10R3

The letter in each component symbol indicates the class or type of component, while the final number identifies the individual items. Table 2 lists the types of components by their letter or alphabetical classification.

TABLE 2. COMPONENT LETTER DESIGNATIONS AND TYPES

LETTER	TYPE
B	Blowers, motors, phase shifters
C	Capacitors
CR	Crystal or metallic rectifiers
F	Fuses
I	Indicator lamps
J	Connector jacks
K	Relays or contactors
L	Inductors
M	Meters
P	Connector plugs
R	Resistors
S	Switches or interlocks
T	Transformers
V	Tubes
VR	Voltage regulators
XC	Sockets for capacitors
XI	Sockets for indicator lamps
XV	Sockets for tubes
Y	Crystals (oscillating)
Z	Impedance networks

Utilizing Tables 1 and 2 and Figure 2, an item with the symbol 2R8 would be in the power amplifier (2) and would be a resistor (R). The "8" refers to the particular item bearing this number. This system is maintained throughout all drawings, parts lists, instruction book text, and for the markings inside the transmitter.

CIRCUITS

Figure 3 is the block diagram for the BTA-5G/10G equipment. Overall schematic diagrams for the BTA-5G and BTA-10G transmitters are supplied in Figures 20 and 21, respectively.

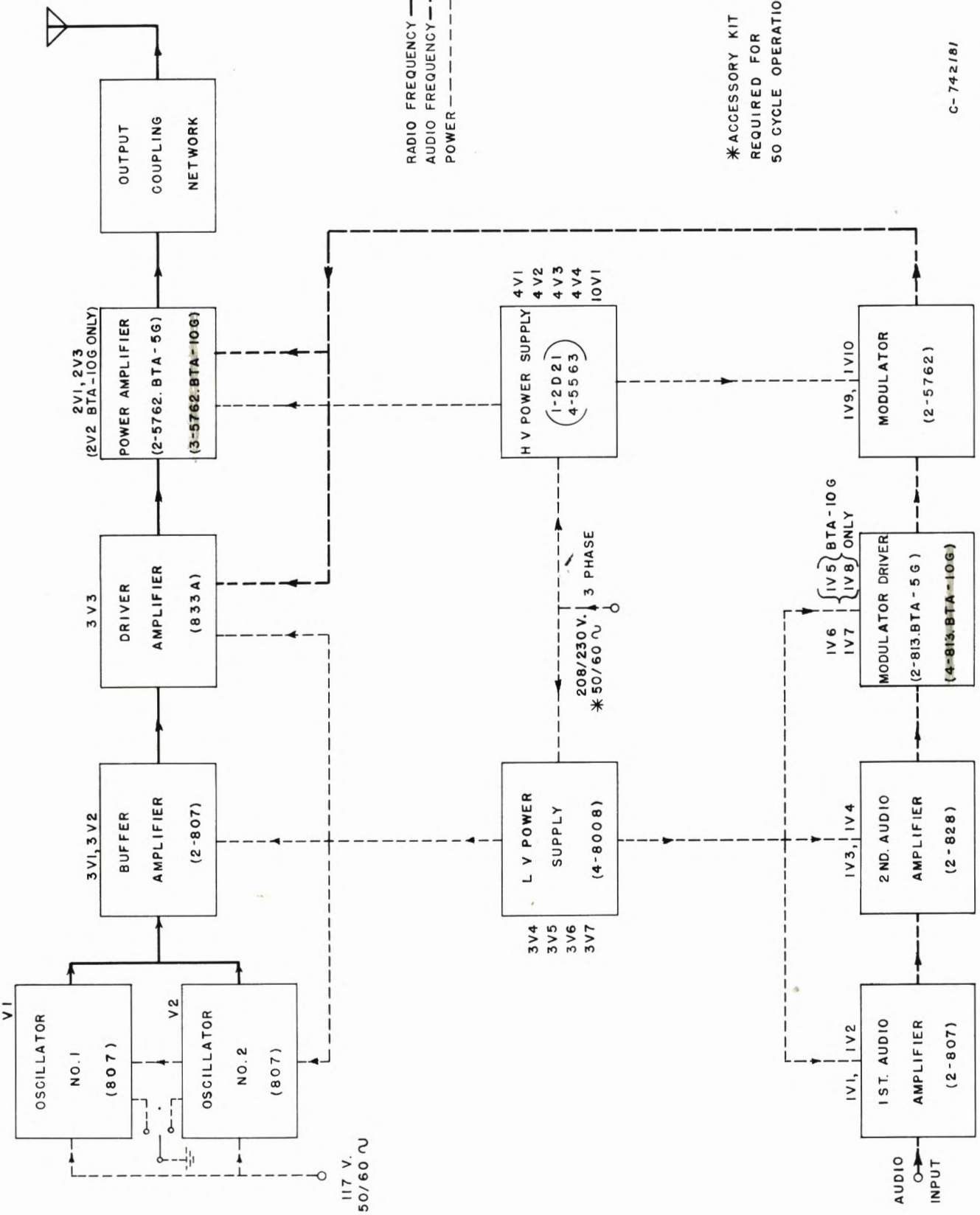


Figure 3. Overall Block Diagram (742181)

Radio-Frequency Circuits

The BTA-5G and BTA-10G transmitters are supplied with two oscillator units complete with crystals. These oscillators may be adjusted to the exact assigned frequency by means of a vernier control and will maintain this frequency within plus or minus five cycles. Front panel oscillator switching is provided to enable selection of either oscillator. The oscillator feeds two type 807 tubes in parallel, operating as a buffer amplifier with a tapped coil in the plate circuit. No neutralization is required, and the plate circuit does not require tuning after initial set-up has been made. The frequency monitor coupling is taken from the cathode circuit of the buffer stage.

The buffer excites a driver amplifier which consists of one 833-A tube utilizing a tunable inductor in the plate circuit, and a broadband neutralization transformer.

The 833-A tube drives the power amplifier which consists, in the BTA-5G, of two parallel-connected 5762 tubes. A third 5762 tube is added in the power amplifier of the BTA-10G. The plate circuit of the power amplifier is tuned by a vacuum-type variable capacitor, neutralization being accomplished by means of a broadband transformer. All r-f stages in the transmitter operate class C.

The power amplifier tank circuit and output matching components form a symmetrical network which provides equal load impedance to both sidebands, thereby eliminating a possible source of distortion. A transformer connected in the transmitter output circuit supplies energy to the modulation monitor.

Audio-Frequency Circuits

The audio amplifier consists of two 807 tubes, operating push-pull class A, resistance coupled to two 828 tubes also operating push-pull class A. These tubes are resistance coupled to two 813 tubes (in the BTA-5G transmitter) operating push-pull class AB_1. In the BTA-10G, two additional 813's are added to form a push-pull parallel class AB_1 circuit. The sockets and circuitry for these tubes are factory wired into the BTA-5G transmitters to facilitate a power increase. This modulator driver amplifier is direct-coupled to the two 5762 class B modulator tubes, which provide high-level plate modulation power to the r-f power amplifier.

Low audio distortion within the frequency range of 50 to 10,000 cycles, at all percentages of modulation, is obtained by modulating the plate voltage of the r-f driver simultaneously with that of the power amplifier. This improves the linearity of the power amplifer by varying its grid drive in proportion to the modulation. Hum and distortion are further reduced by utilizing inverse feedback in the audio section.

Use of type 5762 tubes in both the power amplifier and the modulator stages permits interchange of tubes between these stages with consequent increase in the useful tube life. Filament voltages for all tubes in the transmitter are regulated to extend tube life.

Power Supplies

Bias voltage for the audio driver amplifier and the modulator tubes is obtained from a selenium rectifier. The low plate and screen voltages for the oscillators, buffer and driver amplifiers, and the audio stages are supplied by a low-voltage rectifier which uses four RCA-8008 tubes. Plate voltages for the power amplifier and modulator are obtained from a four-phase rectifier utilizing four type 5563-A thyratron tubes.

Thyratron Rectifier Circuit

The thyratron rectifier employs four thyratron tubes, 4V1 to 4V4, in a circuit which provides a normal voltage of 4750 volts dc but which is adjustable for outputs from 0 to 5000 volts. Advantage is taken of the basic thyratron principle whereby anode conduction

can be prevented by the use of a suitably-high negative bias. Once conduction has started, however, the grid loses control and conduction can be stopped only by making the anode negative with respect to the filament.

The thyratrons are normally biased to about -90 volts, which is sufficient to prevent conduction under any condition of plate voltage. Conduction may then be initiated by superimposing, on the bias, a sharp voltage pulse which overcomes the bias. By accurately controlling the timing of the pulse, so that conduction starts at the beginning or end of the positive half-cycle of the a-c plate supply, either maximum or minimum output voltage is obtained from the rectifier. Any intermediate timing of the pulses results in an output voltage intermediate between maximum and minimum.

The high-voltage thyratron rectifier utilizes a four-phase star connection in which the a-c anode voltages of adjacent tubes 4V1 to 4V4 are 90^{0} apart instead of 120^{0}, as in the more familiar three-phase rectifier circuit. The phase change from the three-phase line to the four phases supplying the rectifier tubes is accomplished by the use of two transformers in a single housing (6T1). The primary winding of 6T1 is Scott-connected, as shown in the schematic diagram.

Grid voltage for the thyratrons carries three requirements:

1. Proper negative grid bias.
2. Positive grid pulses.
3. Means for varying pulse phase.

The 90-volt grid bias is developed by rectifier 10CR6, in the secondary circuit of transformer 10T1, and applied to the thyratron grids through 10CR4 and 10CR5.

The positive grid pulses are generated in "pulse" transformers 10T2 and 10T3. The voltage supplied to the "pulse" transformers is obtained from stepdown transformers 4T6 to 4T8, which first reduce the incoming voltage from 230 to 115 volts. Output from 4T6 to 4T8 is coupled to synchro 5B1, which serves as a phase shifter for the three-phase output to transformers 4T3 and 4T4. The required four-phase output is obtained by Scott-connection of the primaries of 4T3 and 4T4. Transformers 4T3 and 4T4 also serve as high-voltage isolation transformers since all circuits beyond this point are at high potential.

The two "pulse" transformers, 10T2 and 10T3, convert the 60-cycle sine-wave input to a 60-cycle peaked voltage, or pulse, with a magnitude of about 190 volts peak. The connections from 10T2 and 10T3 to the rectifier tubes, therefore, carry both the 90-volt grid bias and the superimposed 190-volt pulse.

High-Voltage Overload Protective Circuit

Ability of the thyratron grids to control the high-voltage d-c output is utilized in the associated overload protection circuits. Thus, to interrupt the high-voltage at any time, it is necessary only to supply a negative bias voltage high enough to over-ride the positive 190-volt pulses on the grid. This high-value bias is provided by the overload circuit which, when energized, furnished -250 volts to the thyratron grids, preventing ignition, and interrupting the d-c output within less than one-half cycle of the power-line frequency. In addition to this extremely rapid protection, automatic recycling of the overload protective circuits is provided.

Basically, the overload circuit utilizes a type 2D21 thyratron, 10V1, which is normally biased so as to be non-conducting. When an overload occurs, however, the increased current flow provides a positive voltage which overcomes the bias on the 2D21 tube and causes it to fire. Firing of this tube develops the required -250 volts bias on the thyratron grids, stops their conduction, and causes the overload relays to remove all high voltages.

Fixed bias for the type 2D21 tube, 10V1, is developed by rectifier 10CR6, which also supplies the -90 volts bias for thyratron rectifier 4V1 to 4V4. Under normal operating conditions, the positive voltage developed across PA plate and modulator resistors 4R21 and 4R22 is less than the bias on 10V1 so that it does not conduct. When an overload occurs, however, the increased voltage drop across 4R21 and 4R22 will apply a higher positive voltage on the grid of 10V1, overcoming the fixed bias and causing 10V1 to fire.

When 10V1 conducts, a negative voltage equal to that developed by rectifier 10CR6, plus the voltage appearing across resistor 10R3 and relay 10K4, will be applied through rectifiers 10CR4 and 10CR5 to the grids of 4V1 to 4V4. These tubes will then stop conducting, removing all high plate voltages from the power amplifier and modulator stages. Potentiometer 10R4 provides means for adjusting the overload operating level.

Automatic recycling is provided by relay 10K1, in the plate circuit of 10V1, which operates approximately one-quarter second after 10V1 begins to conduct, due to the time constant of 10C3, 10R13, 10R6, and 10K1. This opens the plate circuit of 10V1 and stops conduction. The -250 volts cut-off bias is then removed from the grids of 4V1 to 4V4 and plate voltage will be reapplied to the power amplifier and modulator stages.

If the overload persists, control tube 10V1 will be re-energized and again remove the high voltage. This automatic recycling will be repeated approximately eight times within a period of two seconds. At the end of this interval, which is determined by delay capacitors 10C1 and 10C2, relay 10K2 will be energized, short circuiting control tube 10V1 and locking itself in this position. Cut-off bias is then applied countinuously through the contacts of 10K2 to the grids of 4V1 to 4V4.

Whenever tube 10V1 conducts, relay 10K4 in its cathode circuit is closed momentarily, thereby energizing relay 4K5 which seals itself closed and lights the H. V. OVERLOAD indicator, 4I4.

After the overload has been cleared, the overload protection circuit may be reset and the H. V. OVERLOAD indicator lamp extinguished by pressing HV OL RESET button 5S4 on the control panel.

Rectifier Arc-Back Protective Circuit

Protection of the thyratron rectifier tubes against arc-back is obtained in a manner similar to that used for overload protection. Thus, a high negative bias is used to prevent thyratron ignition in the event of an arc-back.

The anode current of each thyratron rectifier tube flows through one of the associated resistors - 4R1 to 4R4. In shunt with each resistor is one of the following relay-rectifier combinations: 4K1-4CR1, 4K2-4CR2, 4K3-4CR3, and 4K4-4CR4.

Normally, the current flow through the associated cathode resistors, 4R1 to 4R4, is kept from the cathode of 10V1 by the selenium rectifiers, 4CR1 to 4CR4.

In the event of an arc-back in one of the rectifier tubes, the current flow is reversed through the cathode resistors and this voltage is applied to the grid and cathode of 10V1. Tube 10V1 then fires, and the high plate voltages are removed as previously described for overloads.

To indicate which tube is involved in the arc-back, relay 4K1 to 4K4 have holding contacts and remain energized when an arc-back occurs. This lights the associated indicator lamps, 4I5 to 4I8, which remain lit until the OL LAMP RESET pushbutton, 5S9, is depressed.

Monitoring Circuits

To provide for operation of a modulation monitor, transformer 2T2 and jack 2J1 are furnished.

R-f output from the transmitter is measured by r-f ammeter 2M6 in the output network. Remote antenna ammeter connections are also shown for 2M6, for use when the BPA-10 Antenna Tuner and monitor rectifier are utilized.

Control Console

The RCA Type BTC-1B Universal Transmitter Control Console is not supplied with the transmitter but is available on separate order. The BTC-1B console provides centralized control of audio mixing circuits and transmitter control circuits.

Individual-turret design divides the console into two sections: one section is devoted to microphone, audio, monitoring, and related circuits; the other console section contains all necessary indicating lights and switches for normal transmitter operation.

The BTC-1B console is of all-metal construction and is assembled at the time of installation from two turret control sections, two desk sections, and two end sections.

Additional data on the BTC-1B console is contained in the instruction book supplied with the console.

POWER-CHANGE CIRCUIT

The optional power change, or cut-back circuit is utilized where reduced output power is required for night operation. This circuit incorporates either of two kits, depending on the transmitter power. The MI-28092 kit enables the BTA-10G output to be reduced to 5 kw merely by throwing a switch. Similarly, the BTA-5G transmitted power can be reduced to 1 kw by installation of the MI-28092-A kit.

BTA-5G Power-Change Kit

The MI-28092-A kit is utilized for power reduction in the BTA-5G. Power change is accomplished by switching 5S6 to the "low-power" position, which connects a second synchro unit, 12B1, in place of 5B1. Synchro 12B1 can then be adjusted to provide a lower PA and modulator plate voltage for reduced power. The BTA-5G transmitter at 1-kw output normally operates at approximately 2200 volts plate power.

To provide the necessary bias change for the modulator tubes, resistors 11R2A and 11R2B are switched in or out, as required. Simultaneously, pad 11R1 is switched in for low-power operation to maintain a constant modulation level.

Synchro 12B1 is switched in place of synchro 5B1 to provide a lower value of plate voltage for reduced power output. The primaries of 12B1 and 5B1 are energized at all times, but the secondaries are connected as required through the contacts of relay 12K1. Indicator lights 2I2 and 2I3 serve to indicate the power output level of the transmitter.

BTA-10G Power Change Kit

The BTA-10G Power Change Kit, MI-28092, functions to reduce the r-f output of the BTA-10G by unloading the power amplifier stage by means of an r-f contactor. When the contactor is energized by operating switch 5S6 to the HI-POWER position the coupling tap on coil 2L3 is adjusted for 10-kw output. When the contactor is de-energized by operating switch 5S6 to the LO-POWER position, the low power coupling tap is adjusted for 5 kw output.

Simultaneously with the operation of the r-f contactor, the compensator relay is operated. This relay automatically compensates for a-f response.

INSTALLATION

Installation details for the BTA-5G/10G transmitters are supplied in a separate instruction book, IB-30226, and will not be repeated here. For a check on components installed or connected during installation, refer to the associated photographs, Figures 7 to 19, and the following connection diagrams:

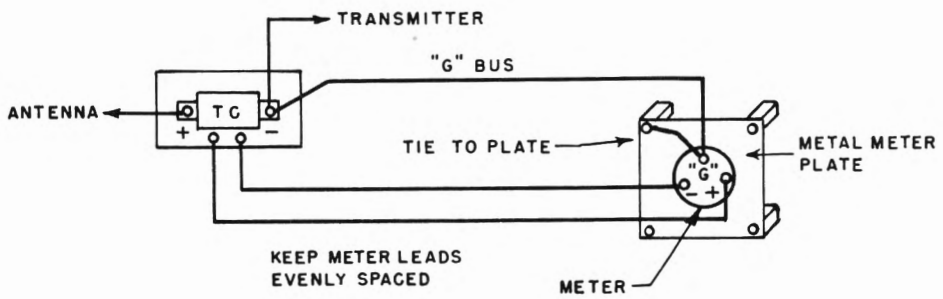
UNIT	CONNECTION DIAGRAM
Control Panel	Fig. 23
Modulator	Fig. 24
Thyratron	Fig. 25
Power Amplifier	Fig. 26
Exciter	Fig. 27
Rectifier and Control	Fig. 28

For BTA-10G transmitters, where the MI-28062 conversion kit has been installed, check all connections against the overall schematic diagram, Figure 21.

Vacuum capacitor 2C18, item 4 of MI-28057, was set aside during installation and should be installed at this time. When handling vacuum capacitors use all precautions normally observed with vacuum tubes. Do not use excessive force during installation and be certain that the connector on the free end does not exert undue mechanical strain.

To install capacitor 2C18, operate the PA TUNE control to the maximum clockwise setting, using the tuning crank supplied. Rotate the shaft of capacitor 2C18 slowly by hand to its maximum clockwise setting, until a definite stop is felt. Then rotate the shaft approximately one turn in the opposite direction. Insert the capacitor in the mounting clamp, Figure 10, until the capacitor shaft is well seated in the drive shaft coupling. Tighten the mounting clamp and the two setscrews in the coupling. Connect the free end to terminal 57B as shown in Figure 26.

Where an antenna ammeter is to be connected, the following installation procedure should be utilized:



In order to prevent excessive r-f voltages from developing across the meter movement, it is necessary that the dummy meter case be used to insulate the meter from the front panel. In addition, the meter plate, the thermocouple and the meter should be connected together with a common bus, as illustrated in the drawing. This bus is connected between the "G" terminal of the meter, the transmitter side of the thermocouple and the meter mounting plate.

Care should be taken in properly dressing the leads from the thermocouple to the meter. They must be kept at a safe distance from the transmitter chassis and dressed with equal spacing, as is normally done in the case of open wire transmission line.

If these precautions are observed, no difficulty should be experienced with meter movement failures.

Install the two crystal units on the shelves in the front of the exciter cabinets.

The tubes and frequency-determining parts should not be installed at this time; explicit instructions will be supplied in the next section, ADJUSTMENTS AND TUNING.

ADJUSTMENTS AND TUNING

ADJUSTMENTS

Before any attempt is made to apply plate and bias voltages to the transmitter, the control and protective circuits should be checked to insure that all connections have been made properly. This will make certain of the designed equipment protection and prevent possible damage to components. The cause of any deviation from specified operation should be corrected before proceeding with any subsequent operations.

Control Circuit Check

Check to make certain no transmitter tubes have been installed in their sockets. Operate all circuit breakers and switches to the **OFF** position, including plate circuit or transmitter-start switches on the console.

Check the high-voltage grounding switches for proper operation, using a battery and buzzer, or the low scale on the ohmmeter.

At terminals 27D and 28D, disconnect the primary leads to low voltage transformer 3T3. Refer to Figures 16 and 28 for details. Carefully tape and insulate these leads to prevent accidental contact or grounding. Similarly, disconnect and tape the primary leads to high-voltage transformer 6T1.

Take out the six screws holding the panel cover plate situated over the overload relays in the Rectifier and Control Unit. This cover plate is at the front of the cabinet, just above the center partition. Removal of this plate will facilitate observation of the overload relays during checking.

Connect an external indicator light or alarm between terminals 13D and 14D. This light will operate on 230 volts ac and is intended for checking low-voltage overloads by providing visual or aural warning of any irregularity during this check.

Using a piece of insulating material, block air interlock relay 4K13 so that it will remain in the closed position.

Close the incoming power switches which supply 115 volts, single-phase ac for the crystal heaters, cabinet lights, and convenience outlets. The CRYSTAL HEATER 1 and CRYSTAL HEATER 2 lights, 3I3 and 3I4, should glow and will be energized intermittently with operation of the crystal heater thermostats. The lumiline lamps at the front and rear of each cabinet should light when panel **LIGHTS** switch 5S3 is closed.

Close the incoming power switches so as to make 230 volt, three-phase ac available at the transmitter.

Note that the primary windings of plate transformer 6T1 are supplied with ±5% taps which may be changed by opening the enclosure doors. Transformer 6T1 is also equipped with series line reactors to limit the fault current. In operation, if the voltage regulation does not fall within prescribed limits due to unusually high power-line impedance, the reactors may be short-circuited by means of the links provided.

TABLE 3. TRANSFORMER PRIMARY TAPS, BTA-5G AND BTA-10G

Transformer	208-VOLT LINE			230-VOLT LINE		
	-5%	208V	+5%	-5%	230V	+5%
1T2	1-2	1-2	1-3	1-3	1-4	1-4
1T5	1-2	1-2	1-3	1-3	1-4	104
1T6	208, -5%	208, 0	208, +5%	230, +5%	230, 0	230, +5%
1T7	190	190	205	205	220	220
1T8	190	190	205	205	220	220
2T3	190	190	205	205	220	220
2T5	190	190	205	205	220	220
3T2	1-2	1-2	1-3	1-3	1-4	1-4
3T3	208, -11	208, 0	208, +11	230, -11	230, 0	230, +11
3T4	190	190	205	205	220	220
3T5	190	190	205	205	220	220
4T1	190	190	205	205	220	220
4T2	190	190	205	205	220	220
4T5	208, -11	208, 0	208, +11	230, -11	230, 0	230, +11
6T1	See transformer nameplate					

HO 94096

Operate LINE breaker 4S1 and TRANSMITTER switch 5S1 to the ON position. Contactor 4K6 should close.

Close CONTROL switch 4S4. In the Rectifier and Control Unit, blower 4B1 will start and CONTROL SHORT indicator lamps 4I9 and 4I10 will glow dimly inasmuch as they are in series across the 230-volt control circuit. Since 4K13 has been blocked in the closed position, its contacts are closed, and filament contactor 4K8 will be energized.

Close FILAMENT switch 4S8. The following should take place.

ITEM	ACTION
Filament hours meter 4M3	energized
Filament lamp 2I4	energized
Plate time-delay relay 4K12	energized, closes after 60 seconds
High-voltage overload reset relay 4K14	energized
Thyratron undervoltage relay 10K3	energized

Using a voltmeter of known accuracy, measure the filament voltage at each tube socket. These voltage readings should be approximately as listed in Table 4 but will generally be higher since tubes are not in the sockets.

TABLE 4. TUBE SOCKET FILAMENT VOLTAGES

TUBE SYMBOL	SOCKET VOLTAGE	POINT OF MEASUREMENT
1V1, 1V2	6.3 volts	pins 1-5
1V3, 1V4	10 volts	pins 1-5
1V5 to 1V8	10 volts	pins 1-7
1V9, 1V10	12.6 volts	fil. terminals
2V1 to 2V3	12.6 volts	fil. terminals
3V1, 3V2	6.3 volts	pins 1-5
3V3	10 volts	fil. terminals
3V4 to 3V7	5 volts	pins 2-3
4V1 to 4V4	5 volts	pins 2-4
10V1		pins 3-4

Close all interlocked sliding doors and make sure all the lower panel covers are in place. This should complete the interlock circuit and INTERLOCK lamp 1I3 will light.

Close the BIAS circuit breaker, 4S5, applying power to the modulator bias supply and lighting BIAS lamp 1I4. Under-bias relay 1K3 should be energized and BIAS VOLTAGE meter 1M11 should indicate approximately 450 volts.

Operate PLATE circuit breaker 4S2 and PLATE switch 5S2 to the ON position. Low-voltage contactor 4K10 will be energized and a set of contacts on 4K10 will close high-voltage contactor 4K9. HIGH VOLTAGE lamp 2I1 should light.

Opening PLATE switch 5S2 should de-energize HIGH VOLTAGE lamp 2I1 and contactor 4K9.

Check the interlock protective circuit by successively opening and closing each interlocked sliding door or lower panel cover. In each case the INTERLOCK lamp, 1I3, and the HIGH VOLTAGE lamp, 2I1, should be extinguished then re-energized.

With the PLATE breaker and PLATE switch in the ON position, open the BIAS breaker, 4S5. The following should take place:

ITEM	ACTION
Under-bias relay 1K3	de-energized
BIAS lamp 1I4	de-energized
BIAS VOLTAGE meter 1M11	no reading
HIGH VOLTAGE lamp 2I1	de-energized
High-voltage plate contactor 4K9	de-energized
Low-voltage plate contactor 4K10	de-energized

Now close BIAS breaker 4S5 and, after all lights and relays have been re-energized, open FILAMENT switch 4S8. The following should take place:

ITEM	ACTION
FILAMENT HOURS meter 4M3	de-energized
FILAMENT lamp 2I4	de-energized
Plate time-delay relay 4K12	de-energized
Under-bias relay 1K3	de-energized
BIAS lamp 1I4	de-energized
BIAS VOLTAGE meter 1M11	no reading
HIGH VOLTAGE lamp 2I1	de-energized
High-voltage plate contactor 4K9	de-energized
Low-voltage plate contactor 4K10	de-energized

Close FILAMENT switch 4S8, so as to restore power on all items de-energized.

Simulate an overload in the low-voltage power system by mechanically tripping overload relay 4K7. Normally-closed contacts of 4K11 should open in the plate circuit causing the following to occur:

ITEM	ACTION
Low-voltage plate contactor 4K10	de-energized
High-voltage plate contactor 4K9	de-energized
HIGH VOLTAGE lamp 2I1	de-energized
LOW VOLTAGE O. L. lamp 4I3	energized
(External light or alarm)	energized

Depress O. L. RESET pushbutton 5S7. This will extinguish LOW VOLTAGE O. L. lamp 4I3 and restore the previous condition to the low-voltage power circuits. Open the LINE breaker.

Remove the covers from the following relays: 1K1, 1K2, 2K1, 2K2, 2K3, 4K1, 4K2, 4K3, 4K4, 10K1, and 10K2, so that overload checks can be made.

Install a type 2D21 tube in socket 10XV1 on the thyratron control chassis. Then swing the thyratron control unit outward on its hinges.

Operate LINE breaker 4S1 and TRANSMITTER switch 5S1 to the ON position. Check the closing time of time-delay relay 4K12, the contacts of which should close in approximately 60 seconds.

Close the LINE breaker and, using an insulated screwdriver, short-circuit pin 2 of socket 10XV1 to chassis for a period of approximately three seconds.

Relay 10K4 should close, lighting HIGH-VOLTAGE O. L. lamp 4I4 and energizing relay 4K5. Relay 4K5 will seal itself in the closed position, and the external lamp or alarm will be energized.

Relay 10K1 will operate through about eight cycles (approximately two seconds), after which period relay 10K2 should close and seal itself in that position.

Depress the HIGH-VOLTAGE O. L. RESET pushbutton, 5S4. Relay 4K5 should be de-energized, along with HIGH-VOLTAGE OVERLOAD lamp 4I4 and the external lamp. Relay 4K14 will open and de-energize relay 10K2. When pushbutton 5S4 is released, relay 4K14 will be energized.

Open LINE breaker 4S1. Swing the thyratron control chassis back into its normal position and secure it in position with the chassis twist-lock fasteners. Close the LINE breaker.

Using an insulated rod, simulate an overload by mechanically closing overload indicator relay 1K1. The relay should seal itself in the closed position and MOD-1 O. L. indicator lamp 5I4 should light. Depressing O. L. LAMP RESET pushbutton 5S9 should de-energize relay 1K1 and lamp 5I4.

In a similar manner, simulate overloads one by one in the following relays which should light the lamps noted:

OVERLOAD RELAY	INDICATOR LAMP
1K2	MOD-2 O. L., 5I5
2K1	PA-1 O. L., 5I1
2K2	PA-2 O. L., 5I2
2K3	PA-3 O. L., 5I3 (BTA-10G only)
4K1	ARC BACK 4V1, 4I5
4K2	ARC BACK 4V2, 4I6
4K3	ARC BACK 4V3, 4I7
4K4	ARC BACK 4V4, 4I8

Remove all power by opening TRANSMITTER switch 5S1 and LINE breaker 4S1. Replace the covers over the overload relays.

Install the type 5762 PA tubes, 2V1 and 2V2, and the type 5762 modulator tubes, 1V9 and 1V10, in their respective sockets. Do not, however, connect the leads to the tubes.

Remove the insulating material previously inserted to block air interlock relay 4K13 in the closed position.

Close all interlocked sliding doors and make sure the cabinet lower panel covers are in place.

Operate LINE circuit breaker 4S1 and TRANSMITTER switch 5S1 to the ON position. After time-delay relay 4K12 has closed, operate PLATE switch 5S2 to the ON position. Note that closing of 5S2 does not energize any relays since air interlock relay 4K13 is not energized.

Operate BLOWER circuit breaker 4S7 to the ON position. Main blower 3B1 should start and, when the blower reaches operating speed, the air interlock switch 1S5 should close, energizing air interlock relay 4K13. Check the direction of blower rotation which should rotate counterclockwise when viewed from the front of the transmitter. If rotation is incorrect, open the LINE breaker and interchange any two of the 230-volt 3-phase power line connections at the transmitter. DO NOT INTERCHANGE CONNECTIONS AT THE BLOWER.

Operating the OSC switch, 5S5, to the OSC. 1 or OSC. 2 positions should energize the associated indicator lights, 3I5 or 3I6.

Switching power switch 5S6 to the HI POWER or LO POWER positions should energize indicator lamps 2I2 or 2I3.

Since the remainder of the control circuits have already been checked, operate the TRANSMITTER switch and the LINE breaker to the OFF position. Operate all other panel breakers and switches to the OFF position.

Reconnect the primary leads of 3T3 to terminals 27D, 28D, and those to transformer 6T1.

Check the settings of the LINE and PLATE circuit breakers. The pointer on these breakers should be as follows:

LINE, 4S1	PLATE, 4S2
pointer at 800 (BTA-5G)	pointer at 600 (BTA-5G)
pointer at 1100 (BTA-10G)	pointer at 900 (BTA-10G)

These breakers are indicated in Figure 15. Replace the panel cover plate on the Rectifier and Control Unit.

Install the remainder of the tubes, but do not connect the plate caps on the type 5563-A and 8008 rectifier tubes. Make certain these caps do not touch ground. Then re-apply filament power and allow the transmitter to operate in this condition for a minimum of 30 minutes. This procedure will expel all mercury globules from the filaments of the type 5563-A and 8008 rectifier tubes. This 30-minute "seasoning" procedure should be repeated whenever new tubes are installed. In the future, whenever the mercury-vapor rectifier tubes are removed from their sockets, they should be handled carefully and in an upright position. If this is not done, it will be necessary to repeat the 30-minute break-in procedure before plate voltage is applied.

Operate all circuit breakers and switches to the OFF position.

ARC-GAP ADJUSTMENT

Adjust the spacing of the protective arc-gaps to the values listed in Table 5.

TABLE 5. ARC-GAP SPACING

UNIT	LOCATED ON OR NEAR	SPACING
Modulator	sockets, 1XV9, 1XV10	1/8 inch
Exciter	reactor 3L8	1/16 inch
Rectifier and Control	reactor 4L1	1/16 inch
Rectifier and Control	reactor 4L2 (BTA-10G only)	1/16 inch

TUNING

Before actual tuning it is necessary to make certain coil adjustments, capacitor changes, and to install the frequency-determining components required for the assigned frequency. All circuit breakers and switches should be in the OFF position.

Component Adjustments

Slide the oscillator units off the mounting shelves, and check each crystal frequency to be sure it is the same as the allocated frequency. Remove the cover from each unit and connect the jumper on coil L1 to the position specified in Table 6. Refer to Figures 13 and 22 for coil location.

TABLE 6. OSCILLATOR COIL SETTINGS

FREQUENCY	JUMPER CONNECTION ON L1
535 to 700 kc	Remove (use entire coil)
700 to 1000 kc	Tap 2
1000 to 1300 kc	Tap 3
1300 to 1620 kc	Tap 4

Replace the oscillator covers, and reinstall the units in the exciter cabinet.

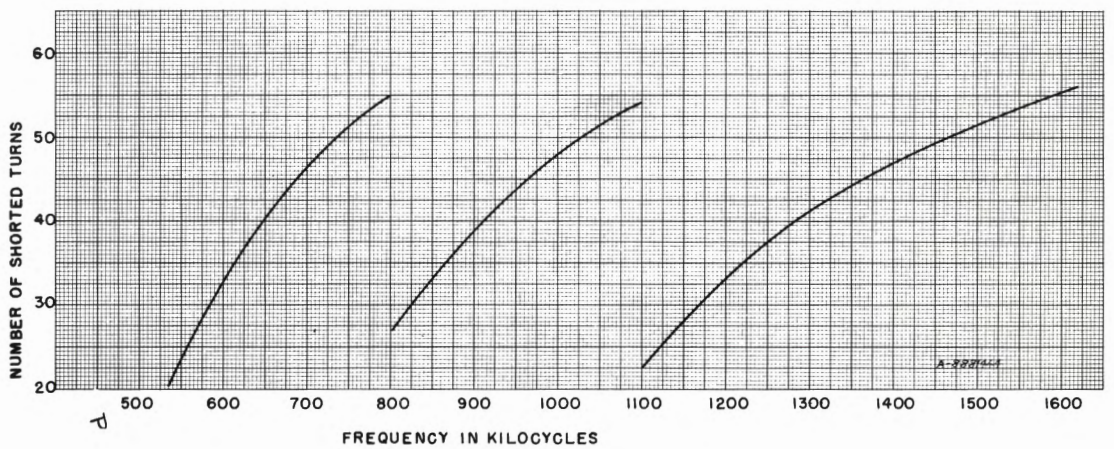
At the upper rear of the Exciter Unit, connect the links on capacitors 3C28 and 3C29 and short-circuit turns on coil 3L4 as specified in Table 7. Items 3C28 and 3C29 are the center capacitors in the group, as indicated in Figure 12 and as shown on the exciter connection diagram, Figure 27.

After the jumper on 3L4 has been connected as specified, temporarily disconnect the output lead from the coil.

TABLE 7. BUFFER TANK SETTINGS

FREQUENCY	ITEMS AND CONNECTIONS
535 to 780 kc	3C28 and 3C29 in parallel
780 to 1120 kc	3C28 alone (3C29 not used)
1120 to 1620 kc	3C28 and 3C29 in series

SETTINGS, JUMPER ON 3L4



Upon completing the adjustments in Table 7, make the jumper connections on 3L6 and 2L2 in accordance with Figures 4 and 5. Driver tank coil 3L6 is located at the upper rear of the Exciter Unit; PA tank coil 2L2 is mounted at the rear of the PA Unit. Refer to Figures 10 and 12 for locations.

The frequency-determining parts are supplied on MI-28090 or MI-28091 (BTA-5G or BTA-10G). These capacitors must be installed in varying values and combinations depending on the assigned frequency and the impedance of the transmission line and antenna network. Tables 8 and 9, for the BTA-5G and BTA-10G, respectively, cover the installation of these capacitors. Since the position of the shorting jumper on coil 2L3 varies with the output impedance, this adjustment is also covered in Tables 8 and 9. The capacitors being connected in parallel across 2L3 should be mounted at the upper rear of the PA Unit, as indicated in Figure 10.

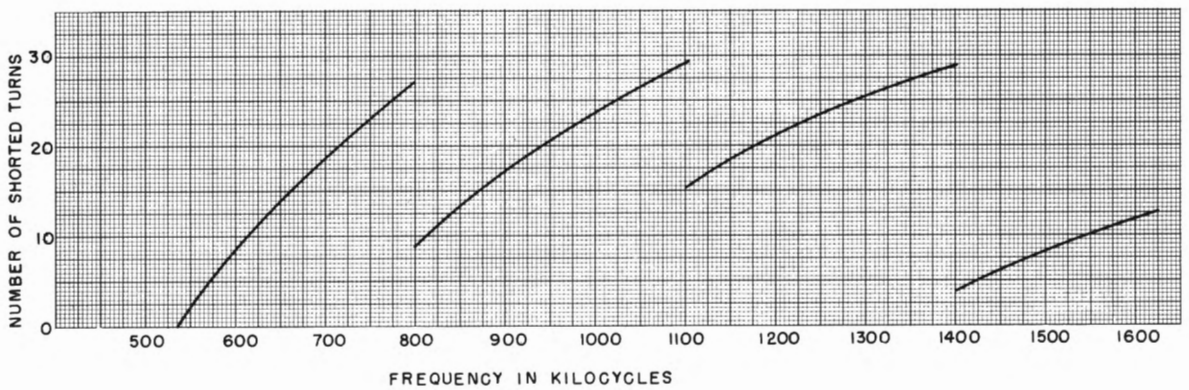


Figure 4. Tuning Chart, Jumper Connections on Driver Tank Coil 3L6 (8881446)

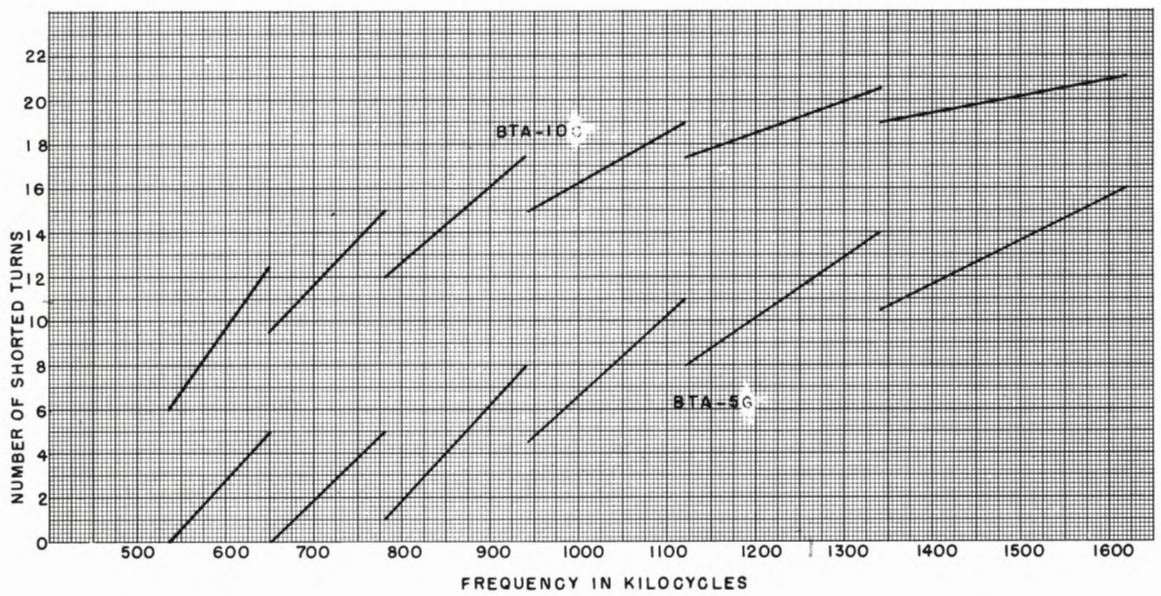


Figure 5. Tuning Chart, Jumper Connections on PA Tank Coil 2L2 (8881445)

TABLE 8. BTA-5G FREQUENCY-DETERMINING COMPONENTS

Frequency and Items	Item Symbols		Total Capacity, MMF
	Install in Clips, Rear of PA Unit	Install in Parallel Across 2L3	
- 51.5 OHM OUTPUT LINE - (APPROX. 9-1/2 TURNS ON 2L3 SHORTED)			
535-650 kc	2C16, 2C17		1,000
(MI-28090-1)		2C20, 2C21, 2C22	24,000
650-780 kc	2C16		500
(MI-28090-4)		2C20, 2C21, 2C22, 2C32	20,000
780-940 kc	2C16		500
(MI-28090-7)		2C20, 2C21, 2C22, 2C32	17,000
940-1120 kc		2C20, 2C21, 2C22	15,000
(MI-28090-10)			
1120-1340 kc		2C20, 2C21, 2C22	12,000
(MI-28090-13)			
1340-1620 kc		2C20, 2C21, 2C22, 2C32	10,500
(MI-28090-16)			
- 72 OHM LINE - (APPROX. 9 TURNS ON 2L3 SHORTED)			
535-650 kc	2C16, 2C17		1,000
(MI-28090-2)		2C20, 2C21, 2C22, 2C32	18,000
650-780 kc	2C16		500
(MI-28090-5)		2C20, 2C21, 2C22	15,000
780-940 kc	2C16		500
(MI-28090-8)		2C20, 2C21, 2C22	12,000
940-1120 kc		2C20, 2C21, 2C22	11,000
(MI-28090-11)			
1120-1340 kc		2C20, 2C21, 2C22	9,000
(MI-28090-14)			
1340-1620 kc		2C20, 2C21, 2C22, 2C32	7,500
(MI-28090-17)			
- 230 OHM LINE - (3 to 8 TURNS ON 2L3 SHORTED)			
535-650 kc	2C16, 2C17		1,000
(MI-28090-3)		2C20, 2C21, 2C22	6,000
650-780 kc	2C16		500
(MI-28090-6)		2C20, 2C21, 2C22	4,500
780-940 kc	2C16		500
(MI-28090-9)		2C20, 2C21, 2C22, 2C32	4,000
940-1120 kc		2C20, 2C21, 2C22, 2C32	2,500
(MI-28090-12)			
1120-1340 kc		2C20, 2C21, 2C22, 2C32	2,800
(MI-28090-15)			
1340-1620 kc		2C20, 2C21, 2C22, 2C32	2,400
(MI-28090-18)			

TABLE 9. BTA-10G FREQUENCY-DETERMINING COMPONENTS

Frequency and Items	Item Symbols: Install in Clips, Rear of PA Unit	Item Symbols: Install in Parallel Across 2L3	Total Capacity, MMF
- 51.5 OHM LINE - (APPROX. 9 TURNS ON 2L3 SHORTED)			
535-650 kc	2C16, 2C17		1,000
(MI-28091-1)		2C20, 2C21, 2C22, 2C32	20,000
650-780 kc	2C16, 2C17		1,000
(MI-28091-4)		2C20, 2C21, 2C22, 2C32	16,000
780-940 kc	2C16, 2C17		1,000
(MI-28091-7)		2C20, 2C21, 2C22, 2C32, 2C33	15,000
940-1120 kc	2C16		500
(MI-28091-10)		2C20, 2C21, 2C22, 2C32	12,000
1120-1340 kc	2C16		500
(MI-28091-13)		2C20, 2C21, 2C22, 2C32, 2C33	10,000
1340-1620 kc	2C16		500
(MI-28091-16)		2C20, 2C21, 2C22, 2C32, 2C33, 2C34	7,800
- 72 OHM LINE - (APPROX. 9 TURNS ON 2L3 SHORTED)			
535-650 kc	2C16, 2C17		1,000
(MI-28091-2)		2C20, 2C21, 2C22, 2C32, 2C33, 2C34	18,000
650-780 kc	2C16, 2C17		1,000
(MI-28091-5)		2C20, 2C21, 2C22, 2C32, 2C33	15,000
780-940 kc	2C16, 2C17		1,000
(MI-28091-8)		2C20, 2C21, 2C22, 2C32, 2C33, 2C34	12,000
940-1120 kc	2C16		500
(MI-28091-11)		2C20, 2C21, 2C22, 2C32, 2C33	10,000
1120-1340 kc	2C16		500
(MI-28091-14)		2C20, 2C21, 2C22, 2C32, 2C33, 2C34	7,800
1340-1620 kc	2C16		500
(MI-28091-17)		2C20, 2C21, 2C22, 2C32, 2C33, 2C34	6,000
- 230 OHM LINE - (1 to 6 TURNS ON 2L3 SHORTED)			
535-650 kc	2C16, 2C17		1,000
(MI-28091-3)		2C20, 2C21, 2C32, 2C33, 2C34	4,600
650-780 kc	2C16, 2C17		1,000
(MI-28091-6)		2C20, 2C21, 2C22, 2C32	4,000
780-940 kc	2C16		500
(MI-28091-9)		2C20, 2C21, 2C22	3,000
940-1120 kc	2C16		500
(MI-28091-12)		2C20, 2C21, 2C22, 2C32, 2C33	2,500
1120-1340 kc	2C16		500
(MI-28091-15)		2C20, 2C21, 2C22, 2C32	2,000
1340-1620 kc	2C16		500
(MI-28091-18)		2C20, 2C21, 2C22, 2C32, 2C33	2,000

Buffer Tuning

Connect the plate caps on rectifier tubes 3V4 and 3V7, and rotate the modulator balance potentiometer, 1R45 to its center position and modulator bias potentiometer 1R46, to the extreme counterclockwise position. Refer to Figure 7 for location of these items. Close all interlocked sliding doors, and operate the following switches and controls to the positions specified:

POWER, 5S6	----------	HI POWER
LIGHTS, 5S3	----------	ON
OUTPUT, 5B1	----------	extreme counterclockwise
LINE, 4S1	----------	ON
TRANSMITTER, 5S1	----------	ON
CONTROL, 4S4	----------	ON
BLOWER, 4B1	----------	ON
FILAMENT, 4S8	----------	ON
BIAS, 4S5	----------	ON
L. P. RECTIFIER, 4S6	----------	ON
PLATE, 5S2	----------	ON

If the oscillator is operating properly, the oscillator cathode current indicated on OSCILLATOR CATH. CURRENT meter 3M1 should be approximately 25 ma. The BUFFER GRID CURRENT 3M2, should be approximately 2.5 ma. Record the value of BUFFER CATHODE CURRENT on meter 3M3.

Open the PLATE switch, 5S2, and move the short-circuiting jumper connection one turn in either direction on the buffer plate inductance, 3L4. Reapply the plate power and note the value on the BUFFER CATHODE CURRENT meter, 3M3. If the indicated current is lower, continue moving the short-circuiting tap in the same direction; if the current is higher, move the tap in the opposite direction. Repeat this checking procedure until the tap is connected to the point on 3L4 giving minimum indication on BUFFER CATHODE CURRENT meter 3M3.

Connect the output tap of inductance 3L4 to approximately the mid-point of the unshorted portion of the coil. Apply power and note the indication on DRIVER GRID CURRENT meter 3M4, which should be approximately 70 ma for the BTA-5G or 62 ma for the BTA-10G. If the indicated value is low, move the output tap toward the plate end of 3L4. Move the tap in the opposite direction if the driver grid current is to be decreased.

When the correct current is indicated on DRIVER GRID CURRENT meter 3M4, recheck the setting of the short-circuiting tap on inductance 3L4 so as to obtain minimum cathode current.

When the buffer adjustment is completed open PLATE switch 5S2 and the L.P. RECTIFIER breaker 4S6.

Driver Tuning

Connect the plate cap on rectifier tube 3V5 only. Insert the tuning crank, MI-28060, item 16, into the DRIVER TUNE control and close PA RECTIFIER breaker 4S6.

Close PLATE switch 5S2 and, observing DRIVER PLATE CURRENT meter 3M5, immediately rotate the DRIVER TUNE control to the position of minimum indicated plate current.

Open the PLATE switch, and connect the output tap to the unshorted portion of inductance 3L6. Close the PLATE switch and note the reading on PA GRID CURRENT meter 2M7. Continue this adjusting procedure until the PA GRID CURRENT meter, 2M7, indicates approximately 100 ma.

Open **PLATE** switch 5S2 and **L. P. RECTIFIER** breaker 4S6.

Connect the plate cap on rectifier tube 3V6.

Close the **PLATE** switch and the **L. P. RECTIFIER** breaker.

Readjust the position of the coupling tap on inductance 3L6 until slightly more than the required value of power amplifier grid current is obtained: 0.5 ampere for the **BTA-5G** or 0.6 ampere for the **BTA-10G**, as indicated on **PA GRID CURRENT** meter 2M7.

Readjust the **DRIVER TUNE** control, if necessary, for minimum driver plate current.

When the driver adjustments are completed, open **PLATE** switch 5S2 and **L. P. RECTIFIER** breaker 4S6.

Neutralizing the Power Amplifier

Before tuning the **PA** stage, it should be neutralized as follows:

1. Connect an oscilloscope to **PA** tank coil 2L2, through a capacitor of approximately 10 mmf.
2. Operate the **L. P. RECTIFIER** breaker and the **PLATE** switch to the **ON** position.
3. Rotate the **PA TUNE** control, 2C18, using the tuning crank, for maximum r-f voltage as indicated on the oscilloscope.
4. Rotate neutralization capacitor 2C12 until the oscilloscope indicates minimum r-f voltage. See Figure 9 for location of 2C12.
5. Alternately adjust the **PA TUNE** control and neutralization capacitor 2C12 until neither control has any reaction on the other.
6. Check the neutralization adjustments by rotating the **PA TUNE** control and noting the effect on **PA GRID CURRENT** meter 2M7. The reaction on 2M7 should be slight when passing through resonance.
7. Open the **L. P. RECTIFIER** breaker and the **PLATE** switch, and disconnect the oscilloscope.

Power Amplifier Tuning

Connect the plate caps on the type 5563A rectifier tubes, 4V1 to 4V4. Check that the locking clips on 2C16 and 2C17 (if required) are fastened tightly in place over the ends of the mounting clips.

Connect the output coupling tap on coil 2L3 approximately one-half turn from the grounded end of the coil. Make sure the **PA** output terminal is connected to a suitable r-f load.

Adjust the **PA TUNE** control, 2C18, to the approximate setting specified in Table 10.

TABLE 10. APPROXIMATE SETTINGS, PA TUNE CONTROL

FREQUENCY	BTA-5G	BTA-10G
535 to 650 kc	6	4
650 to 780 kc	17	15
780 to 940 kc	21	2
940 to 1120 kc	4	6
1120 to 1340 kc	7	15
1340 to 1620 kc	10	20

Make sure the **OUTPUT** control, 5B1, is in the extreme counterclockwise position.

Operate **L. P. RECTIFIER** breaker 4S6, **PLATE** breaker 4S2, and **PLATE** control switch 5S2 to the **ON** position.

Rotate the **OUTPUT** control until **PA PLATE VOLTAGE** meter 2M5 indicates approximately 3000 volts. Note the indications on **PA PLATE CURRENT** meter 2M4, then quickly adjust the **PA TUNE** control for minimum plate current. Record this value of plate current and the **PA TUNE** control indication.

Check the four type 5563A rectifier tubes for the characteristic blue glow of mercury vapor rectifiers. If one or more of these tubes do not appear to be functioning, or if the plate voltage is low or varies erratically as the **OUTPUT** control is adjusted, shut down the transmitter, and check the connections on high-voltage plate transformer 6T1. Be sure to use a grounding stick before touching any component.

The connections to 6T1 should be exactly as shown on the schematic diagram. Any variations from the specified connections will disturb the phasing of the high-voltage rectifier circuit as well as the related phasing of the pulses which control the output voltage. Hence, one or more rectifier tubes may be firing at the wrong time or not at all. Voltage output then would be low, or erratic, or may even increase with counterclockwise rotation of the **OUTPUT** control instead of with clockwise rotation.

If all connections are correct, and the plate voltage passes through the maximum value as the **OUTPUT** control is rotated, the mechanical stop on the control may require adjustments. Refer to "Output Control Adjustment" under **MAINTENANCE**, for the corrective procedure.

For elimination of any further difficulties in obtaining the proper high-voltage output, refer to "Trouble-Shooting, High-Voltage Rectifier," under **MAINTENANCE**.

If the plate voltage circuit is operating satisfactorily, rotate the **OUTPUT** control over its entire range. The plate voltage should vary smoothly from zero at the extreme counterclockwise position to approximately 5000 volts at the extreme clockwise position.

Open the **PLATE** switch, 5S2, and change the position of the shorting tap on inductance 2L3 approximately one-quarter turn in either direction. Close the **PLATE** switch and compare the plate current with the value previously recorded. If the indicated current has increased, continue moving the shorting tap in the same direction in small increments until a peak value is obtained. If the current decreased, move the tap in the opposite direction until the peak plate current is indicated.

While observing **PA PLATE VOLTAGE** meter 2M5, rotate **OUTPUT** control 5B1 until the meter indicates a voltage of 4750 volts.

Adjust the position of the coupling tap on inductance 2L3 to obtain a current value, indicated on RF OUTPUT CURRENT meter 2M6, approximately five percent less than the current required for normal power output. In some instances, it may be necessary to connect the coupling tap to coil turns within the shorted section of inductance 2L3. Recheck the PA TUNE control setting each time the coupling tap is moved. If appreciable retuning is required, it is an indication of overcoupling during the tuning of 2L3. In this event, the coupling tap must be moved to less than one-half turn from ground and the tuning procedure repeated.

Adjust the PA TUNE control until the RF OUTPUT CURRENT meter indicates the required value for normal output. Do not allow the power amplifier plate current to exceed the maximum value for the type of transmitter used: BTA-5G, 2 amperes; BTA-10G, 3 amperes. Note that as the PA TUNE control is rotated clockwise the output decreases. The transmitter should never be operated with the PA TUNE control on the counterclockwise side of resonance.

Recheck all adjustments and compare meter indications with the typical values listed in Tables 11 or 12. Record the actual meter readings, coil tap positions, and tuning control settings for future reference.

Overload Circuit Adjustments

With all transmitter r-f circuits tuned and the equipment functioning normally, operate the TRANSMITTER switch, 5S1, to the OFF position. After an approximate ten-second interval, operate the TRANSMITTER switch to the ON position. The tube filaments will light and, after a 60-second delay, the plate voltage will be applied. At the instant of plate voltage application, overload relay 10K1 should operate not more than three times, interrupting the plate current and then stabilizing with the plate voltage ON and H. V. OVERLOAD indicator, 4I4, lighted. Pressing the H. V. RESET button, 5S4, on the control panel will extinguish the H. V. OVERLOAD indicator. This operation automatically checks the functioning of the thyratron overload protection circuit each time the plate voltage is applied.

If relay 10K1 operates more than three times, or if the high voltage is automatically removed and locked out, adjust the thyratron control circuit as follows:

WARNING

The thyratron control and rectifier tube chassis operate at a 5000-volt potential above ground. Always attach a grounding rod to these chassis before making any adjustments.

a. Open PLATE switch 5S2 and, after attaching a grounding rod to the thyratron control unit chassis, connect the tap lead on resistor 4R22 so as to short circuit all but two sections of the resistor. Completely remove the tap lead from resistor 4R21.

b. Decrease the resistance of bias potentiometer 10R4, by rotating it counterclockwise, until relay 10K1 is actuated. Then advance the bias control about one-eighth turn in the counterclockwise direction. Potentiometer 10R4 is indicated in Figure 17.

c. Remove the grounding rod and reapply the plate voltage. If the relay operates more than three times, readjust the bias control until correct functioning is obtained.

d. Note the dial setting of the PA TUNE control.

e. While observing the PA PLATE CURRENT meter, 2M4, quickly detune the PA TUNE control noting the plate current value required to trip the overload protection circuit. The overload circuit should trip at indicated current values of 2 amperes for the BTA-5G transmitter, or 3.5 amperes for the BTA-10G transmitter. If the overload circuit is not tripped within two seconds, open the PLATE switch, 5S2.

f. Should readjustment be required, make certain that PLATE switch 5S2 is in the OFF position, then attach a grounding rod to the thyratron control chassis.

g. If the overload circuit trips at less than the required value, rotate the bias control, 10R4, slightly counterclockwise. If the overload circuit trips at a higher current value or does not trip at all, rotate 10R4 in the clockwise direction.

h. Recheck the trip current value as described previously under "e". Repeat the adjustment procedure, if necessary, until correct functioning is obtained.

Modulator Adjustments

To adjust the modulator, first note the reading on MODULATOR PLATE CURRENT ammeters 1M9 and 1M10. Then open the PLATE switch and rotate bias potentiometer 1R46 in the clockwise direction. Close the PLATE switch and again note the reading on 1M9 and 1M10. Continue this adjustment procedure until the reading on both meters is approximately 0.12 ampere.

Now adjust potentiometer 1R45 so that the modulator currents, as indicated on 1M9 and 1M10, are equal. This is the optimum condition, since the type 813 modulator driver tubes may show slight unbalance under some operating conditions.

Readjust 1R46, if necessary, for the desired current of 0.12 ampere on 1M9 and 1M10.

Apply a 1000-cycle tone to the modulator input. Overmodulate the transmitter to obtain modulator plate currents as listed in Tables 11 or 12. The overload circuit should trip at the following approximate modulator currents:

BTA-5G - 1.2 a per tube
BTA-10G - 2.2 a per tube

If the overload circuit trips at currents other than these values, note the tripping current and then adjust the tap on resistor 4R22.

After the overload circuit is operating properly, readjust the modulator arc-gap spacing until the gaps flash over occasionally on 100% modulation peaks. Then increase the spacing slightly beyond this setting.

Connect the modulation monitor r-f input circuit to jack 2J1, and adjust the tap on transformer 2T2 to supply the amount of energy required for proper operation of the monitor.

Connect the frequency monitor r-f input to jack 3J3, and adjust variable resistor 3R11 for the required output for monitor operation. This resistor is indicated in Figure 12.

Hum-Bucking Circuit Adjustment

Potentiometer 1R54 should be adjusted for minimum power line-frequency hum in the audio system only if the hum level is too high. Normally this control should be set at minimum (extreme counterclockwise). To adjust potentiometer 1R54, measure the residual hum in the usual manner and note the level. Shut off the transmitter plate power and adjust potentiometer 1R54 so that the movable arm is slightly above ground potential. Again measure and note the residual hum level. Continue this procedure until minimum hum level is obtained.

Final Adjustments

With all transmitter circuits tuned and the equipment functioning normally, operate TRANSMITTER switch 5S1 to the OFF position. After an interval of approximately ten seconds operate the TRANSMITTER switch to the ON position. The tube filaments will light and after 60 seconds delay plate voltage will be applied. At the instant of plate voltage application, overload relay 10K1 should operate not more than three times, interrupting the plate current and then stabilizing with the plate voltage on and H. V. OVERLOAD indicator 4I4 lighted. Pressing the OL RESET button, 5S4, will extinguish the H. V. OVERLOAD indicator. This operation automatically checks the functioning of the thyratron overload protection circuit each time the plate voltage is applied.

If relay 10K5 operates more than three times, or if the high voltage is automatically removed and locked out, the overload circuit is too sensitive and potentiometer 10R4 should be readjusted as previously described under "Overload Circuit Adjustments".

Check the transmitter operating frequency, using a frequency monitor. For any slight corrections required, adjust the crystal unit trimmer, C1. This trimmer is accessible from the front of the oscillator unit as shown in Figure 13.

Recheck all tuning adjustments and readjust where necessary. Check all current and voltage readings for compliance with typical values indicated in Tables 11 and 12. Readjust where necessary. Recheck distortion, output frequency, and noise level. This completes the tuning procedure. Shut down the transmitter by operating TRANSMITTER SWITCH 5S1 and LINE breaker 4S2 to the OFF position.

ADJUSTING ANTENNA ARC-GAPS

If arc-gaps are installed across the antenna base insulators, these gaps should be carefully adjusted to obtain protection during excessively dusty or humid weather conditions. Set the arc-gap spacing so that flashover occurs just beyond the point of 100 percent sine wave modulation.

ADJUSTMENTS FOR REDUCED-POWER OPERATION

If either of the optional reduced-power kits have been installed, make the necessary adjustments as follows:

BTA-5G Reduced-Power Adjustments

Adjustments for reduced-power operation of the BTA-5G equipment require the optional MI-28092-A kit, which should have previously been installed as instructed. This kit makes it possible to operate POWER switch 5S6 to the LO POWER position and simultaneously reduce the plate voltage on the modulator and PA stages. Before any reduced-power adjustments are made, it is necessary first that the transmitter be completely adjusted for full-power output.

1. Operate POWER switch 5S6 to the LO POWER position.
2. Operate the PLATE switch 5S2 to ON.
3. Adjust synchro unit 12B1, supplied with the MI-28092-A kit, until the desired power output is obtained.
4. Adjust kit bias control 11R2 so that the modulator plate current, with no modulation, is approximately 100 ma per tube, as indicated on MOD. CATHODE CURRENT meters 1M9 and 1M10.

5. Operate POWER switch 5S6 to HI POWER, and modulate the transmitter to 50% modulation, using a 1000-cycle tone. Utilize the modulation monitor for modulation indication.

6. Operate POWER switch 5S6 to the LO POWER position. Adjust the kit pad, 11R1, so that the modulation monitor again indicates 50% modulation.

Reduced-power operation may now be effected by operating POWER switch 5S6 to the LO POWER position.

BTA-10G Reduced-Power Adjustments

The MI-28092 kit must have been installed as previously instructed in order for the BTA-10G equipment to be operated at reduced-power outputs. This kit makes it possible to reduce the output of the BTA-10G to 5 kw. Before any reduced-power adjustments are made, it is necessary first that the transmitter be completely adjusted for full-power output. Then make the following adjustments:

1. Operate POWER switch 5S6 to the LO POWER position.

2. Operate PLATE switch 5S2 to ON.

3. Adjust the low power coupling tap on coil 2L3 as indicated under POWER AMPLIFIER TUNING to obtain the required power output.

4. Modulate the transmitter with a 1000-cycle tone and adjust variable resistor R1 of the compensator unit for best response at the higher frequencies.

Reduced power operation may now be achieved by operating POWER switch 5S6 to LO POWER. No other adjustments are required.

METER READINGS

TABLE 11. BTA-5G TYPICAL PANEL METER READINGS

METER SYMBOL	PANEL DESIGNATION	METER UNITS	MODULATION PERCENTAGE 0%	35%	100%
	5,000 WATTS POWER OUTPUT				
1M1	1ST AF1	ma	8.5	8.5	8.4
1M2	1ST AF2	ma	8.5	8.5	8.4
1M3	2ND AF1	ma	72	72	72
1M4	2ND AF2	ma	72	72	72
1M5	3RD AF1	ma	23	23	67
1M6	3RD AF3	ma	23	23	67
1M7	3RD AF2	ma	-	-	-
1M8	3RD AF4	ma	-	-	-
1M9	MOD. PLATE CUR. 1	amp	0.12	0.31	0.78
1M10	MOD. PLATE CUR. 2	amp	0.12	0.31	0.78
1M11	BIAS VOLTAGE	volts	450	450	450
2M1	PA 1K1	amp	1.05	1.05	1.05
2M2	PA 1K2	amp	-	-	-
2M3	PA 1K3	amp	1.05	1.05	1.05
2M4	PA PLATE CUR.	amp	1.60	1.60	1.60
2M5	PA PLATE VOLTS	volts	4700	4700	4700
2M7	PA GRID CUR.	amps	0.5	0.5	0.5
3M1	OSCILLATOR CATHODE	ma	25	25	25
3M2	BUFFER GRID CUR.	ma	2.5	2.5	2.5
3M3	BUFFER CATHODE CUR.	ma	60	60	60
3M4	DRIVER GRID CUR.	ma	70	70	70
3M5	DRIVER PLATE CUR.	ma	300	300	300
4M1	A.C. VOLTAGE	volts	230	230	230
4M2	INT. HIGH VOLTAGE	volts	1700	1700	1700
	1,000 WATTS POWER OUTPUT				
1M1	1ST AF1	ma	8.5	8.5	8.5
1M2	1ST AF2	ma	8.5	8.5	8.5
1M3	2ND AF1	ma	72	72	72
1M4	2ND AF2	ma	72	72	72
1M5	3RD AF1	ma	23	23	30
1M6	3RD AF3	ma	23	23	30
1M7	3RD AF2	ma	-	-	-
1M8	3RD AF4	ma	-	-	-
1M9	MOD. PLATE CUR. 1	amp	0.10	0.15	0.30
1M10	MOD. PLATE CUR. 2	amp	0.10	0.15	0.30
1M11	BIAS VOLTAGE	volts	450	450	450
2M1	PA 1K1	amp	0.63	0.63	0.63
2M2	PA 1K2	amp	-	-	-
2M3	PA 1K3	amp	0.63	0.63	0.63
2M4	PA PLATE CUR.	amp	0.70	0.70	0.70
2M5	PA PLATE VOLTS	volts	2100	2100	2100
2M7	PA GRID CUR.	amps	0.55	0.55	0.55
3M1	OSCILLATOR CATHODE	ma	25	25	25
3M2	BUFFER GRID CUR.	ma	2.5	2.5	2.5
3M3	BUFFER CATHODE CUR.	ma	60	60	60
3M4	DRIVER GRID CUR.	ma	70	70	70
3M5	DRIVER PLATE CUR.	ma	300	300	300
4M1	A.C. VOLTAGE	volts	230	230	230
4M2	INT. HIGH VOLTAGE	volts	1700	1700	1700

TABLE 12. BTA-10G TYPICAL PANEL METER READINGS

METER SYMBOL	PANEL DESIGNATION	METER UNITS	MODULATION PERCENTAGE		
			0%	35%	100%
	10,000 WATTS POWER OUTPUT				
1M1	1ST AF1	ma	8.5	8.5	8.4
1M2	1ST AF2	ma	8.5	8.5	8.4
1M3	2ND AF1	ma	72	72	72
1M4	2ND AF2	ma	72	72	72
1M5	3RD AF1	ma	14	14	84
1M6	3RD AF3	ma	14	14	84
1M7	3RD AF2	ma	14	14	84
1M8	3RD AF4	ma	14	14	84
1M9	MOD. PLATE CUR. 1	amp	0.12	0.43	1.45
1M10	MOD. PLATE CUR. 2	amp	0.12	0.42	1.45
1M11	BIAS VOLTAGE	volts	450	450	450
2M1	PA 1K1	amp	1.20	1.20	1.20
2M2	PA 1K2	amp	1.20	1.20	1.20
2M3	PA 1K3	amp	1.20	1.20	1.20
2M4	PA PLATE CUR.	amp	3.0	3.0	3.0
2M5	PA PLATE VOLTS	volts	4700	4700	4700
2M7	PA GRID CUR.	amps	0.6	0.6	0.6
3M1	OSCILLATOR CATHODE	ma	25	25	25
3M2	BUFFER GRID CUR.	ma	2.5	2.5	2.5
3M3	BUFFER CATHODE CUR.	ma	60	60	60
3M4	DRIVER GRID CUR.	ma	62	62	62
3M5	DRIVER PLATE CUR.	ma	400	400	400
4M1	A.C. VOLTAGE	volts	230	230	230
4M2	INT. HIGH VOLTAGE	volts	1700	1700	1700
	5,000 WATTS POWER OUTPUT				
1M1	1ST AF1	ma	8.5	8.5	8.5
1M2	1ST AF2	ma	8.5	8.5	8.5
1M3	2ND AF1	ma	72	72	72
1M4	2ND AF2	ma	72	72	72
1M5	3RD AF1	ma	14	14	70
1M6	3RD AF3	ma	14	14	70
1M7	3RD AF2	ma	14	14	70
1M8	3RD AF4	ma	14	14	70
1M9	MOD PLATE CUR. 1	amp	0.12	0.30	0.80
1M10	MOD. PLATE CUR. 2	amp	0.12	0.30	0.80
1M11	BIAS VOLTAGE	volts	450	450	450
2M1	PA 1K1	amp	0.73	0.73	0.73
2M2	PA 1K2	amp	0.73	0.73	0.73
2M3	PA 1K3	amp	0.73	0.73	0.73
2M4	PA PLATE CUR.	amp	1.60	1.60	1.60
2M5	PA PLATE VOLTS	volts	4700	4700	4700
2M7	PA GRID CUR.	amps	0.60	0.60	0.60
3M1	OSCILLATOR CATHODE	ma	25	25	25
3M2	BUFFER GRID CUR.	ma	2.5	2.5	2.5
3M3	BUFFER CATHODE CUR.	ma	60	60	60
3M4	DRIVER GRID CUR.	ma	62	62	62
3M5	DRIVER PLATE CUR.	ma	400	400	400
4M1	A.C. VOLTAGE	volts	230	230	230
4M2	INT. HIGH VOLTAGE	volts	1700	1700	1700

OPERATION

ROUTINE OPERATION

In routine operation, it is necessary only to operate the following items for starting and stopping the transmitter:

LINE circuit breaker
TRANSMITTER switch

All other circuit breakers and switches should be left in the ON position at the end of each shut-down.

Where unusual conditions make it desirable to employ additional heating time for the rectifier tube filaments, before the application of plate voltage, keep the PLATE switch in the OFF position. After the required interval, operate the PLATE switch to the ON position. Normally, sufficient warm-up time is provided by the plate time-delay relay.

To interrupt transmission for a short interval, operate the PLATE switch to OFF. This will maintain filament power on the tubes, and the transmitter will be returned to immediate operation when the PLATE switch is closed.

For stability, the crystal units are intended to be operated at all times, except when the transmitter is to be shut down for extended periods. Therefore, the external switch controlling crystal heaters power should not be opened at routine shut-downs. The crystal units require a minimum of 30 minutes warm-up time before operating the transmitter.

When the installation includes a control console, such as the BTC-1B, operate the console "station start" and "plate" switches as required by the method of interconnection utilized. Thus, to start or shut down an installation employing a BTC-1B console, operate the console STA. START and PLATE switches in addition to the transmitter switches and breakers specified. For further information on the BTC-1B console, refer to the instruction book, IB-30227, accompanying the console.

At start-up, and at regular intervals during operation, note and record the panel meter readings in a suitable log. This will aid in maintaining the proper operating conditions, and will disclose irregularities and gradual changes which indicate the need for tube replacement. Refer to Tables 11 or 12, as pertinent, for typical panel meter readings.

OVERLOADS AND INTERRUPTIONS

If an overload occurs, the overload lamp will light and, if the overload persists for more than approximately two seconds, plate power will be removed from the transmitter. After the overload source has been located and the necessary corrective action taken, depress the O. L. RESET button. This will restore plate power and the transmitter will be returned to operation.

In the event of power-line interruptions, the transmitter will be shut down for the period of interruption, but will be returned to operation automatically after the required interval for filament warm-up and time-delay relay operation.

In case of an arc-back in one of the thyratron tubes, the corresponding indicator relay will be closed, thereby lighting its associated indicator lamp. Lamps will be extinguished when the O. L. RESET button is depressed.

REDUCED-POWER OPERATION

Reduced-power operation, for "day-night" transmission, is provided when the optional power-change kit is installed. Power reduction, or increase, is achieved merely by operating the **POWER** switch to either the **LO POWER** or **HI POWER** position.

FUSES

In addition to the overload relays and circuit breakers, fuses are utilized in the power input to the crystal units, and for protection of the cabinet lighting circuits and convenience outlets. These fuses are as follows:

ITEM	RATING	LOCATION
3F1, 3F2	1 ampere	Exciter Unit
3F3, 3F4	15 amperes	Exciter Unit

MAINTENANCE

GENERAL

With ordinary care a minimum of service will be required to keep the BTA-5G/10G transmitters in operation. To avoid interruptions during broadcasts, however, a regular schedule of inspection should be established. Table 13, a recommended schedule for the transmitter, should be correlated with other station equipment maintenance to insure overall peak efficiency.

Always open the LINE circuit breaker and discharge circuits with a grounding stick before touching any component.

TABLE 13. RECOMMENDED OVERALL MAINTENANCE SCHEDULE

- DAILY -
- Check and compare all meter readings at start-up. Adjust filament voltages if necessary. Take steps to correct any condition revealed by abnormal reading.
- Make general visual inspection after shut-down. In particular check motor and blower bearings for evidence of overheating.
- If overloads have occurred, examine components concerned at shut-down, and repair or replace as necessary.
- Check filament connections on the type 5762 tubes for evidence of overheating. Tighten connections if required.
- WEEKLY -
- Clean internal parts of transmitter. Use clean, soft cloth on insulators. Use vacuum cleaner or hand blower for removing dust or dirt.
- Test all door interlocks and grounding switches.
- Test operation of overload circuits. (Refer to "Control Circuit Checks," under ADJUSTMENT AND TUNING.)
- Check PA and output r-f circuits for evidence of heating at connector or junction points.
- Make overall check on frequency, distortion, and noise level.
- MONTHLY -
- Check condition of relay contacts. Service if necessary.
- Inspect air filter. Clean if necessary, using vacuum cleaner.
- Check grease in blower motor. Lubricate if required. See Table 14.
- Inspect blower drive belt. Adjust if required.
- Check and record tube socket voltages in audio section. Compare with previous readings to detect irregularities.

TABLE 13. RECOMMENDED OVERALL MAINTENANCE SCHEDULE (cont.)

- QUARTERLY -
- Operate all spare mercury-vapor tubes for 30 minutes, filament only.
- Make detailed inspection of every unit in transmitter. Use any test deemed necessary.
- Lubricate auxiliary blower motors 2B1 and 4B1. See Table 14.
- Clean air filter. Refer to following heading, "Air Filter."
- Clean blower impellers.
- Inspect and service all contactors.
- Lubricate all tuning drive mechanism gears and bearings. See Table 14.
- SEMI-ANNUALLY -
- Inspect relay contacts and replace where required.
- Clean pole faces on contactors.
- Test spare tubes.
- Tighten all connections in transmitter.
- Lubricate blower. Refer to Table 14.

CLEANING

Ceramic insulators and bushings should be kept clean at all times. Insulators subject to stress in high-voltage d-c fields may rupture if sufficient dust accumulates to cause a corona discharge. Clean insulators by using a soft clean cloth and carbon tetrachloride.

Keep tube envelopes and vacuum capacitors clean to avoid possible puncture of the glass due to ion bombardment or corona. Tissue paper and alcohol are effective for this purpose.

Clean plate tank coils with a dry cloth. NEVER USE LIQUID POLISH OR STEEL WOOL ON THESE ITEMS.

Keep safety gaps clean. If gaps are pitted, polish them with crocus cloth.

Blower blades should be cleaned regularly to preserve efficiency. Use a wire brush for removal of caked deposits of dirt, then repaint the blades with a good grade of quick-drying synthetic resin enamel.

MECHANICAL SERVICING

Lubrication

Refer to the lubrication chart, Table 14, for items requiring periodic lubrication.

TABLE 14. LUBRICATION CHART

ITEM	INSTRUCTIONS	LUBRICANT
Main blower, 3B1	Both the blower fan and motor are equipped with ball bearings and Alemite grease fittings. These bearings should be relubricated every six months while the fan is in use. Fill the bearings, using only a low-pressure grease gun, since a high-pressure gun may rupture the grease seals.	Use a high-grade, neutral ball-bearing grease such as Keystone No. 44, Lubrike M-21, or Alemite No. 38.
Auxiliary blower motors, 2B1 and 4B1	Oil every three months.	Use a few drops of SAE 30 oil
Tuning drive mechanism gears and bearings	Grease every three months.	Use petrolatum, Lubriplate No. 110, or equivalent.

Air Filter

The air filters in the transmitter may be cleaned several times with a vacuum cleaner before it becomes necessary to replace the filter element. The special cleaning tool, item 20 of MI-28060, supplied with the installation material, fits standard vacuum cleaner hoses and will facilitate filter cleaning.

Where unusual atmospheric conditions result in oily or sooty deposits on the filter, the filter may be cleaned by using one of the following two methods:

Low Pressure Steam Cleaning

Steam mixed with a concentrated detergent and water solution and applied at low pressure will remove any sooty or oily foreign substances from the filter cells. These steam-cleaning facilities are available at most automotive service stations. The detergent may be any mild household detergent.

To clean the filter suspend it horizontally so that the steam may be applied from above, to the side which is normally inside the cabinet. This will clean the filter in the reverse direction from normal air flow. Apply the steam-detergent mixture at not over 10 pounds pressure, with the steam nozzle not closer than 6 inches to the filter. Do not use more than 10 pounds gage steam pressure or the filter will be damaged. When clean, rinse the filter in clean water, and allow to dry thoroughly before re-installing.

Dip Tank Cleaning

Boiling a soiled filter cell in a concentrated detergent and water solution will clean the filter where steam-cleaning equipment is not available. Any mild household detergent may be used.

To clean the filter, suspend it horizontally in the tank, so that dirt will fall to the bottom as it is loosened. The filter surface which is normally inside the cabinet should be up. Boil approximately one hour, or longer if required. When clean, rinse the filter in clean water, and allow to dry thoroughly before re-installing.

Sliding Doors

Plastic observation windows are used in the sliding doors and in front of the high-voltage rectifier tubes. Clean these windows with a soft cloth and mild soap and water. DO NOT USE CHEMICAL SOLVENTS OR ABRASIVE COMPOUNDS.

If it becomes necessary to remove one of the sliding doors, first take off the intercabinet separator channel at the rear of the door track. Disassemble the combination latch and handle.

Carefully slide the door toward the rear of its track. Catch the lower roller assemblies, which will become detached as each door section clears the track.

If the sliding doors are removed from the cabinets, care should be taken when replacing the door rollers in order to assure free operation. The rollers are a loose fit in the door assemblies to provide maximum movement and to avoid binding in the guide rails. The three-roller assemblies (stock no. 94551) are not symmetrical since the two end rollers are 1/64 inch off center with respect to the center mounting pin. Thus, the unit could be installed in either of two positions, although one would cause the rollers to bind. All three-roller assemblies must be inserted with the riveted end of the center roller shaft toward the outside of the door. This will prevent binding when rounding the corner of the guide rails.

It is also recommended that the roller opening in the guide rails be checked from one end to the other, to avoid any binding action against the rollers. The guide rail opening should not be less than 13/32 inch, and any deviation from this minimum dimension may be corrected by sliding a 13/32 inch diameter steel rod vertically along the opening.

Vacuum Capacitors

Variable vacuum capacitor 2C18 should be examined and lubricated periodically. Driving shaft set-screws should be checked and, if necessary, tightened. Clean the glass envelope using the same method as for vacuum tubes. Mounting and connection fasteners should be checked and kept tight to prevent undue heating.

If vacuum capacitors become gassy, they may be degassed by installing them in the transmitter and following the procedure described for tubes under "Electrical Servicing".

CAUTION

When handling capacitors for maintenance or replacement, use precaution to avoid undue strains on the glass-to-metal seals and to prevent damage from rough handling or improper installation.

When replacing variable vacuum capacitor 2C18, the part of the universal joint attached to the capacitor shaft should be removed with the capacitor and transferred to the replacement on the bench. This practice will insure that calibration readings previously recorded will apply with a minimum of error. It is advisable, however, to recheck the calibration of any circuits that may be affected by capacitor replacement.

To install the replacement variable vacuum capacitor, hand-rotate the capacitor shaft to its extreme clockwise position. Back off the shaft one full turn from this position.

Insert a tuning crank into the PA TUNE control then rotate this control to its extreme clockwise position. Clamp the capacitor in its mounting bracket and connect it to terminal 57B.

Attach the drive shaft from the PA TUNE control to the shaft of 2C18.

To lubricate the variable vacuum capacitor, first remove the capacitor from its bracket. Hand-rotate the capacitor drive shaft toward maximum capacity until the cover cap can be removed. Lubricate the thread with a light grade of machine oil (SAE No. 10). After lubrication, rotate the drive shaft toward minimum capacity and replace the cover cap. Replace the capacitor in its bracket.

Circuit Breakers, Contactors, and Relays

Periodic inspection of circuit breakers, contactors, and relays should be made, and at such time all contacts should be cleaned and adjustments made if necessary. Detailed servicing notes on these items are included under MANUFACTURERS' BULLETINS at the rear of this book.

The contactors in this transmitter have contacts made of a material which does not require dressing even though severely pitted. Contacts may be cleaned with carbon tetrachloride and a soft cloth. Keep the pole faces clean and see that they seat securely. Check operation manually, and tighten any loose screws. Replace broken arc-chutes and defective magnetic blowouts.

Relay contacts should be cleaned with carbon tetrachloride applied with a soft brush, after which they should be burnished with a tool such as the RCA Stock No. 22963 Contact Cleaning Tool. Finally, contacts should be wiped with a clean piece of bond paper.

The contact fingers in control relays should be checked carefully after each cleaning operation. Make sure that good wiping occurs on contact and that stationary contacts do not follow the movable contacts too far, as the latter move to the opposite position.

The plunger of the voltage overload relay must be perfectly free in its tube and should trip its contacts with a definite snap as the toggle is tripped. Contacts should be cleaned with a piece of cloth moistened with carbon tetrachloride, then wiped off with a strip of dry bond paper. In extreme cases, contact surfaces may be burnished with crocus cloth. Always wipe the contacts with dry bond paper after any cleaning or burnished operation. Operate the relay several times to assure correct alignment. Spring tension should be sufficient to cause stationary contact displacement.

ELECTRICAL SERVICING

Tubes

Check all tubes periodically. Tube failure can be anticipated by keeping a log of tube life and replacing tubes when indicated by the log or when reduced output is apparent. The most frequent cause of failure in low-power tubes is a gradual loss of emission with use, or actual filament burn-out. Such a condition is easy to anticipate or recognize if records have been kept on each tube.

Gas-type rectifier tubes fail mostly due to ion bombardment of the filament, which leads to an increase in the tube arc-drop, a tendency toward arc-back, and eventual loss of the filament. In a polyphase rectifier usually more than one tube becomes involved during an arc-back and it is difficult to tell by observation which position is faulty. It is helpful to test the tubes from time to time and keep records which reveal tubes likely to cause trouble. A method for checking these tubes is supplied under **MANUFACTURERS' BULLETINS**, "Testing Mercury-Vapor Rectifier Tubes."

Before use, each spare mercury-vapor rectifier tube should be operated for a minimum of 30 minutes with only filament voltage applied. Store the tubes in an upright position afterward. Take care to avoid tipping the tube or splashing mercury on the tube elements after "seasoning." If mercury is splashed on the elements, it will be necessary to re-season the tube. Re-seasoning of spare tubes is also required every three months due to gradual absorption of mercury vapor by the filament.

The power amplifier and modulator tubes, type 5762, may become slightly gassy if stored for an extended length of time. To prevent this condition, it is recommended that the tubes be operated in the transmitter at intervals of three months or less. For both types of tubes, start operation at a plate voltage of 4,000 volts without modulation. Then gradually increase the plate voltage to maximum, observing whether gas flashes occur. If no flashes take place, the tube is free of gas and may be returned to storage. When gas flashes are observed, reduce the plate voltage to 4,000 volts and then, more slowly than during the first trial, again gradually increase the plate voltage to maximum.

Trouble-Shooting, High-Voltage Rectifier

If there is evidence of irregularity in functioning of the high-voltage rectifier circuit, check the following items:

1. Rectifier tubes 4V1 to 4V4.
2. Pulse transformers 10T2, 10T3.
3. Selenium rectifiers 10CR4, 10CR5.
4. Transformers 4T6 to 4T8.
5. Synchro unit 5B1.

Where rotation of the **OUTPUT** control does not vary the high-voltage output, check the following:

1. Synchro unit 5B1.
2. Transformer 10T1 (winding 8-9).
3. Rectifier 10CR6.
4. Capacitor 10C6.

Should there be indications that the synchro unit 5B1 is overheating, it is recommended that 1 mf., 400-volt capacitors be connected across the following points: R1-R2, R2-R3, and R1-R3. This should appreciably reduce the current and correct the overheating condition.

Trouble-Shooting, Overload Circuit

Where the overload circuit does not recycle on overloads, first check the voltages listed in Table 15, then check the following:

1. Relay 10K1.
2. Capacitors 10C1 to 10C3, 10C5.
3. Resistor 10R13.

If the overload circuit does not operate when an overload occurs, check:

1. Tube 10V1.
2. Rectifier 10Z1, 10Z2, 10CR3, 10CR7.
3. Resistor 10R3, 10R4, or relay 10K4.
4. Resistor 10R6, or relay 10K1.
5. Transformer 10T1, particularly for an open winding between terminals 5, 6, or 7.

If the overload circuit does not lock out after an overload of approximately two seconds duration, check:

1. Relay 10K2.
2. Resistor 10R18, 10R19.
3. Capacitor 10C1, 10C2.

When the plate voltage is off and relay 10K1 recycles continuously until relay 10K2 locks out, check the following:

1. Resistors 10R4, 10R11, 10R14.
2. Rectifiers 10CR6, 10CR8.
3. Capacitor 10C7.
4. Transformer 10T1 (winding 8-9).
5. Rectifier 10CR6.
6. Capacitor 10C6.

TABLE 15. MISCELLANEOUS VOLTAGES AT SIGNIFICANT POINTS

MEASUREMENT	READING
across 10C4	* 250 volts
across 10R14	* 90 volts (not energized)
across 10R14	* 250 volts (energized)

* WARNING: Operate PLATE circuit breaker 4S2 to OFF, before measuring. Do not measure with high-voltage on.

Output Control Adjustment

In some transmitters, it may be necessary to adjust the mechanical stop on the OUTPUT synchro, 5B1, to obtain full range variation of the power amplifier and modulator plate voltage. This is required if the stop limits the output voltage to less than 5000 volts or if, as the control is rotated clockwise, the voltage increases smoothly to 5000 volts and then varies erratically with further rotation. In this case, proceed as follows:

With the transmitter operating, rotate the OUTPUT control clockwise until the PLATE VOLTAGE meter, 2M5, indicates maximum voltage, approximately 5000 volts.

Turn off the transmitter and open the 230 and 115-volt wall switches to remove all power from the transmitter.

Remove the six screws holding the center control panel in place, then lower the panel on its bottom hinge.

Without changing the position of the shaft of 5B1, loosen the two Allen setscrews in the shaft coupling. Hold the shaft of 5B1 to prevent rotation, then turn the **OUTPUT** control knob to its extreme clockwise position, until the filister-head setscrew in the vernier drive bushing strikes the stop bracket.

Retighten the Allen setscrews in the 5B1 shaft coupling.

Replace the control panel and reapply power to the transmitter. Check the functioning of the **OUTPUT** control which should vary the plate voltage from zero volts (extreme counterclockwise position) to full plate voltage (extreme clockwise position).

Antenna Current Readings

Under certain circumstances, when the tower lights are on, the 60-cycle tower lighting current may cause fluctuation or inaccuracies in the antenna current meter reading. This condition is created when the tower itself serves as one side of the lighting circuit and, hence provides a common path for the tower lighting current and the r-f current. Where this situation exists, it is possible to have two ground return paths for the 60-cycle lighting current: one through the antenna coupling equipment and transmitter output circuit; the other in the a-c lighting circuit through the tower lighting chokes to ground where one side of the a-c is grounded. A simplified schematic diagram of a typical circuit illustrating this possibility is shown in Figure 6. To prevent the meter fluctuations, it is necessary for the 60-cycle tower lighting current to be returned via a path other than the r-f circuits feeding the tower.

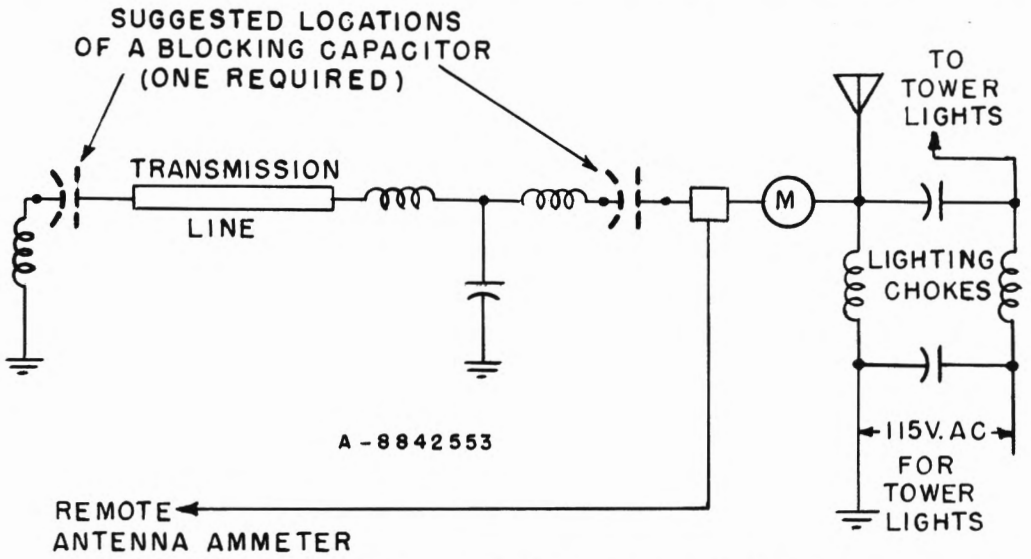


Figure 6. Typical Tower Lighting Circuit (8842553)

If a toroidal tower lighting transformer is used, no antenna current meter fluctuations will occur. Where lighting chokes are utilized, the circuit should be checked for the existence of a second ground path as previously described.

Elimination of the 60-cycle return path through the coupling equipment or transmitter output circuit is achieved by inserting a blocking capacitor in the antenna feed line. The capacitor may be connected in either of two places, just ahead of the antenna current meter or between the transmitter output and the transmission line. The location depends upon the type of coupling circuit used in the line terminating unit. As a general rule, the reactance of the blocking capacitor, shown dotted in Figure 6, should not be greater than approximately one-tenth the characteristic impedance of the transmission line.

To determine whether antenna current meter variations can be caused by the condition just described, turn on the tower lights while the transmitter is off. The presence of any current reading on the antenna current meter at this time indicates the need for corrective measures.

Tube Socket Voltages

Typical tube socket voltages are supplied in Table 16 for the BTA-5G and BTA-10G.

TABLE 16. TYPICAL TUBE SOCKET VOLTAGES, BTA-5G AND BTA-10G

TUBE	TUBE	TUBE	PLATE		CATHODE		GRID		SCREEN		SUPPRESSOR		FILAMENT	
SYMBOL	FUNCTION	TYPE	Pin No.	Volts DC	Pin No.	Volts DC	Pin No.	Volts DC	Pin No.	Volts DC	Pin No.	Volts DC	Pins No.	Volts AC
V1	Crystal Oscillator	807	cap	190	4	17	3	-	2	190	-	-	1-5	6.3
1V1	1st Audio Amp.	807	cap	160	4	35.5	3	20	2	175	-	-	1-5	6.3
1V2	1st Audio Amp.	807	cap	160	4	35.5	3	20	2	175	-	-	1-5	6.3
1V3	2nd Audio Amp.	828	cap	820	(fil. term.)	82	3	0	2	820	4	175	1-5	10.0
1V4	2nd Audio Amp.	828	cap	820	(fil. term.)	82	3	0	2	820	4	175	1-5	10.0
1V5	Modulator Driver	813	cap	1700	(fil. term.)	-135	4	-230	3	820	5	-135	1-7	10.0
1V6	Modulator Driver	813	cap	1700	(fil. term.)	-135	4	-230	3	820	5	-135	1-7	10.0
1V7	Modulator Driver	813	cap	1700	(fil. term.)	-135	4	-230	3	820	5	-135	1-7	10.0
1V8	Modulator Driver	813	cap	1700	(fil. term.)	-135	4	-230	3	820	5	-135	1-7	10.0
1V9	Modulator	5762	socket	4750	(fil. term.)	0	ring	-135	-	-	-	-	leads	12.6
1V10	Modulator	5762	socket	4750	(fil. term.)	0	ring	-135	-	-	-	-	leads	12.6
2V1	Power Amplifier	5762	socket	4700	(fil. term.)	36	ring	-270	-	-	-	-	leads	12.6
2V2	Power Amplifier	5762	socket	4700	(fil. term.)	36	ring	-270	-	-	-	-	leads	12.6
2V3	Power Amplifier	5762	socket	4700	(fil. term.)	36	ring	-270	-	-	-	-	leads	12.6
3V1	1st RF	807	cap	415	4	30	3	-9	2	190	-	-	1-5	6.3
3V2	1st RF	807	cap	415	4	30	3	-9	2	190	-	-	1-5	6.3
3V3	Driver Amplifier	833-A	terminal	1700	(fil. term.)		terminals	-66	-	-	-	-	terminals	10.0
					BTA-5G	18								
					BTA-10G	23								
3V4	LV Rectifier	8008	cap	0	(fil. term.)	*	-	-	-	-	-	-	2-3	5.0
3V5	LV Rectifier	8008	cap	*	(fil. term.)	825	-	-	-	-	-	-	2-3	5.0
3V6	LV Rectifier	8008	cap	*	(fil. term.)	825	-	-	-	-	-	-	2-3	5.0
3V7	LV Rectifier	8008	cap	0	(fil. term.)	*	-	-	-	-	-	-	2-3	5.0
4V1	HV Rectifier	5563-A	cap	3950AC	(fil. term.)	4850	1	§ -90	-	-	-	-	2-4	5.0
4V2	HV Rectifier	5563-A	cap	3950AC	(fil. term.)	4850	1	§ -90	-	-	-	-	2-4	5.0
4V3	HV Rectifier	5563-A	cap	3950AC	(fil. term.)	4850	1	§ -90	-	-	-	-	2-4	5.0
4V4	HV Rectifier	5563-A	cap	3950AC	(fil. term.)	4850	1	§ -90	-	-	-	-	2-4	5.0
10V1	Thyratron Control	2D21	6	§ 255	2	§ 6	1	§ 0	5-7	§ 6	-	-	3-4	§ 6.3
10V1	Thy. Cont. (relay 10K2 energized)	2D21	6	§ 18	2	§ 18	1	§ 0	–	§ 18	-	-	3-4	§ 6.3

CONDITIONS:

POWER switch 5S6 to be in HI POWER position.

All voltages dc and measured to ground unless otherwise indicated. Make d-c measurements with a meter having sensitivity not less than 20,000 ohms per volt.

* 1650 volts dc with 920 volts ac superimposed.

§ WARNING - DO NOT MEASURE WITH HIGH VOLTAGE ON!

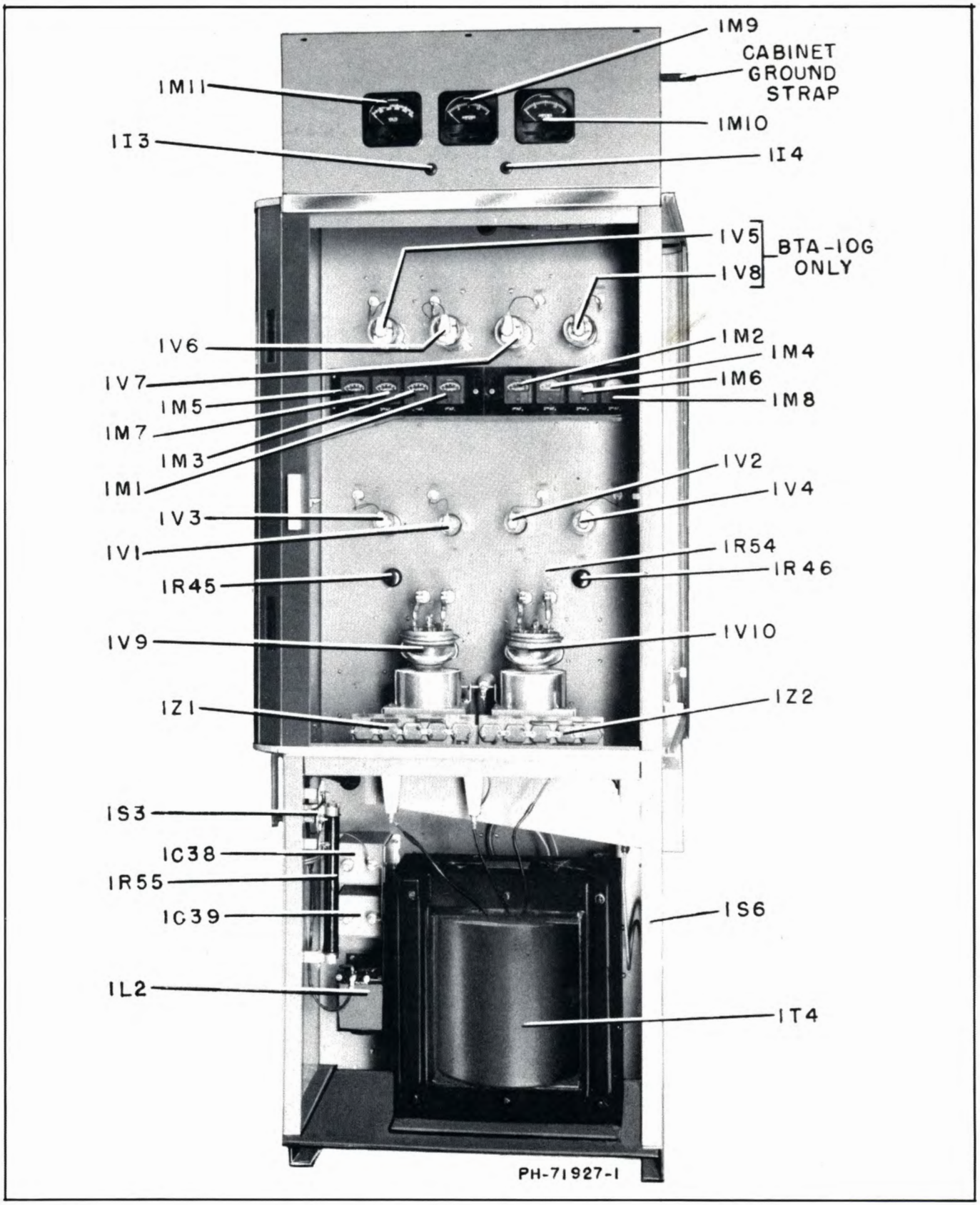


Figure 7. Modulator Unit, Front View

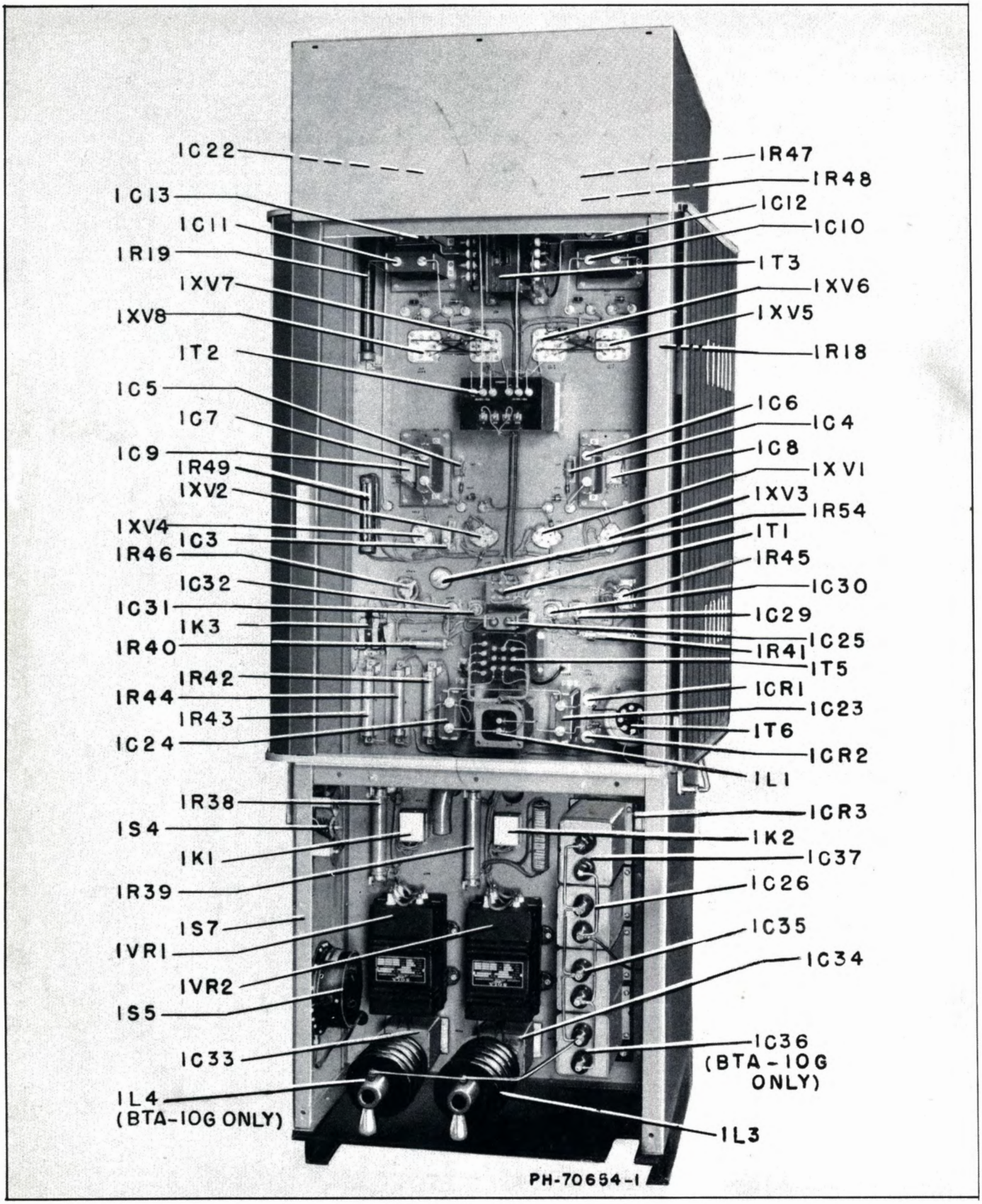


Figure 8. Modulator Unit, Rear View

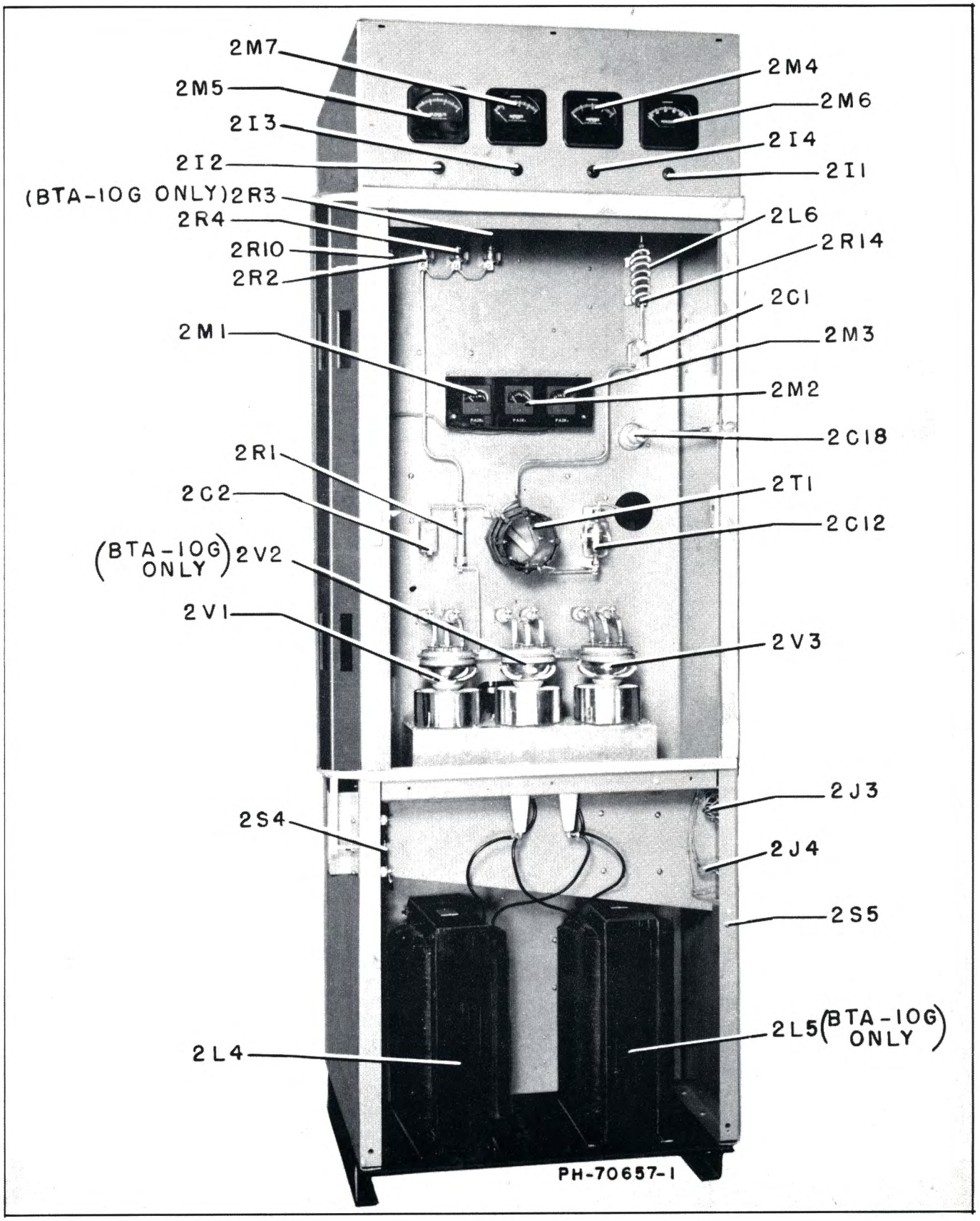


Figure 9. PA Unit, Front View

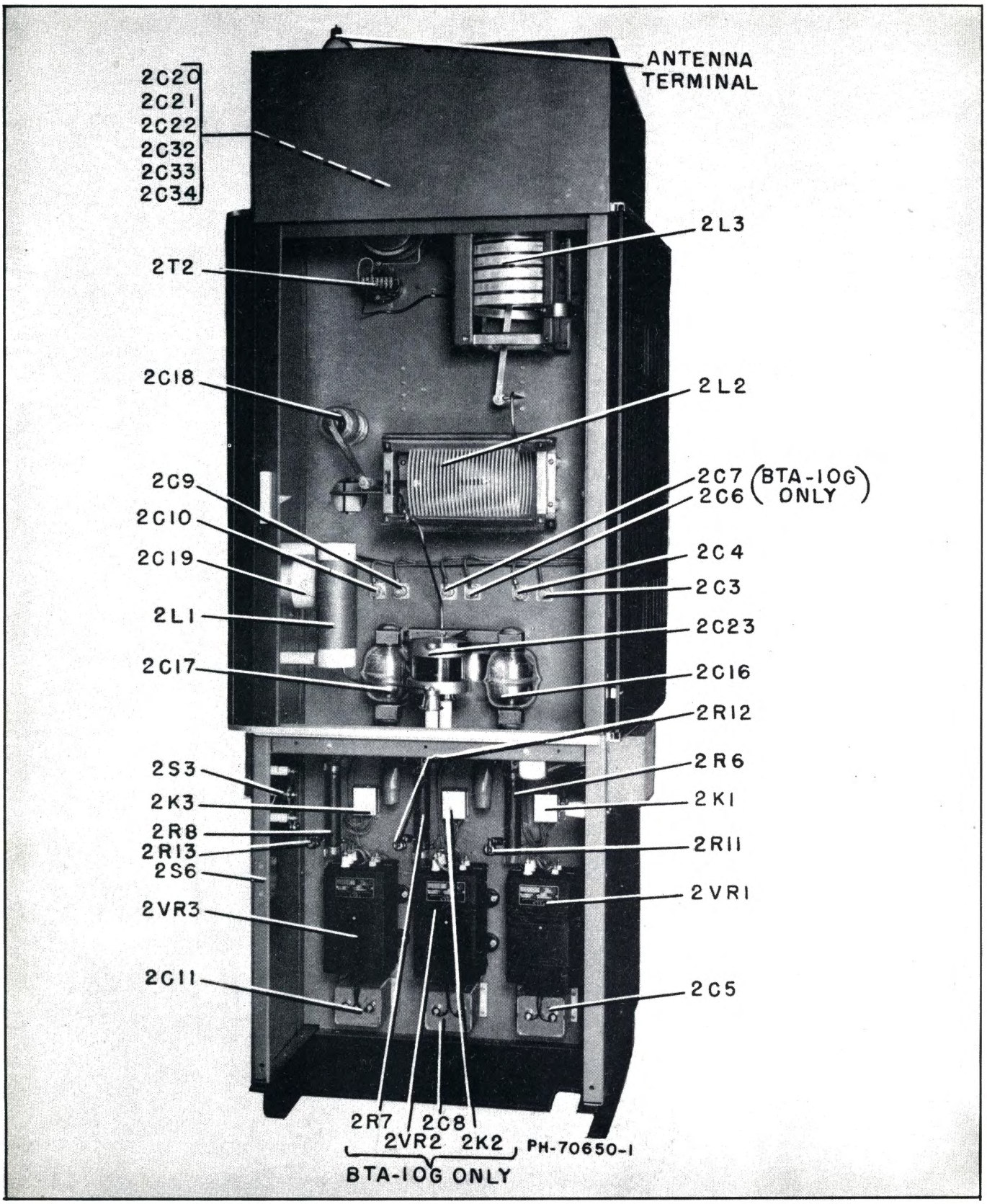


Figure 10. PA Unit, Rear View

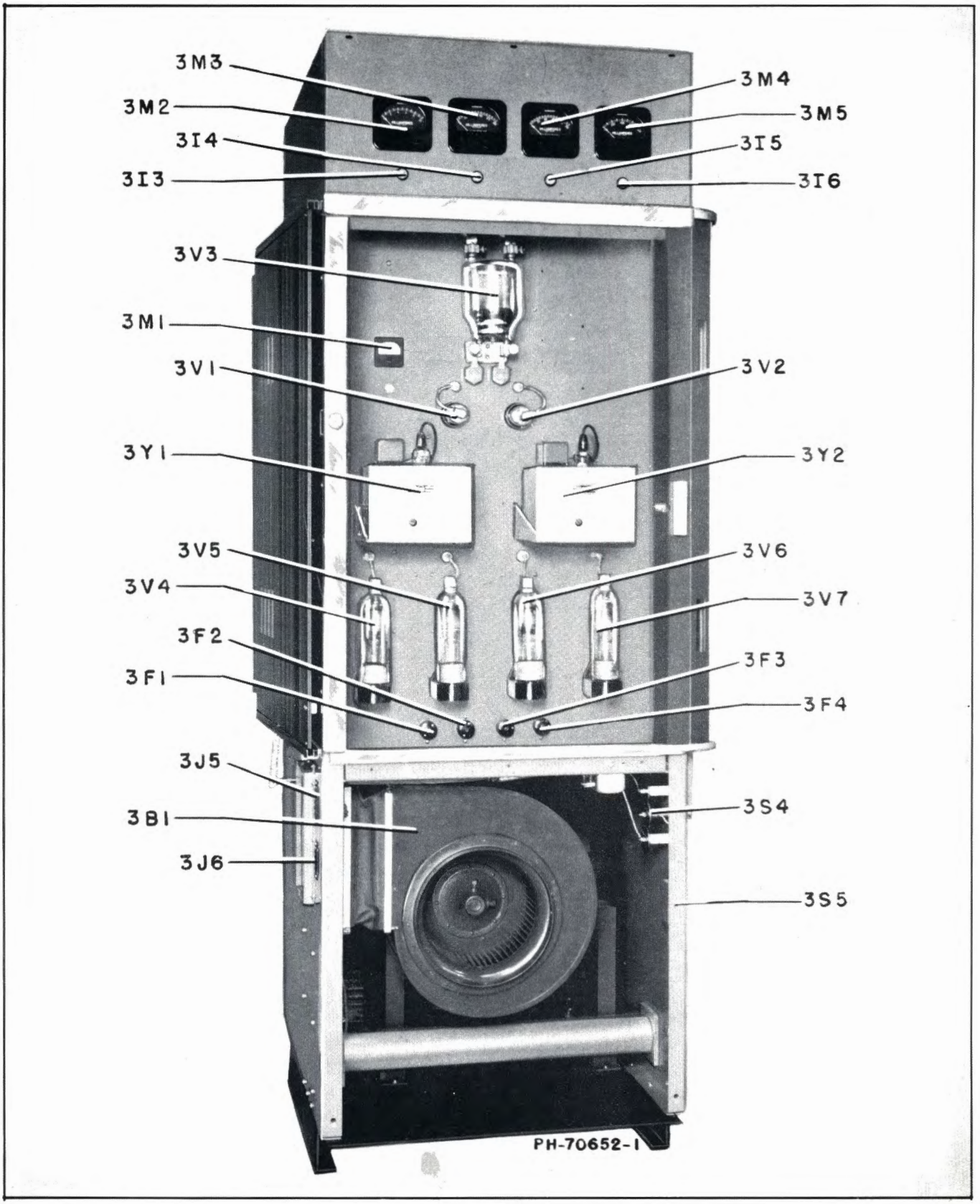


Figure 11. Exciter Unit, Front View

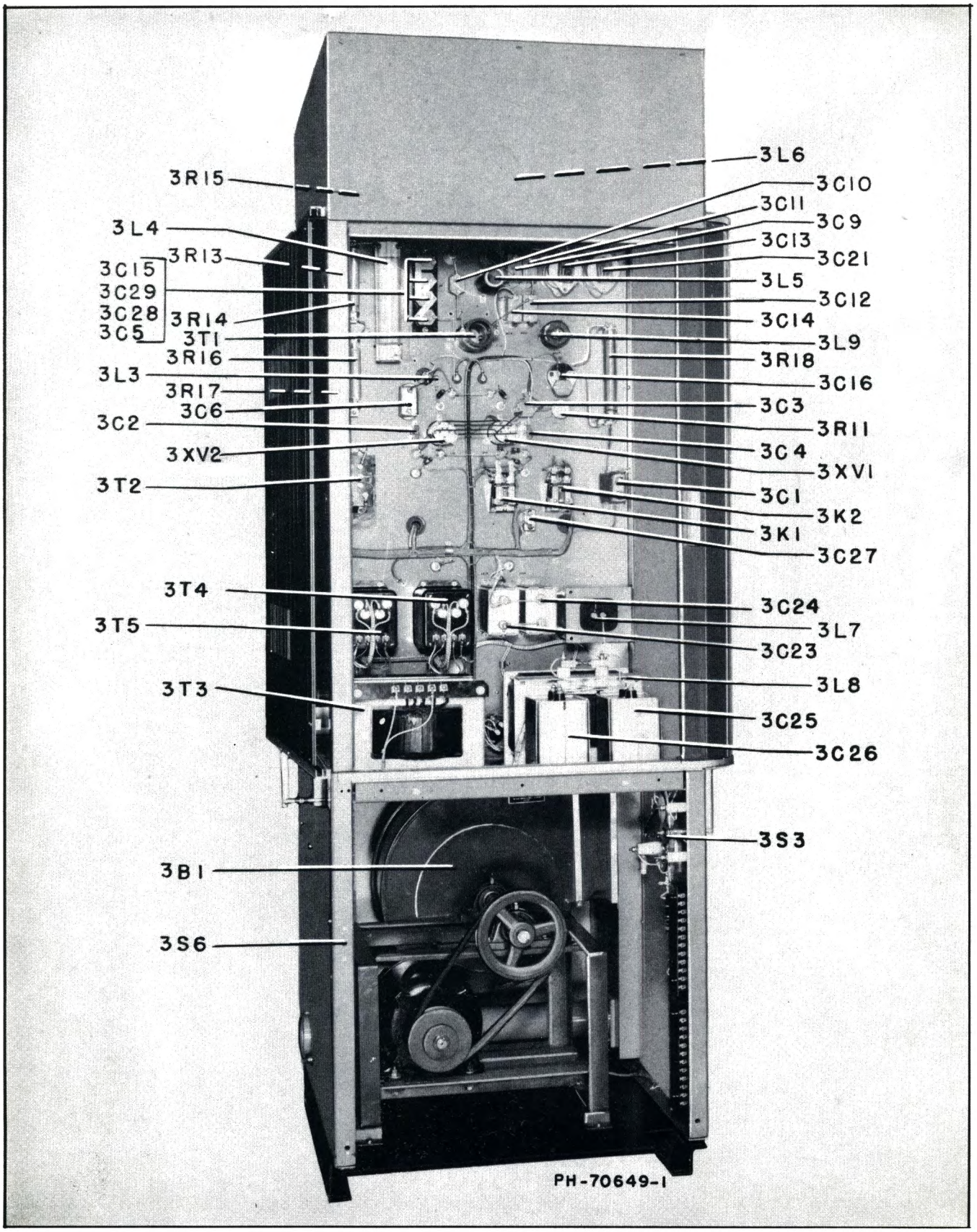


Figure 12. Exciter Unit, Rear View

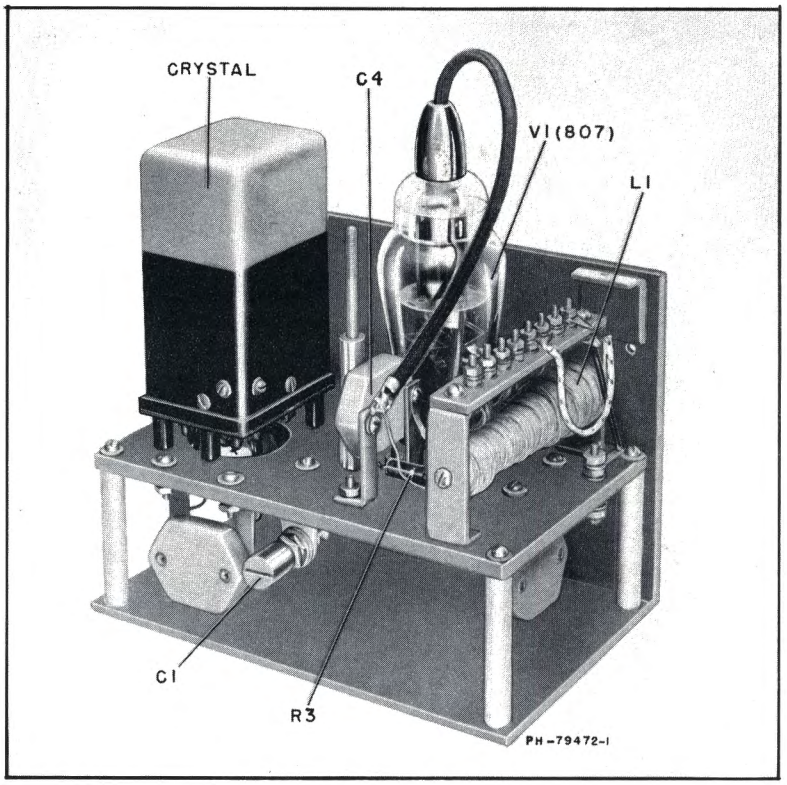


Figure 13. Oscillator Chassis, Front Oblique View

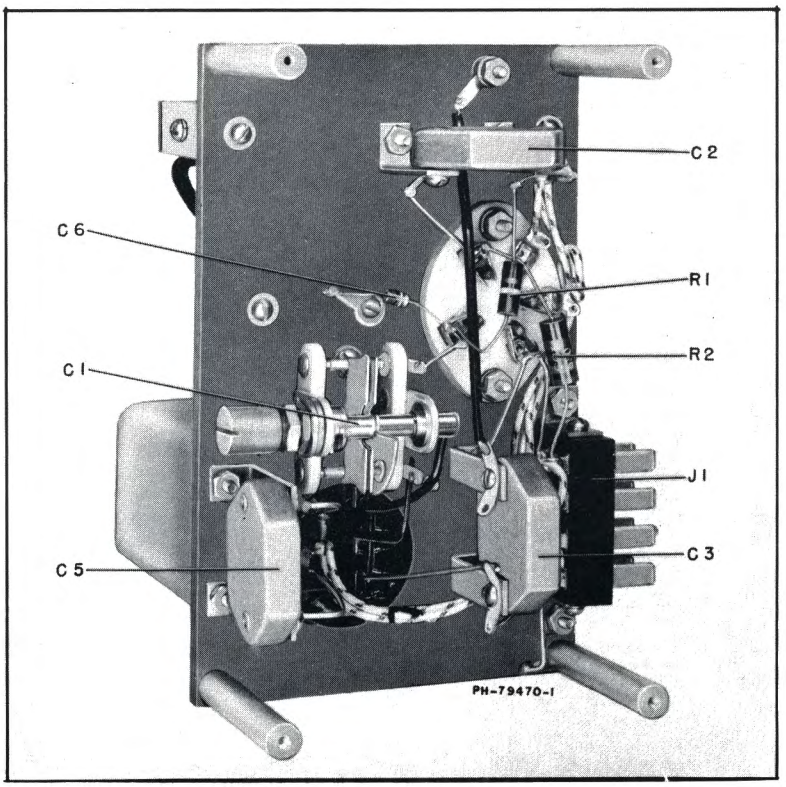


Figure 14. Oscillator Chassis, Wiring Side

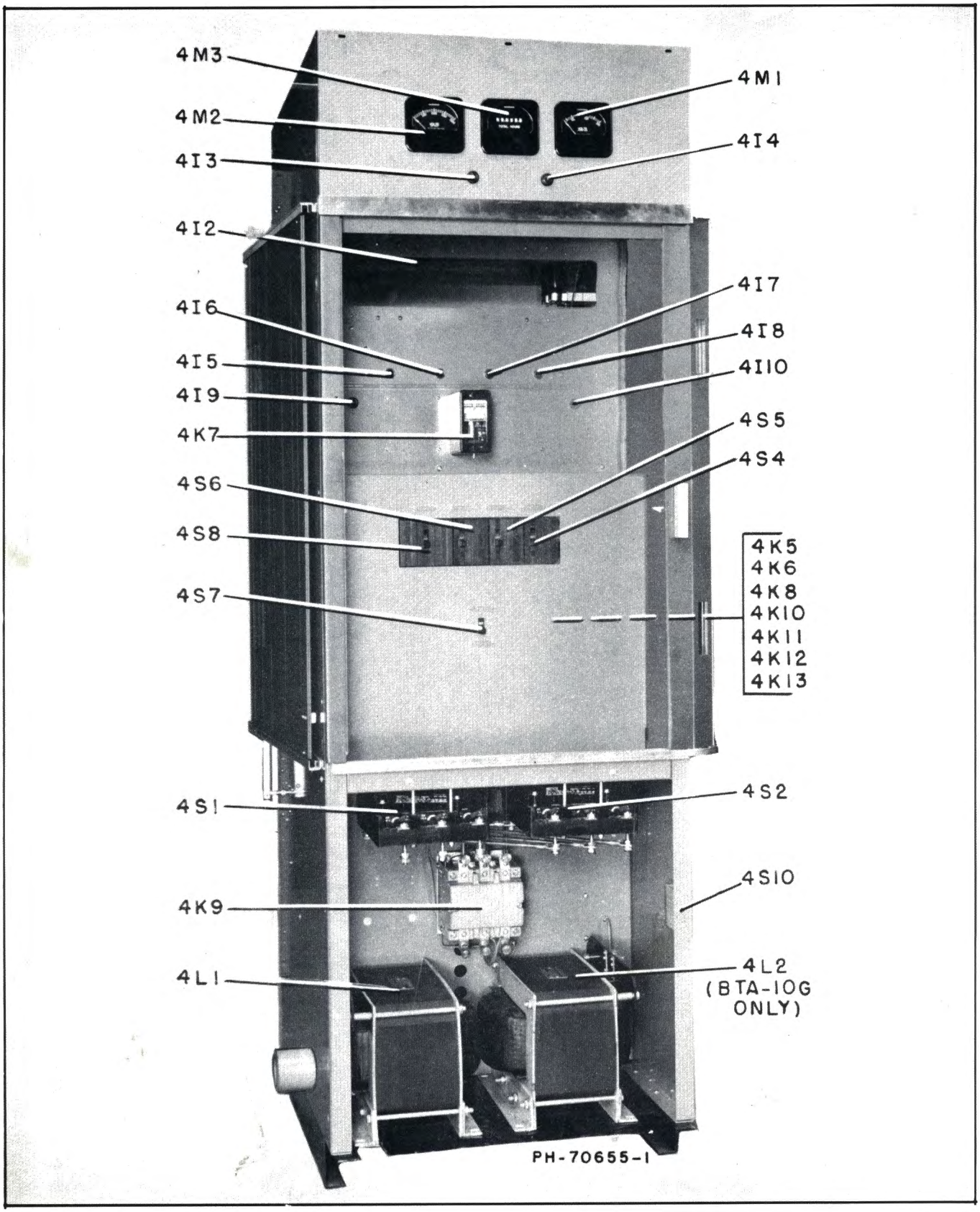


Figure 15. Rectifier and Control Unit, Front View

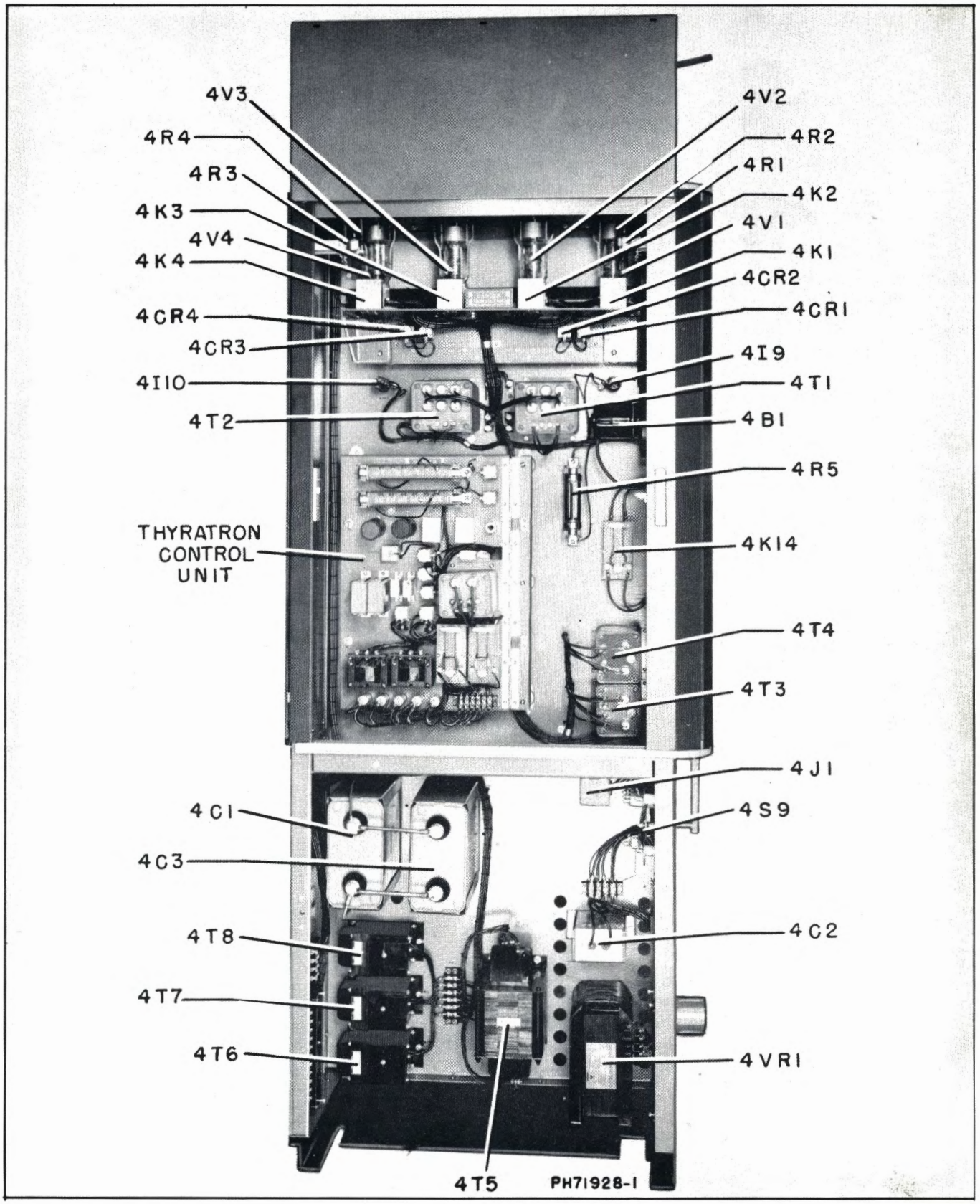


Figure 16. Rectifier and Control Unit, Rear View

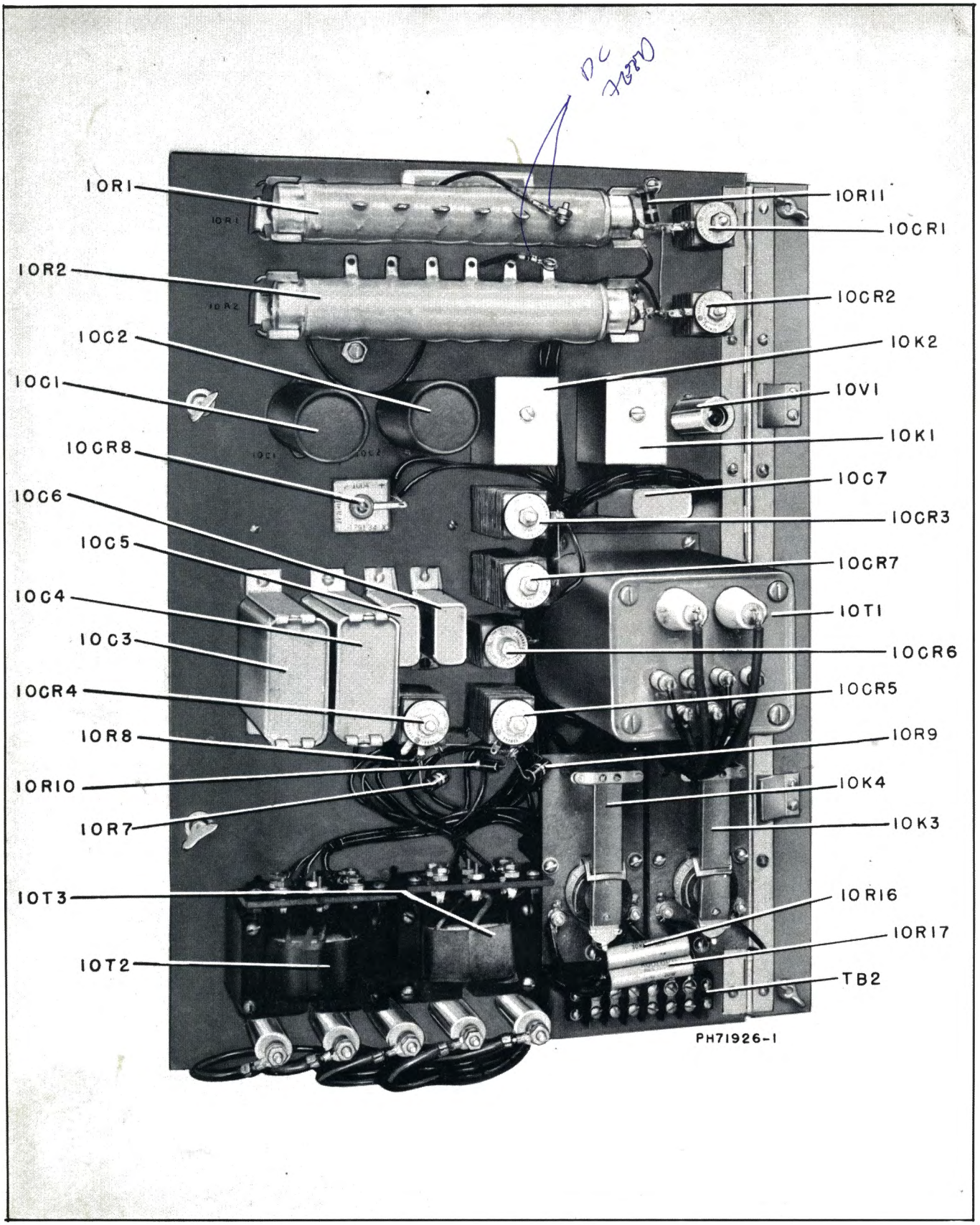


Figure 17. Thyratron Control Chassis, Front View

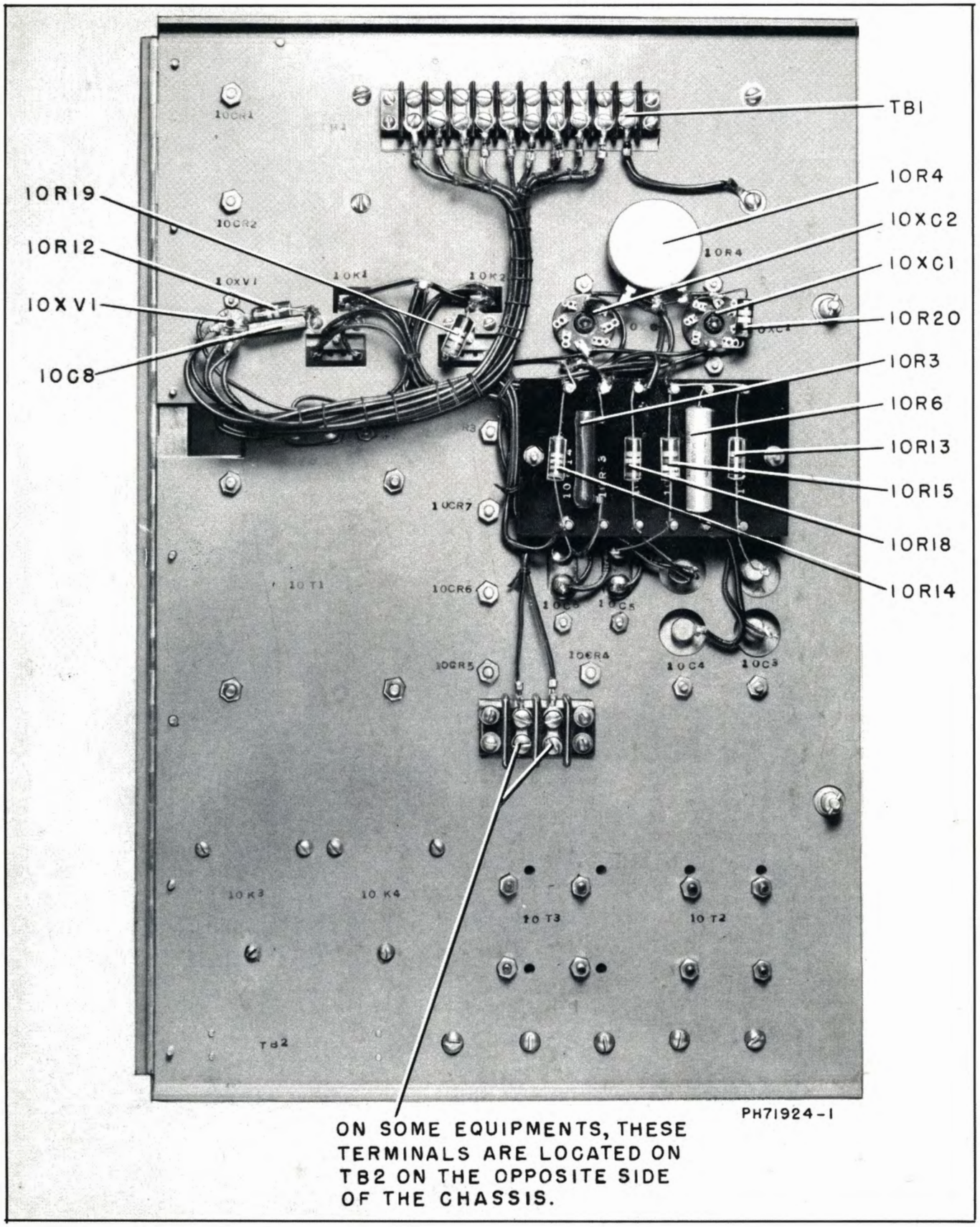


Figure 18. Thyratron Control Chassis, Rear View

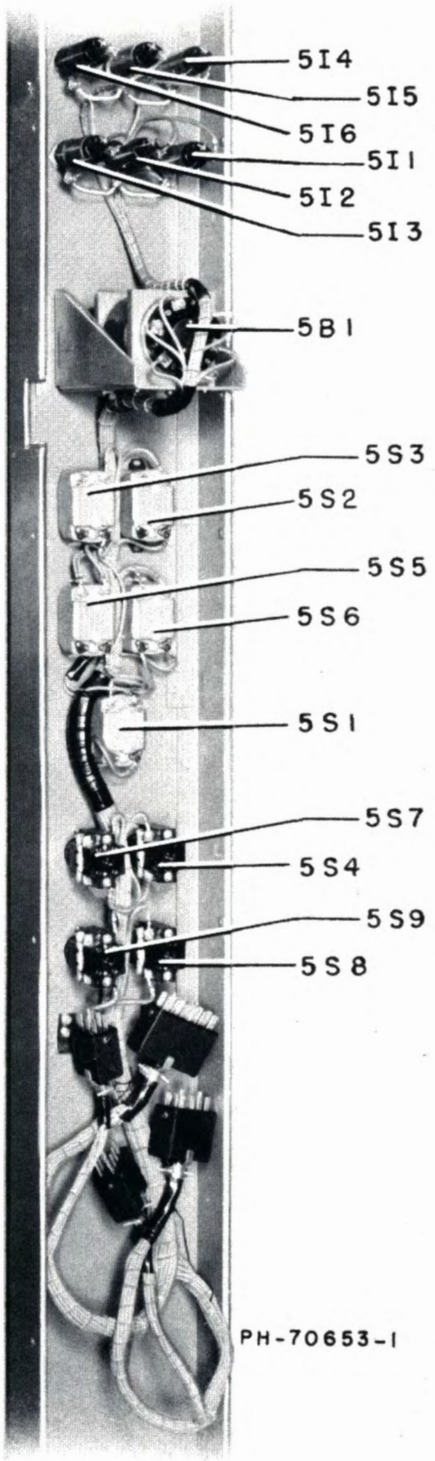


Figure 19. Control Panel, Rear View

REPLACEMENT PARTS AND ENGINEERING SERVICE

When ordering replacement parts, please give symbol, description, and stock number of each item ordered.

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 mechanical or electrical characteristics. Such differences will in no way impair the operation of the equipment.

The following tabulations list service parts, electron tube, and field engineering service ordering instructions according to the geographical location of the station.

SERVICE PARTS

STATION LOCATION	OBTAIN SERVICE PARTS FROM
Continental United States or Alaska	Local Broadcast Equipment Sales Representative, his office, or directly from the Service Parts Order Service, Bldg.60, 19th and Federal Streets, Camden 5, N. J. Emergency orders may be telephoned, telegraphed, or teletyped to RCA Emergency Service, Bldg.60, Camden, N.J. (Telephone: Woodlawn 3-8000).
Dominion of Canada	Local Broadcast Equipment Sales Representative, his office, or directly from RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec.
Outside of Continental United States, Alaska, and the Dominion of Canada	Local Broadcast Equipment Sales Representative, or Service Parts Order Service, RCA International Division, Gloucester, New Jersey. U.S.A.

ELECTRON TUBES

STATION LOCATION	OBTAIN ELECTRON TUBES FROM
Continental United States or Alaska	Local Distributor or nearest of the following warehouses: 34 Exchange Place Jersey City 2, New Jersey 589 E. Illinois Street Chicago 11, Illinois 420 S. San Pedro Street Los Angeles 13, California
Dominion of Canada	Local Broadcast Equipment Sales Representative, his office, or directly from RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec.
Outside of Continental United States, Alaska, and the Dominion of Canada	Local Distributor or from: Tube Department RCA International Division 30 Rockefeller Plaza New York 20, New York. U.S.A.

If for any reason, it is desired to return tubes, please return them to the place of purchase. If this is not convenient, please notify your RCA serving warehouse so that Return Authorization may be forwarded to you.

PLEASE DO NOT RETURN TUBES DIRECTLY TO RCA WITHOUT AUTHORIZATION AND SHIPPING INSTRUCTIONS.

It is important that complete information regarding each tube (including type, serial number, hours of service and reason for its return) be given.

When tubes are returned, they should be shipped to the address specified on the Return Authorization form. A copy of the Return Authorization and also a Service Report for each tube should be packed with the tubes.

FIELD ENGINEERING SERVICE*

STATION LOCATION	REQUEST FIELD ENGINEERING SERVICE FROM
Continental United States or Alaska	Local Broadcast Equipment Sales Representative or the RCA Service Company, Inc., Broadcast Communications Service Division, Camden, N.J. Telephone: Woodlawn 3-8000.
Dominion of Canada	Local Broadcast Equipment Sales Representative, his office, or directly from RCA Victor Company Limited, 1001 Lenoir Street, Montreal, Quebec.
Outside of Continental United States, Alaska, and the Dominion of Canada	Chief Engineer RCA International Division 30 Rockefeller Plaza New York 20, New York, U.S.A.

**Charges for field engineering service will be made at current rates.*

For ordering information see page 63

SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	MODULATOR, MI-28056		
1C1, 1C2	Capacitor: fixed, mica, 270 mmf ±5%, 500 v	727856-233	39638
1C3	Capacitor: fixed, paper, 1 mf +20% -10%, 400 v	984679-153	93898
1C4, 1C5	Capacitor: fixed, mica, 1500 mmf ±5%, 2500 v	728647-245	93913
1C6, 1C7	Capacitor: fixed, paper, 8 mf ±10%, 600 v	984621-7	58649
1C8, 1C9	Capacitor: Faradon, 0.1 mf, 500 v	32224-603	552984
1C10, 1C11	Capacitor: fixed, paper, 4 mf ±10%, 2000 v	984621-36	43849
1C12, 1C13	Capacitor: fixed, paper, 4 mf ±10%, 1500 v	984621-125	58568
1C14 to 1C16	Capacitor: fixed, mica, 390 mmf ±5%, 5000 v (part of 1Z1)	8843560-8	93899
1C17, 1C18	Capacitor: fixed, mica, 20,000 mmf ±2%, 600 v (part of 1Z1)	728647-372	95800
1C19 to 1C21	Capacitor: fixed, mica, 390 mmf ±5%, 500 v (part of 1Z2)	8843560-8	93899
1C22	Capacitor: fixed, paper, 4 mf ±10%, 2000 v. Same as 1C10	984621-36	43849
1C23, 1C24	Capacitor: fixed, paper, 10 mf ±20%, 1000 v	984621-117	18118
1C25	Capacitor: fixed, paper, 10 mf, 400 v	450184-4	57017
1C26	Capacitor: fixed, paper, 1 mf ±10%, 10,000 v	984629-84	93795
1C27	Capacitor: fixed, mica, 390 mmf ±5%, 5000 v (part of 1Z1). Same as 1C14	8843560-8	93899
1C28	Capacitor: fixed, mica, 390 mmf ±5%, 500 v (part of 1Z2). Same as 1C19	8843560-8	93899
1C29 to 1C32	Capacitor: filament bypass, 0.01 mf ±20%, 250 v	8881825-1	54643
1C33, 1C34	Capacitor: fixed, paper, 10 mf ±6%, 660 v (part of 1VR1, 1VR2)	949319-2	93796
1C35	Capacitor: fixed, paper, 1 mf ±10%, 10,000 v. Same as 1C26	984629-84	93795
1C36	NOT USED.		
1C37	Capacitor: fixed, paper, 1 mf ±10%, 10,000 v. Same as 1C26	984629-84	93795
1C38, 1C39	Capacitor: fixed, paper, 4 mf ±10%, 2000 v. Same as 1C10	984621-36	43849
1CR1, 1CR2	Rectifier: bias	453389-2	93911
1CR3	Rectifier: bias	459484-5	95310
1I1, 1I2	Lamp: 115 v, 60 w	885232-2	93916
1I3, 1I4	Light: indicator, interlock	440312-3	
	Lamp		16154
	Jewel - green		44136
	Receptacle		44997
	Resistor		44570
1J1	Receptacle	890041-4	51823
1K1, 1K2	Relay: overload indicator	8832153-1	93917
1K3	Relay: underbias	440489-3	18119
	Contacts only		44545
	Coil only		45817
1L1	Reactor: bias filter, 10 henry, 0.2 a	949250-1	93659
1L2	Reactor: modulator	949476-1	95794
1L3	Coil: compensating	461441-501	95801
1M1, 1M2	Meter: 1st A. F. cathode, 0-10 ma D. C.	457554-1	93797
1M3, 1M4	Meter: 2nd A. F. cathode, 0-100 ma D. C.	457554-2	93798
1M5 to 1M8	Meter: 3rd A. F. Plate, 0-100 ma D. C.	457554-2	93798
1M9, 1M10	Meter: modulator cathode, 0-2 a, D. C.	459447-4	94060
1M11	Meter: bias voltage	459447-5	93901
1R1, 1R2	Resistor: fixed, composition, 33,000 ohm ±5%, 1 w	90496-195	512333
1R3	Resistor: fixed, composition, 2200 ohm ±5%, 2 w	99126-167	522222
1R4, 1R5	Resistor: fixed, composition, 100 ohm ±10%, 2 w	99126-50	522110
1R6	Resistor: fixed, composition, 39,000 ohm ±5%, 2 w	99126-197	522339
1R7	Resistor: fixed, composition, 15,000 ohm ±5%, 2 w	99126-187	522315
1R8, 1R9	Resistor: fixed, composition, 12,000 ohm ±5%, 2 w	99126-185	522312
1R10, 1R11	Resistor: fixed, composition, 2000 ohm ±5%, 2 w	99126-166	522220
1R12, 1R13	Resistor: fixed, composition, 0.22 megohm ±5%, 2 w	99126-215	36744
1R14, 1R15	Resistor: fixed, composition, 62,000 ohm ±5%, 2 w	99126-202	522362
1R16, 1R17	Resistor: fixed, composition, 470 ohm ±10%, 2 w	99126-58	522147
1R18, 1R19	Resistor: fixed, wire wound, 12,500 ohm, 200 w	99037-42	43604
1R20, 1R21	Resistor: fixed, composition, 56,000 ohm ±5%, 2 w	99126-201	28741
1R22 to 1R25	Resistor: fixed, composition, 470 ohm ±10%, 2 w. Same as 1R16	99126-58	522147
1R26 to 1R29	Resistor: fixed, composition, 10 ohm ±10%, 2 w	99126-38	522010
1R30 to 1R32	Resistor: fixed, carbon, 5 megohm ±5%, 2 w (part of 1Z1)	891769-7	93902
1R33, 1R34	Resistor: fixed, composition, 0.1 megohm ±5%, 2 w	891769-17	98118
1R35 to 1R37	Resistor: fixed, carbon, 5 megohm ±5%, 2 w (part of 1Z2)	891769-7	93902
1R38, 1R39	Resistor: fixed, wire wound, 31.5 ohm ±10%, 95 w	99033-16	93903
1R40, 1R41	Resistor: fixed, wire wound, 1250 ohm ±10%, 25 w	99027-32	45508
1R42	Resistor: fixed, wire wound, 630 ohm ±10%, 55 w	99031-29	95798
1R43, 1R44	Resistor: fixed, wire wound, 1000 ohm ±10%, 55 w	99031-31	54624

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
1R45A/B	Resistor: variable, wire wound, dual, front section 750 ohm, rear section 500 ohm, 25 w	427399-6	93906
1R46	Resistor: variable, wire wound, 500 ohm, 50 w	892960-5	93907
1R47	Resistor: fixed, wire wound, 8000 ohm ±10%, 150 w	99035-40	48937
1R48	Resistor: fixed, wire wound, 6200 ohm ±10%, 150 w	890014-16	93908
1R49	Resistor: fixed, wire wound, 10,000 ohm ±10%, 40 w	99029-41	19474
1R50	Resistor: fixed, carbon, 5 megohm ±5%, 2 w (part of 1Z1). Same as 1R30	891769-7	93902
1R51	Resistor: fixed, carbon, 5 megohm ±5%, 2 w (part of 1Z2). Same as 1R35	891769-7	93902
1R52, 1R53	Resistor: fixed, composition, 2700 ohm ±10%, 2 w	99126-67	522227
1R54	Resistor: variable, wire wound, 25 ohm ±10%, 4 w	737847-17	95797
1R55	Resistor: fixed, wire wound, 500 ohm ±10%, 200 w	99037-28	44231
1S1, 1S2	Switch: door interlock	439530-7	93926
1S3, 1S4	Switch: H.V. Grounding		
	Insulator	426767-11	50777
	Washer	8855732-2	95072
	Washer, spring	8890122-1	98689
1S5	Switch: pressure control	883387-2	51114
1S6, 1S7	Switch: door interlock. Same as 1S1	439530-7	93926
1T1	Transformer: A.F. Input	949347-1	93800
1T2	Transformer: filament	900992-1	47791
1T3	Transformer: cathode follower	901065-502	43866
1T4	Transformer: modulation	949349-1	93909
1T5	Transformer: filament	949324-1	93801
1T6	Transformer: bias plate	949348-1	93802
1VR1, 1VR2	Regulator: filament	949319-1	93803
1XI1A/B, 1XI2A/B	Base: lampholder	885233-1	45944
1XI1C/D, 1XI2C/D	Cap: lampholder	885234-1	45945
1XV1, 1XV2	Socket: tube (RCA 807)	843314-2	9920
1XV3, 1XV4	Socket: tube (RCA 828)	843314-2	9920
1XV5 to 1XV8	Socket: tube (RCA 813)	418317-1	9929
1XV9, 1XV10	Socket: tube	740269-501	99896
1Z1, 1Z2	Ladder: feedback	457534-501	93910
	MISCELLANEOUS		
	Clip: fuse, (for 13/16" dia. ferrule)	838400-2	42736
	Clip: fuse, (for 1 1/16" dia. ferrule)	7862770-1	52717
	Clip: fuse, (for 9/16" dia. ferrule)	838400-4	52690
	Connector Assem: tube grid	8849483-501	94328
	Connector Assem: tube cap (RCA 828)	8890120-503	94393
	Connector Assem: tube cap (RCA 807)	8890120-502	94393
	Connector Assem: tube cap (RCA 813)	8890121-504	94327
	Door Assembly: front	740261-504	
	Window - door, plastic	8849420-1	94169
	Spring - window holding	8849416-1	94170
	Door Assembly: rear	740261-505	
	Window - door, plastic	8849420-1	94169
	Spring - window holding	8849416-1	94170
	Knob: (for 1R45. 1R46)	255541-501	69979
	Latch: door, for doors opening from right to left	8849458-501	209160
	Receptacle: hood	897162-1	99898
	Roller Assem: door, bottom (3-roller assembly)	8835531-501	94551
	Roller Assem: door, top (2-roller assembly)	8835532-501	94552
	POWER AMPLIFIER, MI-28057		
2B1	Blower	744473-6	95055
2C1	Capacitor: Faradon, 0.001 mf, 5000 v	32221-689	553071
2C2	Capacitor: Faradon, 0.002 mf, 5000 v	32222-574	553054
2C3, 2C4	Capacitor: filament bypass, 0.01 mf ±20%, 250 v	8881825-1	54643
2C5	Capacitor: fixed, paper, 10 mf ±6%, 600 v (part of 2VR1)	949319-2	93796
2C6 to 2C8	NOT USED.		
2C9, 2C10	Capacitor: filament bypass, 0.01 mf ±20%, 250 v. Same as 2C3	8881825-1	54643
2C11	Capacitor: fixed, paper, 10 mf ±6%, 600 v (part of 2VR3)	949319-2	93796

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
2C12	Capacitor: variable, vacuum, 15-75 mmf, 20,000 v	8814055-1	98053
2C13 to 2C15	NOT USED.		
2C16, 2C17	Capacitor: tank (see freq. det. kit, MI-28090, MI-28091)		
2C18	Capacitor: variable, vacuum, 25-500 mmf, 15,000 v	8849438-2	93923
2C19	Capacitor: Faradon, 1000 mmf, 20,000 v	32232-501	553345
2C20 to 2C22	Capacitor: matching (see freq. det. kit, MI-28090, MI-28091)		
2C23	Capacitor: fixed, mica, 2000 mmf, 15,000 v	32232-536	94392
2C24	NOT USED.		
2C25 to 2C31	Capacitor: meter bypass, 0.01 mmf, 600 v	36655-503	610003
2C32	Capacitor: matching (see freq. det. kit, MI-28090, MI-28091)		
2C33, 2C34	Capacitor: matching (see freq. det. kit, MI-28091)		
2C35, 2C36	NOT USED.		
2I1	Light: indicator, high voltage on	440312-2	
	Receptacle		44997
	Lamp		16154
	Jewel - red		99765
	Resistor		44570
2I2	Light: indicator, high power	440312-2	
	Receptacle		44997
	Lamp		16154
	Jewel - red		99765
	Resistor		44570
2I3	Light: indicator, low power	440312-3	
	Receptacle		44997
	Lamp		16154
	Jewel - green		44136
	Resistor		44570
2I4	Light: indicator, filaments	440312-3	
	Receptacle		44997
	Lamp		16154
	Jewel - green		44136
	Resistor		44570
2I5, 2I6	Lamp: lumiline, 115 v, 60 w	885232-2	93916
2J1	Connector: mod. mon. jack	255223-2	51800
2J2	Receptacle: duplex	890041-4	51823
2J3	Connector: socket, 12 contacts	727969-15	53140
2J4	Connector: socket, 6 contacts	727969-1	51594
2K1	Relay: overload indicator	8832153-1	93917
2K2	NOT USED.		
2K3	Relay: overload indicator. Same as 2K1	8832153-1	93917
2L1	Choke: plate	457558-501	93925
2L2	Coil: tank	740451-2	93927
2L3	Coil: harmonic filter	740451-1	93924
2L4	Reactor: modulation	949350-1	93921
2L5	NOT USED.		
2L6	Coil: suppressor	8824438-501	
2M1, 2M2	Meter: cathode current, 1st P.A. 0-1.5 a	457554-3	93805
2M3	Meter: cathode current, 3rd P.A. 0-1.5 a	457554-3	93805
2M4	Meter: plate current, 0-4 a D.C.	459447-9	93804
2M5	Meter: plate voltage, 0-6000 v. D.C.	459447-10	93806
2M6	Meter: output current		
2M7	Meter: grid current, 0-1 a, D.C.	459447-8	94061
2P1	Connector: plug	252868-1	66344
2R1	Resistor: fixed, composition, 15,000 ohm, 8 w	890144-3	19669
2R2	Resistor: fixed, wire wound, 1600 ohm ±10%, 200 w	99037-33	45983
2R3	NOT USED.		
2R4	Resistor: fixed, wire wound, 1600 ohm ±10%, 200 w. Same as 2R2	99037-33	45983
2R5	NOT USED.		
2R6	Resistor: fixed, wire wound, 31.5 ohm ±10%, 95 w	99033-16	93903
2R7	NOT USED.		
2R8	Resistor: fixed, wire wound, 31.5 ohm ±10%, 95 w. Same as 2R6	99033-16	93903
2R9	Resistor: fixed, composition, 100,000 ohm ±10%, 2 w	99126-86	522410
2R10	Resistor: fixed, wire wound, 6 megohm, 6000 v	878811-11	93919
2R11	Resistor: fixed, composition, 2700 ohm ±10%, 2 w	99126-67	522227
2R12	NOT USED.		
2R13	Resistor: fixed, composition, 2700 ohm ±10%, 2 w. Same as 2R11	99126-67	522227

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
2R14	Resistor: fixed, ceramic, 100 ohm	890145-1	17217
2R15	Resistor: fixed, ceramic, 10 ohm, 86 w	8849447-2	98054
2S1, 2S2	Switch: door interlock	439530-7	93926
2S3, 2S4	Switch: H.V. grounding		
	Insulator	426767-11	50777
	Washer	8855732-2	95072
	Washer, spring	8890122-1	98689
2S5, 2S6	Switch: door interlock. Same as 2S1	439530-7	93926
2T1	Transformer: neutralizing	738532-501	205689
2T2	Transformer: monitoring	737585-501	93662
2VR1	Regulator: filament	949319-1	93803
2VR2	NOT USED.		
2VR3	Regulator: filament. Same as 2VR1	949319-1	93803
2XI1A/B, 2XI2A/B	Base: lampholder	885233-1	45944
2XI1C/D, 2XI2C/D	Cap: lampholder	885234-1	45945
2XV1 to 2XV3	Socket: tube	740269-501	99896
	MISCELLANEOUS		
	Clip: fuse, (for 1 1/16" dia. ferrule)	7862770-1	52717
	Clip: fuse, (for 9/16" dia. ferrule)	838400-4	52690
	Clip Assembly: coil (for 2L2)	8833154-1	96480
	Clip Assembly: coil (for 2L3)	8833155-1	96253
	Connector: grid (RCA 5762 tube)	8849483-501	94328
	Dial Assembly: (for capacitor 2C18)	433422-501	55924
	Door Assembly: front	740261-504	
	Window - door, plastic	8849420-1	94169
	Spring - window holding	8849416-1	94170
	Door Assembly: rear	740261-505	
	Window - door, plastic	8849420-1	94169
	Spring - window holding	8849416-1	94170
	Knob: black, pointer type (for 2C12)	712336-501	17269
	Roller Assembly: door, bottom (3-roller assembly)	8835531-501	94551
	Roller Assembly: door, top (2-roller assembly)	8835532-501	94552
	FREQUENCY-DETERMINING KIT FOR BTA-5G, MI-28090		
	MI-28090-1, 535-650 KC, 51.5-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 8000 mmf, 6000 v	501679-501	553016
	MI-28090-2, 535-650 KC, 72-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 5000 mmf, 8000 v	500460-501	553427
2C32	Capacitor: fixed, mica, 3000 mmf, 15,000 v	500472-501	553382
	MI-28090-3, 535-650 KC, 230-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 2000 mmf, 12,000 v	500470	552366
	MI-28090-4, 650-780 KC, 51.5-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 5000 mmf, 8000 v	500460-501	553427
2C32	Capacitor: fixed, mica, 5000 mmf, 8000 v. Same as 2C20	500460-501	553427

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	MI-28090-5, 650-780 KC, 72-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 5000 mmf, 8000 v	500460-501	553427
	MI-28090-6, 650-780 KC, 230-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 1500 mmf, 12,000 v	500584-501	553381
	MI-28090-7, 780-940 KC, 51.5-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 5000 mmf, 8000 v	500460-501	553427
2C32	Capacitor: fixed, mica, 2000 mmf, 12,000 v	500470-501	552366
	MI-28090-8, 780-940 KC, 72-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 4000 mmf, 12,000 v	500467-501	552360A
	MI-28090-9, 780-940 KC, 230-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 1000 mmf, 15,000 v	500468-501	553345
2C32	Capacitor: fixed, mica, 1000 mmf, 15,000 v. Same as 2C20	500468-501	553345
	MI-28090-10, 940-1120 KC, 51.5-Ohm Line		
2C20 to 2C22	Capacitor: fixed, mica, 5000 mmf, 8000 v	500460-501	553427
	MI-28090-11, 940-1120 KC, 72-Ohm Line		
2C20	Capacitor: fixed, mica, 3000 mmf, 15,000 v	500472-501	553382
2C21, 2C22	Capacitor: fixed, mica, 4000 mmf, 12,000 v	500467-501	552360A
	MI-28090-12, 940-1120 KC, 230-Ohm Line		
2C20 to 2C22	Capacitor: fixed, mica, 800 mmf, 20,000 v	500457-501	552355A
2C32	Capacitor: fixed, mica, 1000 mmf, 15,000 v	500468-501	553345
	MI-28090-13, 1120-1340 KC, 51.5-Ohm Line		
2C20 to 2C22	Capacitor: fixed, mica, 4000 mmf, 12,000 v	500467-501	552360A
	MI-28090-14, 1120-1340 KC, 72-Ohm Line		
2C20 to 2C22	Capacitor: fixed, mica, 3000 mmf, 15,000 v	500472-501	553382
	MI-28090-15, 1120-1340 KC, 230-Ohm Line		
2C20, 2C21	Capacitor: fixed, mica, 800 mmf, 20,000 v	500457-501	552355A
2C22	Capacitor: fixed, mica, 600 mmf, 20,000 v	500456-501	553349
2C32	Capacitor: fixed, mica, 600 mmf, 20,000 v. Same as 2C22	500456-501	553349
	MI-28090-16, 1340-1620 KC, 51.5-Ohm Line		
2C20 to 2C22	Capacitor: fixed, mica, 3000 mmf, 15,000 v	500472-501	553382
2C32	Capacitor: fixed, mica, 1500 mmf, 12,000 v	500584-501	553381

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	MI-28090-17, 1340-1620 KC, 72-Ohm Line		
2C20 to 2C22	Capacitor: fixed, mica, 2000 mmf, 12,000 v	500470-501	552366
2C32	Capacitor: fixed, mica, 1500 mmf, 12,000 v	500584-501	553381
	MI-28090-18, 1340-1620 KC, 230-Ohm Line		
2C20 to 2C22	Capacitor: fixed, mica, 600 mmf	500456-501	553349
2C32	Capacitor: fixed, mica, 600 mmf. Same as 2C20	500456-501	553349
	FREQUENCY-DETERMINING KIT FOR BTA-10G, MI-28091		
	MI-28091-1, 535-650 KC, 51.5-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 5000 mmf, 8000 v	500460-501	553427
2C32	Capacitor: fixed, mica, 5000 mmf, 8000 v. Same as 2C20	500460-501	553427
	MI-28091-2, 535-650 KC, 72-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 3000 mmf, 15,000 v	500472-501	553382
2C32 to 2C34	Capacitor: fixed, mica, 3000 mmf, 15,000 v. Same as 2C20	500472-501	553382
	MI-28091-3, 535-650 KC, 230-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20, 2C21	Capacitor: fixed, mica, 1000 mmf, 15,000 v	500468-501	553345
2C32, 2C33	Capacitor: fixed, mica, 1000 mmf, 15,000 v. Same as 2C20	500468-501	553345
2C34	Capacitor: fixed, mica, 600 mmf, 20,000 v	500456-501	553349
	MI-28091-4, 650-780 KC, 51.5-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 4000 mmf, 12,000 v	500467-501	552360A
2C32	Capacitor: fixed, mica, 4000 mmf, 12,000 v. Same as 2C20	500467-501	552360A
	MI-28091-5, 650-780 KC, 72-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 3000 mmf, 15,000 v	500472-501	553382
2C32, 2C33	Capacitor: fixed, mica, 3000 mmf, 15,000 v. Same as 2C20	500472-501	553382
	MI-28091-6, 650-780 KC, 230-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 1000 mmf, 15,000 v	500468-501	553345
2C32	Capacitor: fixed, mica, 1000 mmf, 15,000 v. Same as 2C20	500468-501	553345
	MI-28091-7, 780-940 KC, 51.5-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 3000 mmf, 15,000 v	500472-501	553382
2C32, 2C33	Capacitor: fixed, mica, 3000 mmf, 15,000 v. Same as 2C20	500472-501	553382

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	MI-28091-8, 780-940 KC, 72-Ohm Line		
2C16, 2C17	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 2000 mmf, 12,000 v	500470-501	552366
2C32 to 2C34	Capacitor: fixed, mica, 2000 mmf, 12,000 v. Same as 2C20	500470-501	552366
	MI-28091-9, 780-940 KC, 230-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 1000 mmf, 15,000 v	500468-501	553345
	MI-28091-10, 940-1120 KC, 51.5-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 3000 mmf, 15,000 v	500472-501	553382
2C32	Capacitor: fixed, mica, 3000 mmf, 15,000 v. Same as 2C20	500472-501	553382
	MI-28091-11, 940-1120 KC, 72-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 2000 mmf, 12,000 v	500470-501	552366
2C32, 2C33	Capacitor: fixed, mica, 2000 mmf, 12,000 v. Same as 2C20	500470-501	552366
	MI-28091-12, 940-1120 KC, 230-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 500 mmf, 20,000 v	500455-501	553352
2C32, 2C33	Capacitor: fixed, mica, 500 mmf, 20,000 v. Same as 2C20	500455-501	553352
	MI-28091-13, 1120-1340 KC, 51.5-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 2000 mmf, 12,000 v	500470-501	552366
2C32, 2C33	Capacitor: fixed, mica, 2000 mmf, 12,000 v. Same as 2C20	500470-501	552366
	MI-28091-14, 1120-1340 KC, 72-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 1300 mmf, 15,000 v	32232-516	96775
2C32 to 2C34	Capacitor: fixed, mica, 1300 mmf, 15,000 v. Same as 2C20	32232-516	96775
	MI-28091-15, 1120-1340 KC, 230-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 500 mmf, 20,000 v	500455-501	553352
2C32	Capacitor: fixed, mica, 500 mmf, 20,000 v. Same as 2C20	500455-501	553352
	MI-28091-16, 1340-1620 KC, 51.5-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 1300 mmf, 15,000 v	32232-516	96775
2C32 to 2C34	Capacitor: fixed, mica, 1300 mmf, 15,000 v. Same as 2C20	32232-516	96775
	MI-28091-17, 1340-1620 KC, 72-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 1000 mmf, 15,000 v	500468-501	553345
2C32 to 2C34	Capacitor: fixed, mica, 1000 mmf, 15,000 v. Same as 2C20	500468-501	553345
	MI-28091-18, 1340-1620 KC, 230-Ohm Line		
2C16	Capacitor: vacuum, 500 mmf, 15,000 v	8832174-1	96758
2C20 to 2C22	Capacitor: fixed, mica, 400 mmf, 20,000 v	500462-501	553354
2C32, 2C33	Capacitor: fixed, mica, 400 mmf, 20,000 v. Same as 2C20	500462-501	553354

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	EXCITER, MI-28058		
3B1	Blower	622792-1	
	Motor		96232
	Belt		96233
	Pulley-variable		96237
	Bearings-blower		96234
	Rotor		96238
	Shock-Mounting-blower		96236
	Shock-Mounting-motor		96235
3C1	Capacitor: fixed, oil, 10 mmf, 400 v	450184-4	57017
3C2	Capacitor: fixed, mica, 0.01 mf ±20%, 1200 v.	728647-65	610003
3C3	Capacitor: fixed, mica, 0.01 mf ±20%, 1200 v	728651-65	610003
3C4	Capacitor: fixed, mica, 0.01 mf ±20%, 1200 v. Same as 3C2	728647-65	610003
3C5	Capacitor: fixed, mica, 0.001 mf ±10%, 2500 v	728647-141	601002
3C6 to 3C8	Capacitor: fixed, mica, 0.01 mf ±20%, 1200 v. Same as 3C2	728647-65	610003
3C9	Capacitor: fixed, mica, 0.002 mf ±5%, 5000 v	32222-574	553054
3C10	Capacitor: fixed, mica, 39 mmf ±5%, 5000 v	8843560-5	93929
3C11	Capacitor: fixed, mica, 200 mmf ±5%, 5000 v	32220-683	553115
3C12	Capacitor: fixed, mica, 0.001 mf ±5%, 5000 v	32221-689	553071
3C13	Capacitor: fixed, mica, 510 mmf ±5%, 6000 v	32225-626	93928
3C14	Capacitor: fixed, mica, 0.002 mf ±5%, 5000 v. Same as 3C9	32222-574	553054
3C15	Capacitor: fixed, mica, 0.01 mf ±20%, 1200 v. Same as 3C2	728647-65	610003
3C16 to 3C20	Capacitor: fixed, mica, 0.01 mf ±20%, 600 v	36655-503	610003
3C21	Capacitor: fixed, mica, 510 mmf ±5%, 6000 v. Same as 3C13	32225-626	93928
3C22	NOT USED.		
3C23, 3C24	Capacitor: fixed, paper, 15 mf ±20%, 1000 v	984621-119	56384
3C25, 3C26	Capacitor: fixed, paper, 15 mf ±20%, 2000 v	984621-141	99538
3C27	Capacitor: fixed, paper, 0.05-0.05 mf +20% -10%, 600 v	984618-572	93626
3C28, 3C29	Capacitor: fixed, mica, 620 mf ±5%, 3500 v	8843560-7	93930
3F1, 3F2	Fuse: crystal heater, 1 amp, 250 v	59075-9	22301
3F3, 3F4	Fuse: 15 amp, 250 v	99108-4	51842
3I1, 3I2	Lamp: lumiline, 60 w, 115 v	885232-2	93916
3I3, 3I4	Light: indicator, 115 v, white	440312-11	
	Receptacle		44997
	Resistor		16155
	Lamp		16154
	Jewel - white		44135
3I5, 3I6	Light: indicator, 220 v, white	440312-5	
	Receptacle		44997
	Resistor		44570
	Lamp		16154
	Jewel - white		44135
3J1, 3J2	Connector: oscillator socket	860899-1	19656
3J3	Connector: monitor jack	255223-2	51800
3J4	Receptacle: duplex	890041-4	51823
3J5	Connector: socket	727969-9	57542
3J6	Connector: socket	727969-5	56077
3K1	Relay: carrier off, 230 v, 50/60 cycles	440489-5	44941
	Coil		44556
	Contact - set		44942
3K2	Relay: carrier off hold, 230 v, 50/60 cycles	440489-1	44558
	Coil		44556
	Contact - set		44545
3L1, 3L2	Coil: buffer parasitic choke	8883316-501	93934
3L3	Coil: buffer plate	412784-501	16892
3L4	Coil: buffer tank	740447-501	94064
3L5	Coil: driver plate	418486-501	19185
3L6	Coil: driver plate tuning, 100 millihenry	740275-501	
	Coil and form only	740275-502	94068
	Adjustable core	446478-503	94069
3L7	Reactor: filter, 10 henry, 0.4 amp	949251-1	93658
3L8	Reactor: filter, 10 henry, 1 amp	900304-1	52038
3L9	Coil: compensating	900526-1	17906
3M1	Meter: oscillator cathode, 0-50 ma D.C.	457554-4	95309
3M2	Meter: buffer grid, 0-10 ma D.C.	459447-3	93808
3M3, 3M4	Meter: buffer cathode, 0-150 ma D.C.	459447-1	94062
3M5	Meter: driver plate, 0-800 ma D.C.	459447-2	94063
3P1	Connector: plug	252868-1	66344
3R1, 3R2	Resistor: fixed, composition, 2200 ohm ±10%, 2 w	99126-66	522222

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
3R3, 3R4	Resistor: fixed, composition, 47 ohm ±20%, 2 w	99126-5	522047
3R5	Resistor: fixed, composition, 4700 ohm ±10%, 2 w	99126-70	522247
3R6	Resistor: fixed, composition, 1800 ohm ±10%, 2 w	99126-65	522218
3R7, 3R8	Resistor: fixed, composition, 47 ohm ±20%, 2 w. Same as 3R3	99126-5	522047
3R9	Resistor: fixed, composition, 300 ohm, 9 w	890144-27	98114
3R10	NOT USED.		
3R11	Resistor: variable, composition, 200 ohm ±10%, 2 w	433196-31	52438
3R12	Resistor: fixed, wire wound, 400 ohm ±5%, 10 w	458574-36	93933
3R13	Resistor: fixed, wire wound, 50 ohm ±10%, 55 w	99031-18	93932
3R14	Resistor: fixed, wire wound, 1250 ohm ±10%, 55 w	99031-32	56613
3R15	Resistor: fixed, wire wound, 2500 ohm ±10%, 55 w	99031-35	46111
3R16	Resistor: fixed, wire wound, 5000 ohm ±10%, 55 w	99031-38	19687
3R17	Resistor: fixed, wire wound, 10,000 ohm ±10%, 55 w	99031-41	46110
3R18	Resistor: fixed, wire wound, 63,000 ohm ±10%, 95 w	99033-49	93936
3S1, 3S2	Switch: door interlock	439530-7	93926
3S3, 3S4	Switch: grounding (part of 8849457-501)		
	Insulator	426767-11	50777
	Washer	8855732-2	95072
	Washer, spring	8890122-1	98689
3S5, 3S6	Switch: door interlock. Same as 3S1	439530-7	93926
3T1	Transformer: neutralizing	448083-501	93935
3T2	Transformer: filament	949324-1	93801
3T3	Transformer: plate	949330-1	93809
3T4, 3T5	Transformer: filament	949325-1	93810
3XF1 to 3XF4	Holder: fuse	426792-10	96712
	Base only		97402
	Plug only		97403
	Lamp - neon, only		48474
	Resistor only		54511
3XI1A/B, 3XI2A/B	Base: lampholder	885233-1	45944
3XI1C/D, 3XI2C/D	Cap: lampholder	885234-1	45945
3XV1, 3XV2	Socket: tube (RCA 807)	843314-2	9920
3XV3	Socket: tube (RCA 833A)	737856-502	96757
3XV4 to 3XV7	Socket: tube (RCA 8008)	8843563-2	93937
3Y1, 3Y2	Crystal Oscillator Unit (See MI-19458)		
	MISCELLANEOUS		
	Boot: (for 3B1 Blower)	8849481-1	94066
	Clamp: boot	8889098-4	94067
	Clip: fuse (for 1 1/16" dia. ferrule)	7862770-1	52717
	Clip: fuse (for 9/16" dia. ferrule)	838400-2	42736
	Dial Assembly	433422-501	55924
	Door Assembly - front	740426-508	
	Window - door, plastic	8849420-1	94169
	Spring - window holding	8849416-1	94170
	Door Assembly - rear	740426-506	
	Window - door, plastic	8849420-1	94169
	Spring - window holding	8849416-1	94170
	Roller Assembly - door, bottom (3-roller assembly)	8835531-501	94169
	Roller Assembly - door, top (2-roller assembly)	8835532-501	94552
	CRYSTAL OSCILLATOR UNIT (MI-19458)		
C1	Capacitor: crystal tuning, 4.5-20 mmf	823075-3	16890
C2, C3	Capacitor: bypass, 0.01 mf ±10%	32203-591	610003
C4	Capacitor: output coupling, 47 mmf ±5%	32200-515	50358
C5	Capacitor: filter, 0.002 mf ±5%	32202-558	602002
C6	Capacitor: feedback, 1 mmf ±10%	99327-12	55331
J1	Plug: power, 8-prong	842766-1	47317
L1	Inductor: plate tank	429932-501	50360
L1A/H	Inductor (part of L1)		
R1	Resistor: grid leak, 150,000 ohm, 1 w	722337-211	512415
R2	Resistor: cathode, 680 ohm, 2 w	722357-155	522168
R3	Resistor: parasitic suppressor, 12 ohm, 1 w	727836-39	512012
X1	Socket: tube, RCA 807	843314-2	9920
X2	Socket: crystal unit	409582-501	16889

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	RECTIFIER AND CONTROL UNIT, MI-28059		
4B1	Blower: tube cooling, complete with motor	744473-2	95055
4C1	Capacitor: fixed, paper, 8 mf ±20%, 5000 v	984629-418	94125
4C2	Capacitor: fixed, oil filled, 10 mf, 735 v AC (part of 4VR1)	949329-3	98170
4C3	Capacitor: fixed, paper, 8 mf ±20%, 5000 v. Same as 4C1	984629-418	94125
4CR1 to 4CR4	Rectifier: selenium, arc back	453389-3	94100
4I1, 4I2	Lamp: lumiline, 60 w, 115 v	885232-2	93916
4I3, 4I4	Lamp: indicator	459610-4	
	Socket		99763
	Resistor		44570
	Jewel - yellow		99767
	Lamp		16154
4I5 to 4I8	Lamp: arc-back indicator	61114-15	11891
4I9, 4I10	Lamp: indicator. Same as 4I3	459610-4	
	Socket		99763
	Resistor		44570
	Jewel - yellow		99767
	Lamp		16154
4J1	Receptacle: power outlet	890041-4	51823
4K1 to 4K4	Relay: arc-back indicator	8832153-1	93917
4K5	Relay: O. L. indicator holding	440489-1	44558
	Coil		44556
	Contact - set		44545
4K6	Relay: magnetic contactor, 3 pole, 50 amps	8832129-1	94101
4K7	Relay: L. P. rect. overload	429580-5	54955
4K8	Relay: magnetic contactor, 2 pole, 25 amps	8832129-2	94102
4K9	Relay: magnetic contactor, 3 pole	8834217-1	94103
4K10	Relay: magnetic contactor, 2 pole, 25 amps. Same as 4K8	8832129-2	94102
4K11	Relay: O. L. indicator holding. Same as 4K5	440489-1	44558
	Coil		44556
	Contact - set		44545
4K12	Relay: time delay	429587-24	96763
4K13	Relay: O. L. indicator holding. Same as 4K5	440489-1	44558
	Coil		44556
	Contact - set		44545
4K14	Relay: SPST, double break, 220 v, 50/60 cycles	458722-2	95510
4L1	Reactor: filter	900431-4	95316
4L2	NOT USED.		
4L3 to 4L6	Reactor: filter	465134-501	97396
4M1	Meter: voltmeter, 0-300 v AC	459447-7	94104
4M2	Meter: L. V. plate, 0-2000 v D. C.	459447-6	94105
4M3	Meter: hourmeter	438447-8	52065
4R1 to 4R4	Resistor: fixed, wire wound, 1.2 ohm, 95 w	99033-2	94106
4R5	Resistor: meter multiplier, 2 megohm	878811-5	50674
4R6	Resistor: fixed, composition, 100,000 ohm ±5%, 2 w	99126-86	522410
4R7 to 4R10	Resistor: fixed, composition, 27,000 ohm ±5%, 2 w	99126-79	522327
4R11 to 4R14	Resistor: fixed, composition, 220 ohm ±5%, 2 w	99126-54	522122
4R15 to 4R20	NOT USED.		
4R21, 4R22	Resistor: fixed, wire wound, 1.6 ohm, 95 w	890146-5	94118
4R23	Resistor: thyrite	472612-501	
	Disc - thyrite unit	8865057-1	205002
	Post	8865055-1	207143
	Bushing	8865054-1	207142
4R24	Resistor: suppressor, 15 ohm, 300 w	427321-13	205430
4S1, 4S2	Circuit Breaker: power on, 100 amps	439373-2	94107
4S3	Switch: door interlock	439530-7	93926
4S4	Circuit Breaker: control, 15 amp	8896322-2	94109
4S5	Circuit Breaker: bias, 5 amp	8896322-3	94108
4S6	Circuit Breaker: control, 15 amp. Same as 4S4	8896322-2	94109
4S7	Starter: blower	458786-1	94110
4S8	Circuit Breaker: filaments, 15 amp, 3 pole	427197-2	94111
4S9	Switch: grounding		
	Insulator	426767-11	50777
	Washer	8855732-2	95072
	Washer, spring	8890122-1	98689
4S10, 4S11	Switch: door interlock. Same as 4S3	439530-7	93926
4S12	Switch: thermal, blower control	8886988-1	55393

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
4T1, 4T2	Transformer: filament	949325-1	93810
4T3, 4T4	Transformer: isolation	949359-1	94112
4T5	Transformer: isolation	8896337-1	55487
4T6 to 4T8	Transformer: step-down	8834208-1	94113
4VR1	Regulator: voltage	949329-1	94332
4XI1A/B, 4XI2A/B	Base: lampholder	885233-1	45944
4XI1C/D, 4XI2C/D	Cap: lampholder	885234-1	45945
4XI3, 4XI4	NOT USED.		
4XI5 to 4XI8	Socket: arc-back indicator	8834220-1	94114
4XV1 to 4XV4	Socket: RCA 5563	842105-1	9936
	MISCELLANEOUS		
	Base: (for 4B1 Blower Motor)		99118
	Clip: mounting, (for 1 1/16" dia. ferrule)	7862770-1	52717
	Clip: mounting, (for 9/16" dia. ferrule)	838400-4	52690
	Connector Assembly: tube cap	8890121-502	94327
	Door Assembly - front	740426-505	
	Spring: window holding	8849416-1	94170
	Window: door, plastic	8849420-1	94169
	Door Assembly - rear	740426-506	
	Spring: window holding	8849416-1	94170
	Window: door, plastic	8849420-1	94169
	Jewel: indicator, amber (3/4" dia. smooth faced)	8834219-1	94115
	Latch: door, for doors opening from left to right	8849458-502	209161
	Mount: shock (for 4K9 contactor)	8891752-2	58079
	Roller Assembly: door, bottom (3-roller assembly)	8835531-501	94551
	Roller Assembly: door, top (2-roller assembly)	8835532-501	94552
	CONTROL PANEL AND INSTALLATION MATERIAL, MI-28060		
5B1	Synchro (differential generator)	458771-1	94401
5I1 to 5I6	Light - indicator	440312-4	
	Lamp		16154
	Resistor		44570
	Receptacle		44997
	Jewel - yellow		99767
5P1	Connector: plug, 10 contacts	727969-10	57556
5P2	Connector: plug, 12 contacts	727969-16	54253
5P3	Connector: plug, 6 contacts	727969-2	51595
5P4	Connector: plug, 8 contacts	727969-6	58978
5S1	Switch: transmitter	860380-8	95008
5S2	Switch: plate	860380-8	95008
5S3	Switch: lights	860380-8	95008
5S4	Switch: L.V. O.L. reset	440316-1	44958
5S5	Switch: Osc. 1 and 2	860380-9	95009
5S6	Switch: Hi and Lo Power	860380-8	95008
5S7	Switch: H.V. O.L. reset	440316-1	44958
5S8	Switch: O.L. test	440316-1	44958
5S9	Switch: O.L. lamp	440316-1	44958
	MISCELLANEOUS		
	Boot: exciter to P.A.	8849474-1	93862
	Boot: P.A. to Mod.	8849476-1	93863
	Boot: exciter to P.S.	8849476-2	93864
	Clamp: boot, exciter to P.A.	8889098-3	93865
	Clamp: boot, P.A. to Mod.	8889098-2	93866
	Clamp: boot, exciter to P.S.	890112-1	58081
	Crank: tuning	887449-503	57078
	Nozzle: cleaning	8832164-3	94331
	PLATE TRANSFORMER, MI-28063-A		
6T1	Plate Transformer	949507-1	94334

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SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	THYRATRON CONTROL UNIT (part of Rectifier and Control Unit)		
10C1, 10C2	Capacitor: dry electrolytic, 80 mf -10% +50%, 450 v	449619-12	56411
10C3, 10C4	Capacitor: fixed, oil, 10 mf, 400 v	450184-4	57017
10C5 to 10C7	Capacitor: fixed, paper, 1 mf ±10%, 600 v	984681-8	56124
10C8	Capacitor: fixed, moulded tubular, 0.1 mf ±10%, 400 v	735715-175	73551
10C9	Capacitor: fixed, paper, 15 mf ±10%, 600 v	990192-10	205429
10C10	Capacitor: fixed, paper, 50 mf ±10%, 600 v	990192-13	205428
10CR1A/D, 10CR2A/D	Rectifier: germanium (part of 10Z1, 10Z2)	1N93	205420
10CR3	Rectifier: selenium	453389-1	93652
10CR4, 10CR5	Rectifier: selenium	453389-4	93912
10CR6	Rectifier: selenium	453389-3	94100
10CR7	Rectifier: selenium. Same as 10CR3	453389-1	93652
10CR8	Rectifier: selenium. Same as 10CR6	453389-3	94100
10K1, 10K2	Relay: thyratron reset	8832153-2	94116
10K3, 10K4	Relay: SPST, double break	458722-1	94117
10L1	Reactor: filter, 5 henries, 13 ma, D.C.	8819771-1	203628
10L2	Choke: R.F. filter, 0.5 millihenry, 300 ma	884432-3	95881
10L3	Reactor: filter, 5 henries, 13 ma, D.C. Same as 10L1	8819771-1	203628
10R1, 10R2	NOT USED.		
10R3	Resistor: bias, 10,000 ohm, 10 w	458574-70	52077
10R4	Resistor: variable, wire wound, 5000 ohm ±10%, 4 w	737847-18	99743
10R5	NOT USED.		
10R6	Resistor: fixed, wire wound, 1800 ohm ±5%, 10 w	458574-52	94124
10R7 to 10R10	Resistor: fixed, composition, 100,000 ohm ±5%, 2 w	99126-86	522410
10R11	Resistor: fixed, composition, 1000 ohm ±5%, 2 w	99126-159	37496
10R12	Resistor: fixed, composition, 10,000 ohm ±5%, 2 w	99126-74	522310
10R13	Resistor: fixed, composition, 150 ohm ±5%, 2 w	99126-52	522115
10R14	Resistor: fixed, composition, 68,000 ohm ±5%, 2 w	99126-84	522368
10R15	Resistor: fixed, composition, 390 ohm ±5%, 2 w	99126-57	93685
10R16, 10R17	Resistor: fixed, wire wound, 20,000 ohm ±5%, 10 w	443853-8	53128
10R18	Resistor: fixed, composition, 10,000 ohm ±5%, 2 w. Same as 10R12	99126-74	522310
10R19	Resistor: fixed, composition, 27,000 ohm ±10%, 2 w	99126-79	522327
10R20	Resistor: fixed, composition, 100,000 ohm ±5%, 2 w. Same as 10R7	99126-86	522410
10R21, 10R22	Resistor: fixed, composition, 1000 ohm ±5%, 2 w. Same as 10R11	99126-159	37496
10R23 to 10R30	Resistor: fixed, composition, 10,000 ohm ±5%, 2 w (part of 10Z1, 10Z2)	99126-74	522310
10T1	Transformer: power	949323-1	94122
10T2, 10T3	Transformer: impulse	949498-1	94123
10XC1, 10XC2	Socket: capacitor	181516-2	45368
10XV1	Socket: tube RCA 2D21	99370-2	53539
10Z1, 10Z2	Rectifier: blocking	472608-501	
	Shield: tube	99369-2	54521
	POWER CHANGE KIT, MI-28092-A		
11K1	Relay: 230 v, 0.044 amp 50/60 cycle	440489-6	44558
	Contact		44545
	Coil		44556
11K2	Relay: type A, 4-pole double-throw operating coil, 220 v, 50/60 cycle AC	8829383-1	203093
11R1	Attenuator: 600/600 ohm impedance ±5%	8854104-31	96270
	Knob: black	255541-501	69979
11R2A/B	Rheostat: 500/500 ohm, 50 w	418840-3	43856
	Knob: black	255541-501	69979
12B1	Power Change Unit: Synchro: differential generator, 115 v ac 60 cycle	458771-1	94401
	Knob: black	255541-508	99893
12K1	Relay: 3 pole double throw	8828528-1	98135

For ordering information see page 63

SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	POWER CHANGE KIT, MI-28092		
K2	Contactor: antenna transfer	8892148-1	95519
	Insulator	426768-17	55151
	Compensator Assembly:		
C1	Capacitor: fixed, 0.027 mf	735715-168	73554
C2	Capacitor: fixed, 10 mf, 400 v	450184-4	57017
K1	Relay	832090-10	43699
L1, L2	Coil: choke, air core, 5 millihenry	834206-5	95645
R1	Resistor: variable, 1000 ohm ±10%, 4 w	737847-5	95644
	ANTENNA TUNING UNIT, MI-28902-B		
C1, C2	Capacitor (For replacement, quote information on nameplate of defective unit.)		
C3	NOT USED.		
C4	Capacitor: plate tuning, fixed, 300 mmf ±5%, 5000 v		553109
C5	Capacitor: plate tuning, fixed, 200 mmf ±5%, 5000 v		553115
C6	Capacitor: 1000 mmf		52619
L1, L2	Coil: antenna loading		MI-7487-A
L3	Coil: pickup		17898
M1	Meter (For replacement, quote the MI reference and scale range, as shown on defective unit.)		
R1	Resistor: interlock, fixed, wire-wound, 6400 ohm ±10%, 90 w		17899
R2	Resistor: audio, fixed, wire-wound, 10,000 ohm ±10%, 90 w		17900
R3	Resistor: 250 ohm, 10 w		48211
R4	Resistor: 125 ohm, 10 w		50708
R5	Resistor: 250 ohm, 10 w. Same as R3		48211
S1	Switch: knife, SPDT, 30 amp, 250 v		54586
T1	Transformer: rectifier filament		17897
X1	Socket: tube, ceramic, octal		18007
	MISCELLANEOUS		
	Clamp: coil tap		18140
	Insulator: ceramic; cylindrical, 5/8" lg x 1/2" dia		50889
	Insulator: ceramic; coil mounting; conical, 5-3/4" lg, 2-5/8" base dia		52475
	Insulator: ceramic; meter panel mounting; cylindrical, 6" lg x 1" dia		90037
	Insulator: ceramic; switch shaft; cylindrical, 6" lg x 3/4" dia		90039
	Insulator: lead-in		MI-19413-1
	Knob: switch		43346
	CONVERSION 5 KW 60 CYCLE to 10 KW 60 CYCLE, MI-28062		
1C36	Capacitor: modulator blocking	984629-84	93795
1L4	Coil: compensating, 56 millihenry ±5%	461441-501	95801
2C6, 2C7	Capacitor: filament	8881825-1	54643
2C8	Capacitor: fixed, paper, 10 mf	949319-2	93796
2K2	Relay: filament	8832153-1	93917
2L5	Reactor: modulation	949350-1	93921
2R3	Resistor: grid	99037-33	45983
2R7	Resistor: filament	99033-16	93903
2R12	Resistor: fixed, composition, 2700 ohm ±10%, 2 w	99126-67	522227
2VR2	Regulator: filament	949319-1	93803
4L2	Reactor: filter	900431-4	95316
	Clip: resistor, (for 1 1/16" dia. ferrule)	7862770-1	52717
	Connector: tube plate (RCA 813)	8890121-504	94327
	Connector: tube grid (RCA 5762)	8849483-501	94328

For ordering information see page 63

SYMBOL NO.	DESCRIPTION	DRAWING NO.	STOCK NO.
	CONVERSION KIT, 5 KW 60 CYCLE to 5 KW 50 CYCLE, MI-28055		
	Meter: hourmeter	438447-36	94330
	Resistor	8814041-1	53748
	Transformer: filament	949318-1	94329
	Voltage Regulator (Inductrol):		
	Transformer: regulating, 4.6 KVA, 240 v, 50/60 cycle	8834296-1	94335
	Relay - voltage regulating		98609
	Contact - movable		98454
	Contact - stationary		97387
	Relay - motor control		98610
	Contact - movable (right-hand)		97391
	Contact - movable (left-hand)		97392
	Contact - stationary		97390
	Capacitor: motor	984629-6	17047
	CONVERSION KIT, 5 KW 60 CYCLE to 10 KW 50 CYCLE, MI-28074		
	Transformer: filament	949318-1	94329

For ordering information see page 63

SYMBOL NO.	DESCRIPTION	QTY.	DRAWING NO.	STOCK NO.
1C1, 1C2	Capacitor: 270 mmf, 500 v	1	727856-233	39638
1C3	Capacitor: 1 mf, 400 v	1	984679-153	93898
1C4, 1C5	Capacitor: 1500 mmf, 2500 v	1	728647-245	93913
1C6, 1C7	Capacitor: 8 mf, 600 v	1	984621-7	58649
1C8, 1C9	Capacitor: 0.1 mf, 500 v	1	32224-603	552984
1C10, 1C11	Capacitor: 4 mf, 2000 v	1	984621-36	43849
1C12, 1C13	Capacitor: 4 mf, 1500 v	1	984621-125	58568
1C22	Capacitor: 4 mf, 2000 v. Same as 1C10	1	984621-36	43849
1C23, 1C24	Capacitor: 10 mf, 1000 v	1	984621-117	18118
1C25	Capacitor: 10 mf, 400 v	1	450184-4	57017
1C26	Capacitor: 1 mf, 10,000 v	1	984629-84	93795
1C29 to 1C32	Capacitor: 0.01 mf	1	8881825-1	54643
1C35	Capacitor: 1 mf, 10,000 v. Same as 1C26	1	984629-84	93795
1C36	NOT USED			
1C37	Capacitor: 1 mf, 10,000 v. Same as 1C26	1	984629-84	93795
1C38, 1C39	Capacitor: 4 mf, 2000 v. Same as 1C10	1	984621-36	43849
1CR1, 1CR2	Rectifier	1	453389-2	93911
1CR3	Rectifier	1	459484-5	95310
1I1, 1I2	Lamp: 115 v, 60 w	2	885232-2	93916
1K1, 1K2	Relay	1	8832153-1	93917
1K3	Relay	1	440489-3	18119
1L1	Reactor	1	949250-1	93659
1M3 to 1M8	Meter: 0-100 ma. DC	1	457554-2	93798
1M9, 1M10	Meter: 0-2 a. DC	1	459447-4	94060
1M11	Meter: 0-500 v. DC	1	459447-5	93901
1R18, 1R19	Resistor: 12,500 ohms, 200 w	1	99037-42	43604
1R38, 1R39	Resistor: 31.5 ohms, 95 w	1	99033-16	93903
1R40, 1R41	Resistor: 1250 ohms, 25 w	1	99027-32	45508
1R42	Resistor: 630 ohms, 55 w	1	99031-29	95798
1R43, 1R44	Resistor: 1000 ohms, 55 w	1	99031-31	54624
1R45A, 1R45B	Rheostat: 500/750 ohms, 25 w	1	427399-6	93906
1R46	Rheostat: 500 ohms, 50 w	1	892960-5	93907
1R47	Resistor: 8000 ohms, 150 w	1	99035-40	48937
1R48	Resistor: 6200 ohms, 150 w	1	890014-16	93908
1R49	Resistor: 10,000 ohms, 40 w	1	99029-41	19474
1S1, 1S2	Switch	1	439530-7	93926
1S5	Switch	1	883387-2	51114
1S6, 1S7	Switch. Same as 1S1	1	439530-7	93926
1T1	Transformer	1	949347-1	93800
1T2	Transformer	1	900992-1	47791
1T3	Transformer	1	901065-502	43866
1T5	Transformer	1	949324-1	93801
1T6	Transformer	1	949348-1	93802
1VR1, 1VR2	Voltage Regulator	1	949319-1	93803
1Z1, 1Z2	Ladder, Feedback	1	457534-501	93910
2C1	Capacitor: 1000 mmf, 5000 v	1	32221-689	553071
2C2	Capacitor: 2000 mmf, 5000 v	1	32222-574	553054
2C3, 2C4, 2C9, 2C10	Capacitor: 0.001 mf	1	8881825-1	54643
2C12	Capacitor: 15-75 mmf, 20,000 v	1	8814055-1	98053
2C18	Capacitor: 25-500 mmf, 15,000 v	1	8849438-2	93923
2C19	Capacitor: 1000 mmf, 20,000 v	1	32232-501	553345
2C25 to 2C31	Capacitor: 0.01 mf, 600 v	2	36655-503	610003
2I5, 2I6	Lamp: 115 v, 60 w	2	885232-2	93916
2K1 and 2K3	Relay	1	8832153-1	93917
2L4	Reactor	1	949350-1	93921
2M1 to 2M3	Meter: 0-1.5 a. DC	1	457554-3	93805
2M4	Meter: 0-4 a. DC	1	459447-9	93804
2M5	Meter: 0-6000 v. DC	1	459447-10	93806
2M7	Meter: 0-1 a. DC	1	459447-8	94061
2R1	Resistor: 15,000 ohms	1	890144-3	19669
2R2, 2R4	Resistor: 1600 ohms, 200 w	1	99037-33	45983
2R6, 2R8	Resistor: 31.5 ohms, 95 w	1	99033-16	93903
2R10	Resistor: 6 meg	1	878811-11	93919
2S1, 2S2, 2S5, 2S6	Switch	1	439530-7	93926
2T1	Transformer	1	738532-501	205689
2VR1, 2VR3	Voltage Regulator	1	949319-1	93803
3B1	Blower:			
	Motor	1	622792-2	96232
	Belt	1	622792-3	96233
	Bearings	2	622792-6	96234
	Shock Mounts	4	622792-8	96236

For ordering information see page 63

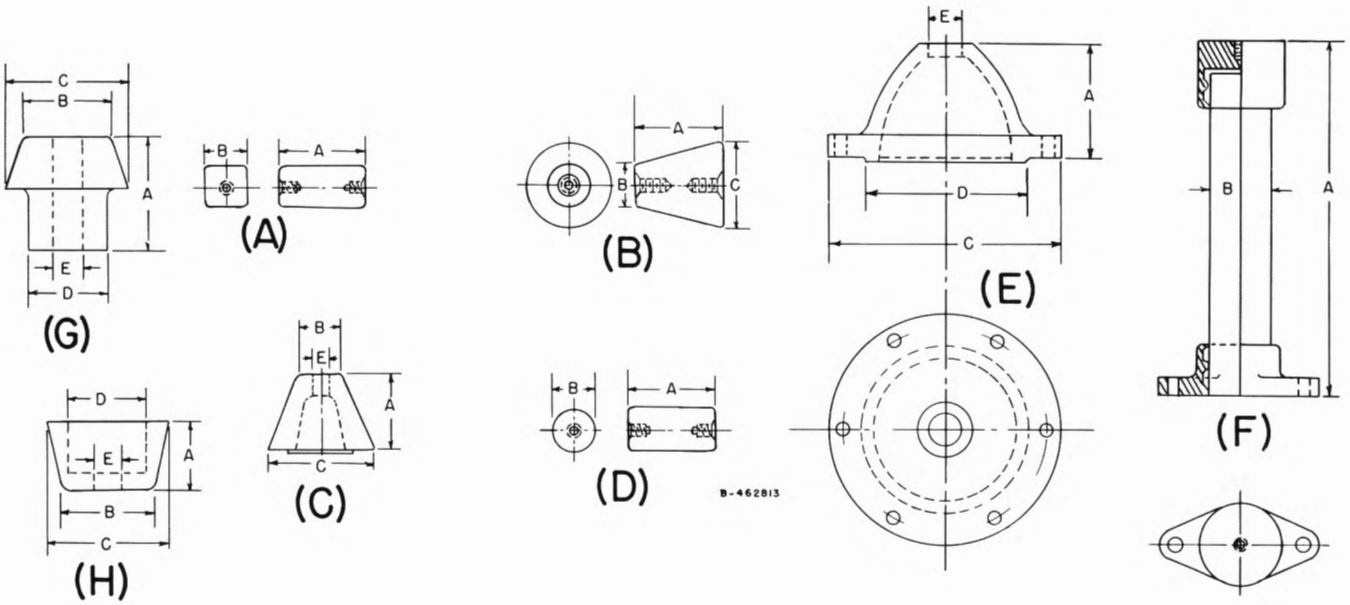
SYMBOL NO.	DESCRIPTION	QTY.	DRAWING NO.	STOCK NO.
3C1	Capacitor: 10 mf, 400 v	1	450184-4	57017
3C2	Capacitor: 0.01 mf, 1200 v	1	728647-65	610003
3C3	Capacitor: 0.01 mf, 1200 v	1	728651-65	610003
3C4	Capacitor: 0.01 mf, 1200 v. Same as 3C2	1	728647-65	610003
3C5	Capacitor: 1000 mmf, 2500 v	1	728647-141	601002
3C6 to 3C8	Capacitor: 0.01 mf, 1200 v. Same as 3C2	1	728647-65	610003
3C9	Capacitor: 2000 mmf, 5000 v	1	32222-574	553054
3C10	Capacitor: 39 mmf	1	8843560-5	93929
3C11	Capacitor: 200 mmf, 5000 v	1	32220-683	553115
3C12	Capacitor: 1000 mmf, 5000 v	1	32221-689	553071
3C13	Capacitor: 510 mmf, 6000 v	1	32225-626	93928
3C14	Capacitor: 2000 mmf, 5000 v. Same as 3C9	1	32222-574	553054
3C15	Capacitor: 0.01 mf, 1200 v. Same as 3C2	1	728647-65	610003
3C16 to 3C20	Capacitor: 0.01 mf, 600 v	2	36655-503	610003
3C21	Capacitor: 510 mmf, 6000 v. Same as 3C13	1	32225-626	93928
3C23, 3C24	Capacitor: 15 mf, 1000 v	1	984621-119	56384
3C25, 3C26	Capacitor: 15 mf, 2000 v	1	984621-141	99538
3C27	Capacitor: 0.05-0.05 mf, 600 v	1	984618-572	93626
3C28, 3C29	Capacitor: 620 mmf, 3500 v	1	8843560-7	93930
3F1, 3F2	Fuse: 1 a, 250 v	6	59075-9	22301
3F3, 3F4	Fuse: 15 a, 250 v	6	99108-4	51842
3I1, 3I2	Lamp: 115 v, 60 w	2	885232-2	93916
3K1	Relay	1	440489-5	44941
3K2	Relay	1	440489-1	44558
3L3	Coil	1	412784-501	16892
3L5	Coil	1	418486-501	19185
3L7	Reactor	1	949251-1	93658
3L8	Reactor	1	900304-1	52038
3M1	Meter: 0-50 ma DC	1	457554-4	95309
3M3, 3M4	Meter: 0-150 ma DC	1	459447-1	94062
3M5	Meter: 0-800 ma DC	1	459447-2	94063
3R11	Rheostat: 200 ohms	1	433196-31	52438
3R12	Resistor: 400 ohms, 10 w	1	458574-36	93933
3R13	Resistor: 50 ohms, 55 w	1	99031-18	93932
3R14	Resistor: 1250 ohms, 55 w	1	99031-32	56613
3R15	Resistor: 2500 ohms, 55 w	1	99031-35	46111
3R16	Resistor: 5000 ohms, 55 w	1	99031-38	19687
3R17	Resistor: 10,000 ohms, 55 w	1	99031-41	46110
3R18	Resistor: 63,000 ohms, 95 w	1	99033-49	93936
3S1, 3S2, 3S5, 3S6	Switch	1	439530-7	93926
3T1	Transformer	1	448083-501	93935
3T2	Transformer	1	949324-1	93801
3T3	Transformer	1	949330-1	93809
3T4, 3T5	Transformer	1	949325-1	93810
4B1	Blower	1	744473-2	95055
4C1, 4C3	Capacitor: 8 mf, 5000 v	1	984629-418	94125
4CR1 to 4CR4	Rectifier	1	453389-3	94100
4I1, 4I2	Lamp: 115 v, 60 w	2	885232-2	93916
4I3. 4I4	Lamp only	6	459610-4	16154
4I5 to 4I8	Lamp: 6.3 v, Mazda #44	1	61114-15	11891
4I9, 4I10	Lamp only. Same as 4I3	6	459610-4	16154
4K1 to 4K4	Relay	1	8832153-1	93917
4K5	Relay	1	440489-1	44558
4K6	Contactor	1	8832129-1	94101
4K7	Relay	1	429580-5	54955
4K8	Contactor	1	8832129-2	94102
4K9	Contactor	1	8834217-1	94103
4K10	Contactor. Same as 4K8	1	8832129-2	94102
4K11	Relay. Same as 4K5	1	440489-1	44558
4K12	Relay	1	429587-24	96763
4K13	Relay. Same as 4K5	1	440489-1	44558
4M1	Meter: 0-300 AC	1	459447-7	94104
4M2	Meter: 0-2000 v, DC	1	459447-6	94105
4R1 to 4R4	Resistor: 1.2 ohms, 95 w	1	99033-2	94106
4S1, 4S2	Circuit Breaker: 100 a	1	439373-2	94107
4S3	Switch	1	439530-7	93926
4S4	Circuit Breaker: 15 a	1	8896322-2	94109
4S5	Circuit Breaker: 5 a	1	8896322-3	94108
4S6	Circuit Breaker: 15 a. Same as 4S4	1	8896322-2	94109
4S7	Switch	1	458786-1	94110
4S8	Circuit Breaker: 15 a	1	427197-2	94111

RECOMMENDED STATION SPARES

For ordering information see page 63

SYMBOL NO.	DESCRIPTION	QTY.	DRAWING NO.	STOCK NO.
4S10, 4S11	Switch. Same as 4S3	1	439530-7	93926
4T1, 4T2	Transformer	1	949325-1	93810
4T3, 4T4	Transformer	1	949359-1	94112
4T6 to 4T8	Transformer	1	8834208-1	94113
10C1, 10C2	Capacitor: 80 mf, 450 v	1	449619-12	56411
10C3, 10C4	Capacitor: 10 mf, 400 v	1	450184-4	57017
10C5 to 10C7	Capacitor: 1mf, 600 v	1	984681-8	56124
10CR1A/D, 10CR2A/D,	Rectifier, 1N93	1		205420
10CR3	Rectifier	1	453389-1	93652
10CR4, 10CR5	Rectifier	1	453389-4	93912
10CR6	Rectifier		453389-3	94100
10CR7	Rectifier. Same as 10CR3	1	453389-1	93652
10CR8	Rectifier. Same as 10CR6	1	453389-3	94100
10K1, 10K2	Relay	1	8832153-2	94116
10K3, 10K4	Relay	1	458722-1	94117
10R1, 10R2	Resistor: 1.6 ohm, 95 w	1	890146-5	94118
10R3	Resistor: 10,000 ohms, 10 w	1	458574-70	52077
10R4	Potentiometer: 5000 ohms, 4 w	1	737847-18	99743
10R6	Resistor: 1800 ohms, 10 w	1	458574-52	94124
10T1	Transformer	1	949323-1	94122
10T2, 10T3	Transformer	1	949498-1	94123

INSULATOR OUTLINES



PARTS LIST

INSULATOR DATA

FOR ORDERING INFORMATION SEE PAGE 63

ITEM	USED NEAR OR FOR	FIG.	DIMENSIONS (INCHES)					TAP SIZE	DRAWING NUMBER	STOCK NUMBER
			A	B	C	D	E			
1	1R18, 1R19, 1R38, 1R39, 1R40, 1R42, 1R43, 1R44, 1R47, 1R48, 2R1, 2R2, 2R3, 2R4, 2R6, 2R7, 2R8, 2R10, 2T1, 3R13 through 3R18, 4R5	A	1	3/4	-	-	-	10-32	426773-2	55972
2	10R1, 10R2	A	1-1/4	3/4	-	-	-	10-32	426773-5	92430
3	1XV9, 1XV10, P.A. grid bus	A	1-1/2	3/4	-	-	-	10-32	426773-8	50578
4	Mounting for 2L6 and 2R4	A	2	3/4	-	-	-	10-32	426773-11	92427
5	4R2, 4R4	A	2-1/2	3/4	-	-	-	10-32	426773-14	50606
6	2C12	A	3	3/4	-	-	-	10-32	426773-17	92577
7	1R4, 1R5, 1R8, 1R9, 1R27, 1R28, 1R29, 3R5, 3R12, 3L5	B	1	5/8	1-1/8	-	-	8-32	426762-2	50888
8	1XV9, 1XV10, 1S3, TB-A, 1L3, 1L4, 2J2, 3S5, 4S9	B	2	5/8	1-1/8	-	-	10-32	426762-11	48658
9	3C9	C	7/8	1/2	1-1/4	-	13/64	-	426761-4	92007
10	3C3, 3C10	D	1/2	3/8	-	-	-	6-32	426765-2	92075
11	1R52, 1R53, 2R11, 2R12, 2R13, 4XV1, 4XV2, 4XV3, 4XV4	D	1	1/2	-	-	-	8-32	426766-8	92011
12	2M6	D	1	3/4	-	-	-	10-32	426767-2	51086
13	3L4	D	1-1/2	3/4	-	-	-	10-32	426767-8	51087
14	1S3, 1S4, 2S3, 2S4, 3S3, 3S4, 4S9, 2C1, 10T2, 10T3	D	2	3/4	-	-	-	10-32	426767-11	50777
15	2C17, 2C18, 2L2, 2L3, 2C12	D	2	1	-	-	-	1/4-20	426768-8	48697
16	Mounting for 2L2, 2L3	D	3	1	-	-	-	1/4-20	426768-14	53795
17	2L1, 2L2	D	4	1	-	-	-	1/4-20	426768-17	55151
18	P.A. Output	E	2-11/16	-	5-1/4	3-3/4	9/16	-	843381-1	48055
19	High Voltage Rectifier Shelf, Thyratron Control Unit	F	3	1	-	-	-	1/4-20	802910-9	95761
20	2C23	F	4	1	-	-	-	1/4-20	802910-10	95760
21	1R8, 1R9, 1R26, 1R27, 1R28, 1R29, 3C2, 3C4, 3Y1, 3Y2	G	7/8	3/4	7/8	31/64	0.200	-	426764-8	51783
22	1R8, 1R9, 1R26, 1R27, 1R28, 1R29, 3C2, 3C4, 3Y1, 3Y2	H	1/2	3/4	7/8	1/2	0.200	-	426764-58	51784

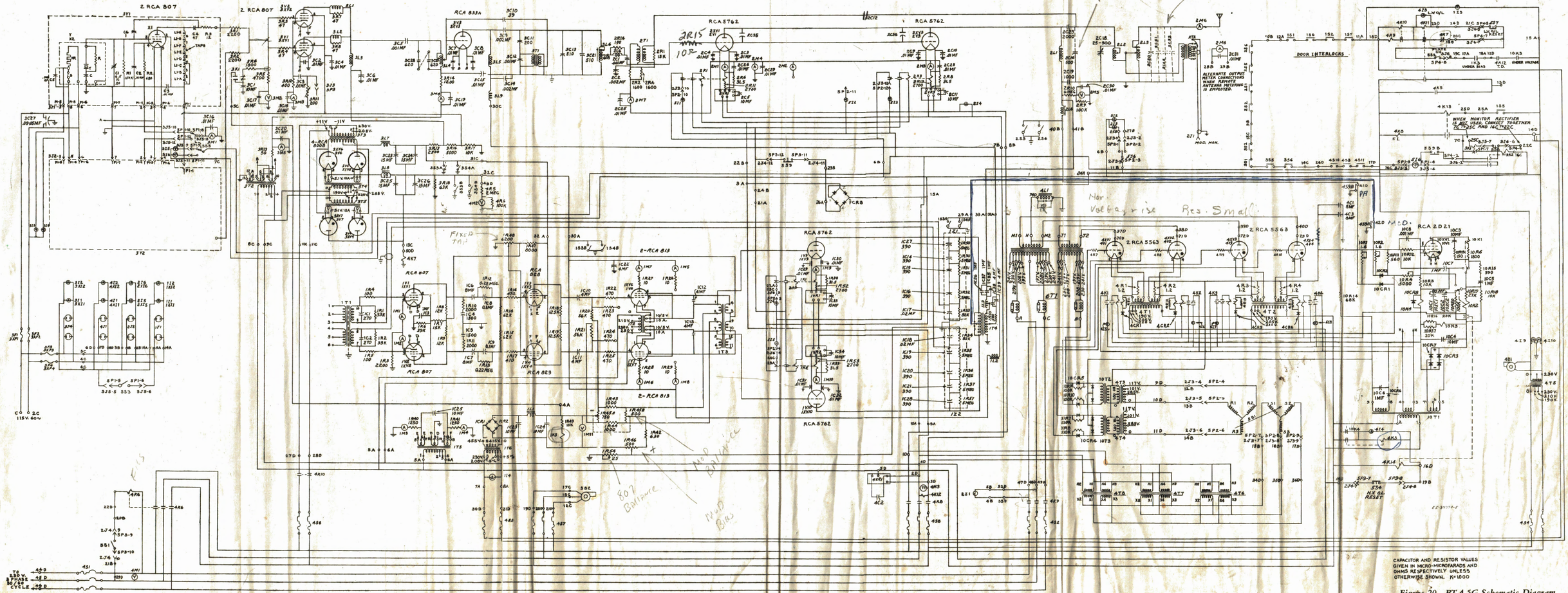


Figure 20—BTA-5G Schematic Diagram

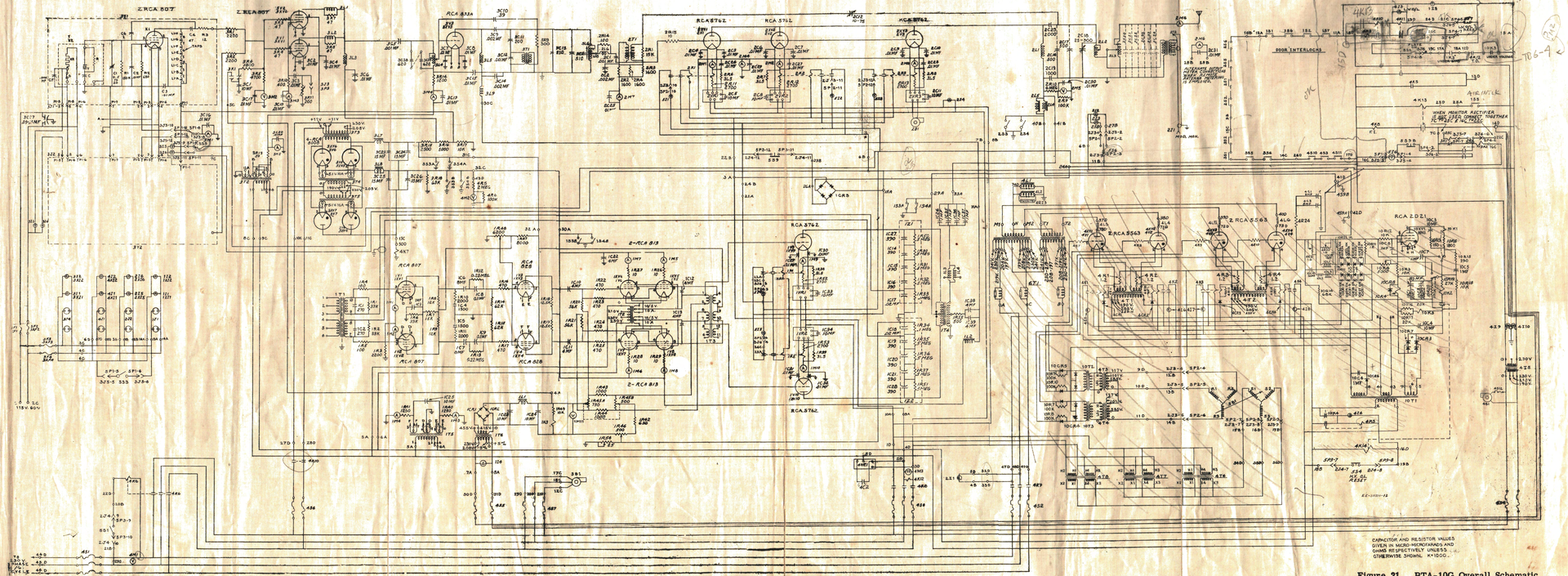


Figure 21. BTA-10G Overall Schematic Diagram (311314)

WIRE TABLE	
WIRE No.	DESCRIPTION
1 — 7	.064 DIA. TINNED COPPER WIRE
11 — 48	No. 16 AWG. 26/.010 DIA. BLACK 2,500 V.

NUMBERS IN WIRES REFER TO WIRE TABLE AND DESTINATIONS RESPECTIVELY Eg. 14-5P2-4 INDICATES WIRE No. 14 IS CONNECTED TO TERMINAL 4 ON 5P2.

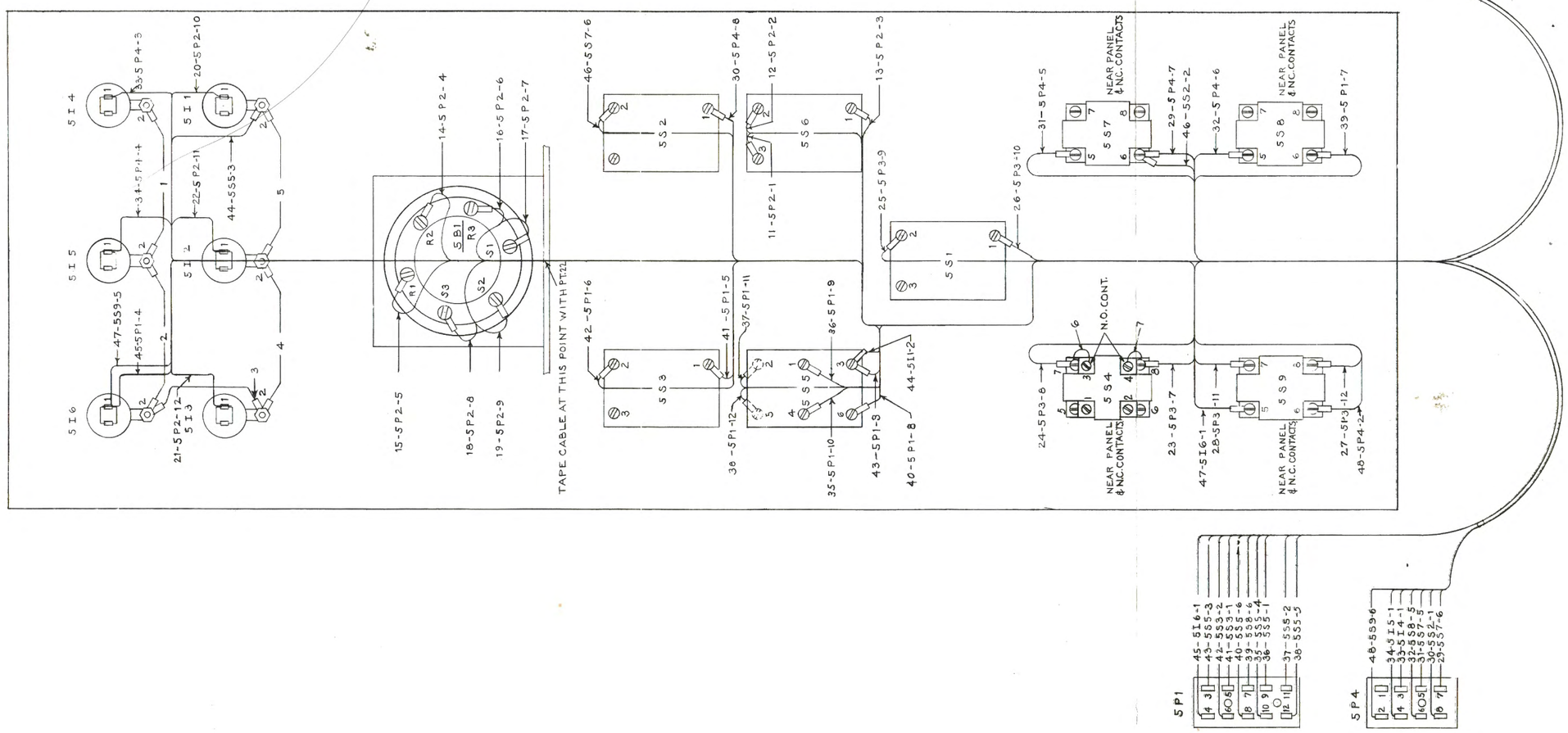


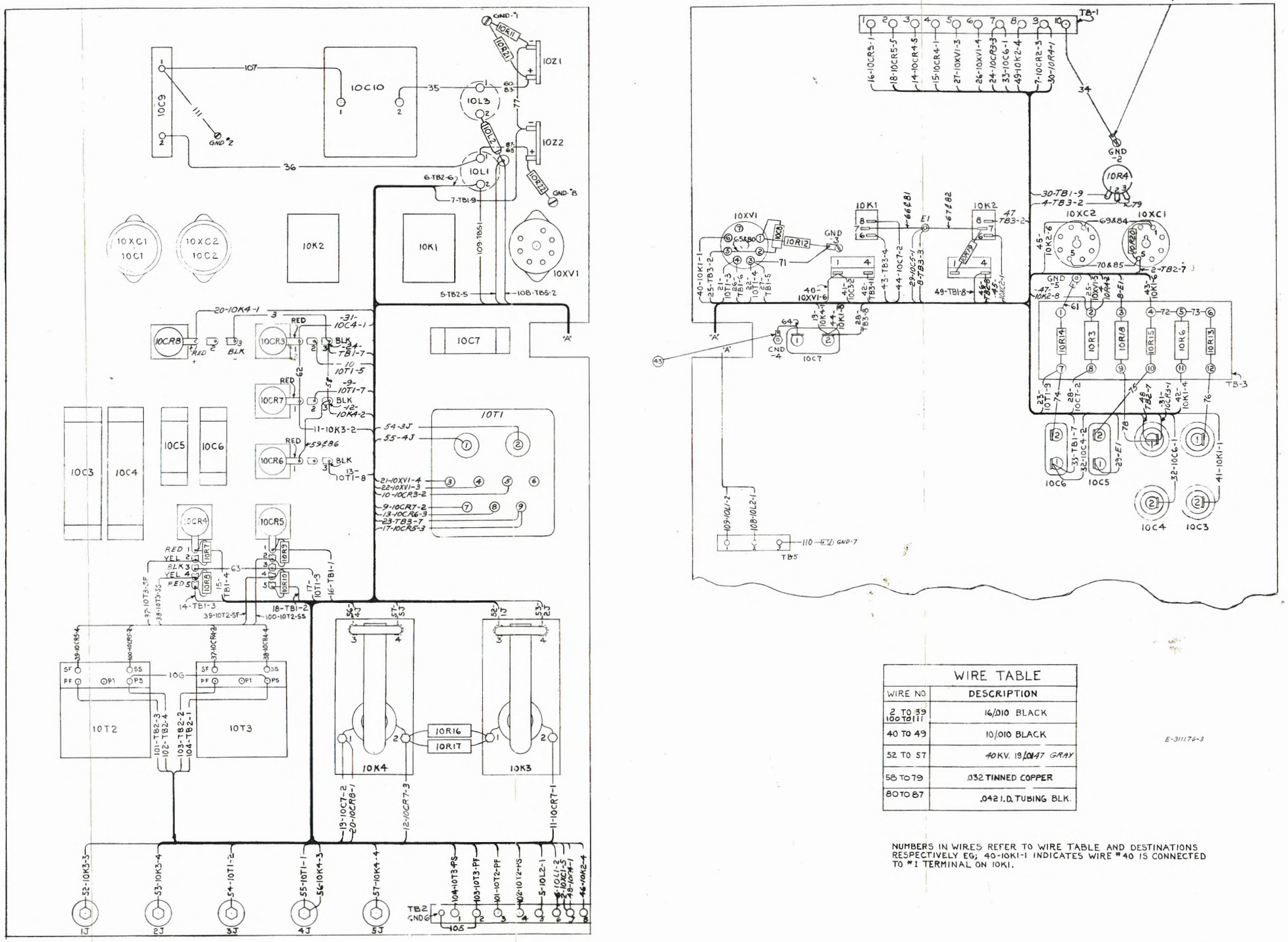
Figure 23. Connection Diagram, Control Panel (311179)

WIRE TABLE	
WIRE No.	DESCRIPTION
1 - 24 26 - 90	26/010 BLK. No.16 AWG. 2500 V.
101 - 104	65/010 BLK No.12 AWG. 2500V.
201-229	1285 DIA. TINNED COPPER WIRE
251-282	.060 DIA. TINNED COPPER WIRE
301-313	.0508 DIA. TINNED COPPER WIRE
364-370	No.14 AWG 19/0147 DIA. GRAY
451-453	CABLE COPPER SHIELDED TWISTED PR. 10/30 #22 AWG.
505-512	.053 ID BLACK TUBING
531-540	.085 ID. BLACK TUBING
581-582	COAXIAL CABLE
601-609	.032 DIA. TINNED COPPER WIRE
621-626	16/010 BLK. No.18 AWG. 600V.
631-636	10/.010 BLK. No.20 AWG. 600V
701	ONE COND. SHIELDED T/P/O "82 AWG

NUMBERS IN WIRES REFER TO WIRE TABLE AND DESTINATIONS RESPECTIVELY. E.G. 48-1VR1-1 INDICATES WIRE #48 IS CONNECTED TO #1 TERMINAL ON 1VR1.

EE-3111121-4

Figure 24. Connection Diagram, Modulator Unit (311121)

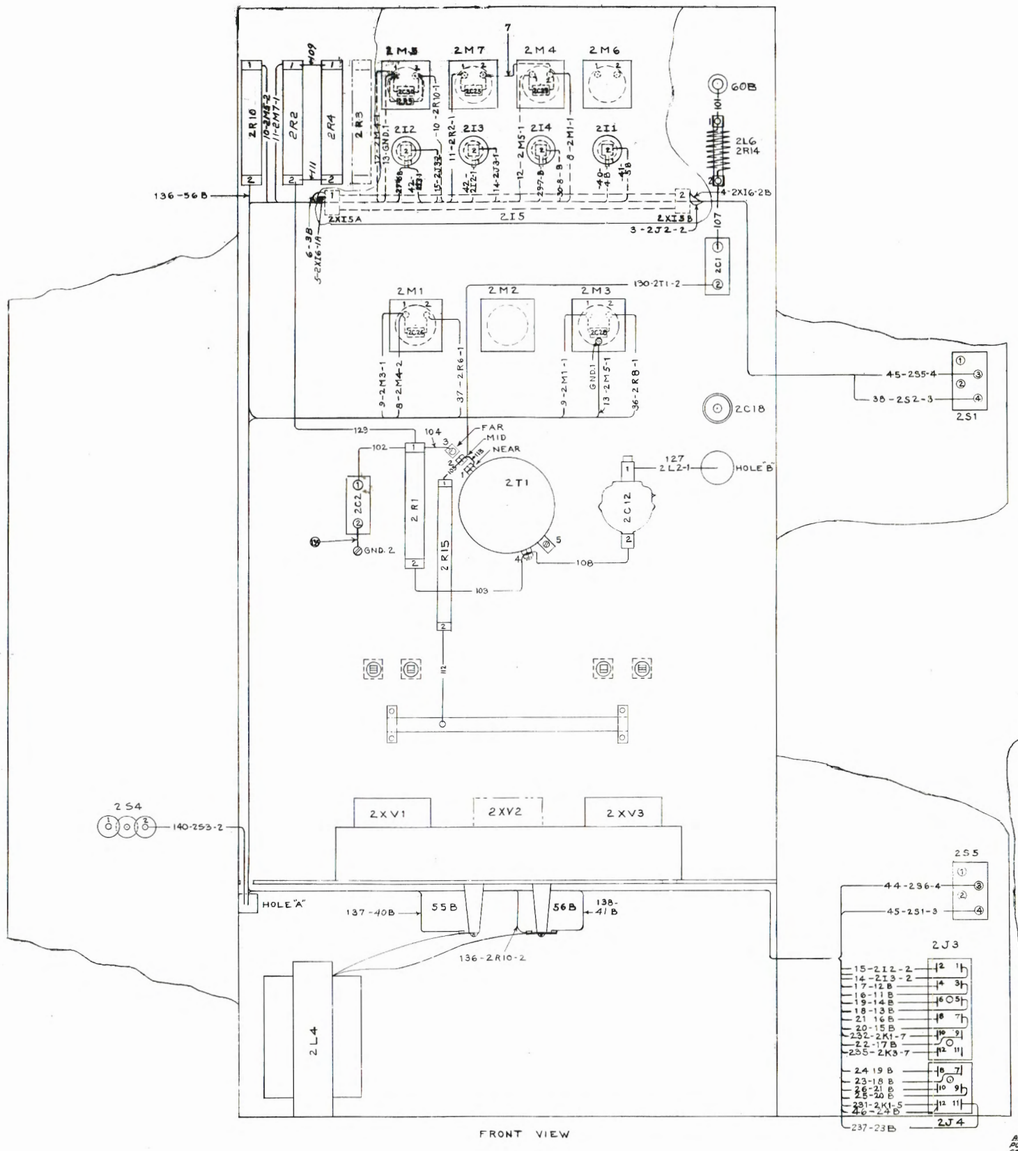


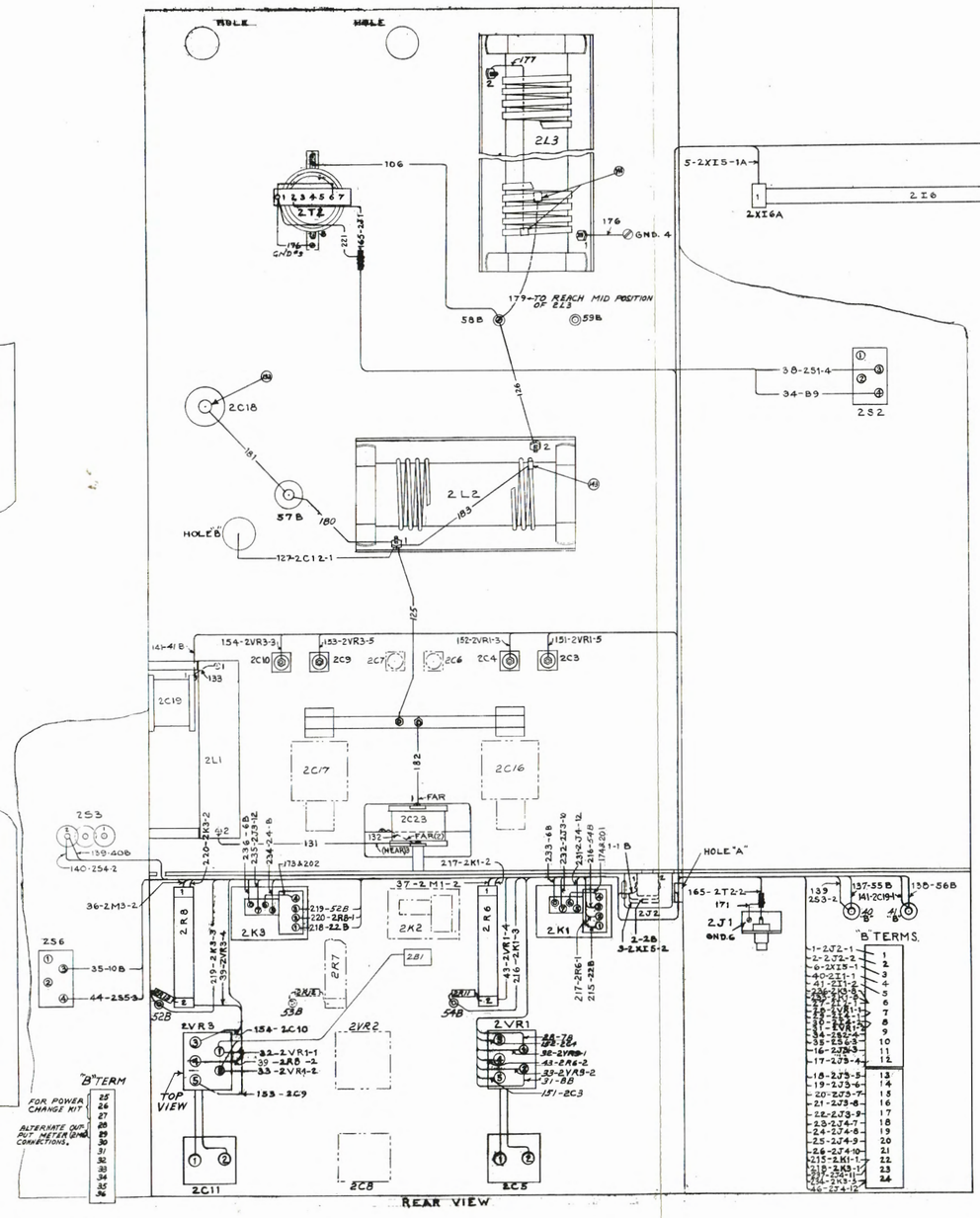
WIRE TABLE	
WIRE NO	DESCRIPTION
2 TO 39 100 TO 111	16/010 BLACK
40 TO 49	10/010 BLACK
52 TO 57	40 KV. 19/0.047 GRAY
58 TO 79	.032 TINNED COPPER
80 TO 87	.042 I.D. TUBING BLK.

E-311176-3

NUMBERS IN WIRES REFER TO WIRE TABLE AND DESTINATIONS RESPECTIVELY EG; 40-10K1-1 INDICATES WIRE #40 IS CONNECTED TO #1 TERMINAL ON 10K1.

Figure 25. Connection Diagram, Thyratron Control Chassis (311176)



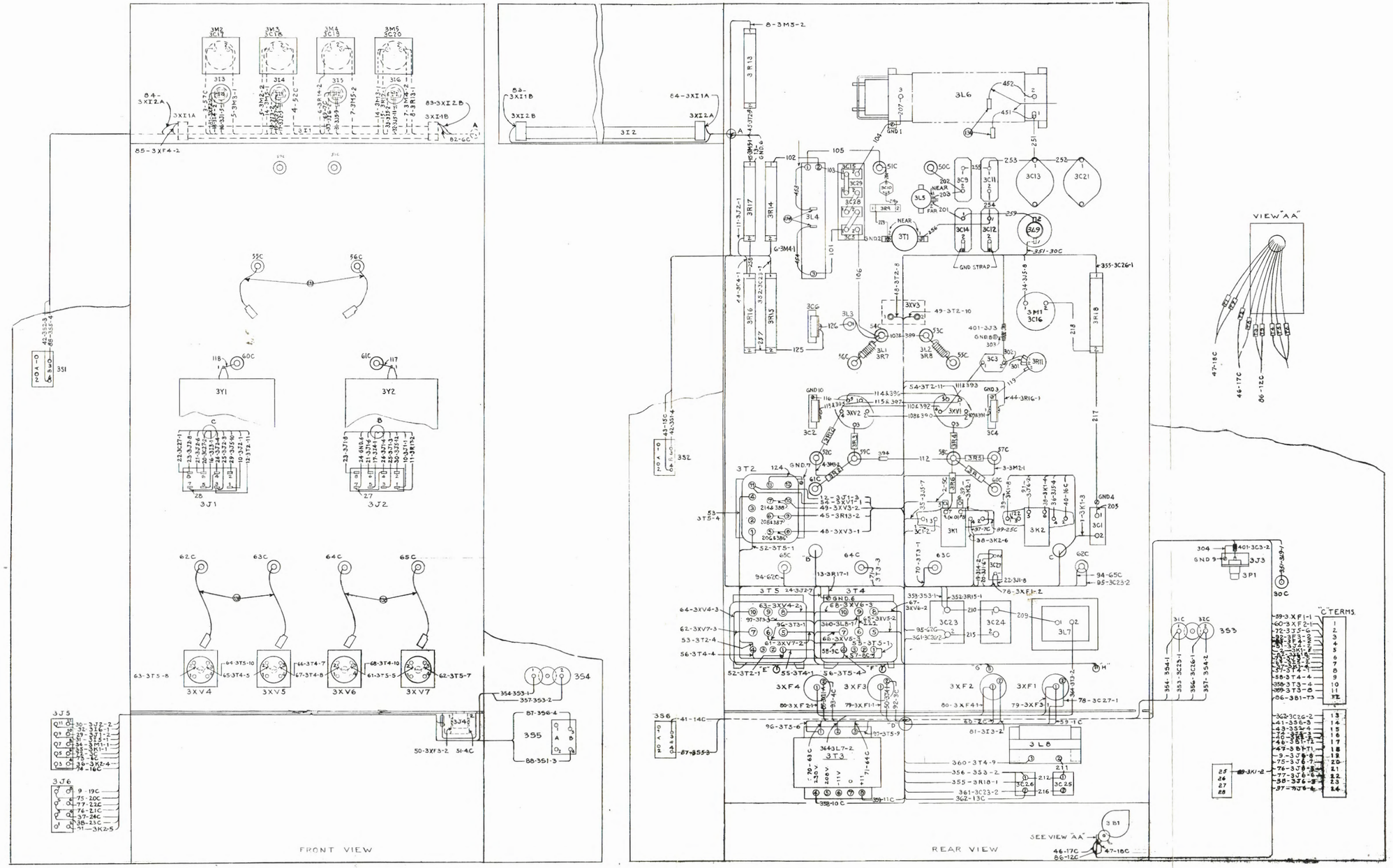


WIRE TABLE	
WIRE No.	DESCRIPTION
1 – 46	26/010 BLACK 2500 V.
101 – 109 2111, 112	1265 DIA TINNED COPPER WIRE
125 – 133	COPPER TUBING TEMPER 1/4 O.D. 032 WALL
136 – 141	40 AW 19/0147 GRAY INSULATION
151 – 154	65/010 BLACK
165	COAXIAL CABLE
171, 173 – 176	0641 DIA. TINNED COPPER WIRE
172 – 177	COPPER (50FT) 1 X .0201 THK.
179 – 183	COPPER (30FT) 1/2 X .0201 THK.
201 – 202	BLK. TUBING .062 I.D.
215 – 221	16/010 BLK. 600 V.
231 – 237	10/.010 BLK. 600 V.

NUMBERS IN WIRES REFER TO WIRE TABLE AND DESTINATIONS RESPECTIVELY E.G.; 3-2XI5-2, INDICATES WIRE No. 3 IS CONNECTED TO TERMINAL No. 2 ON 2XI5.

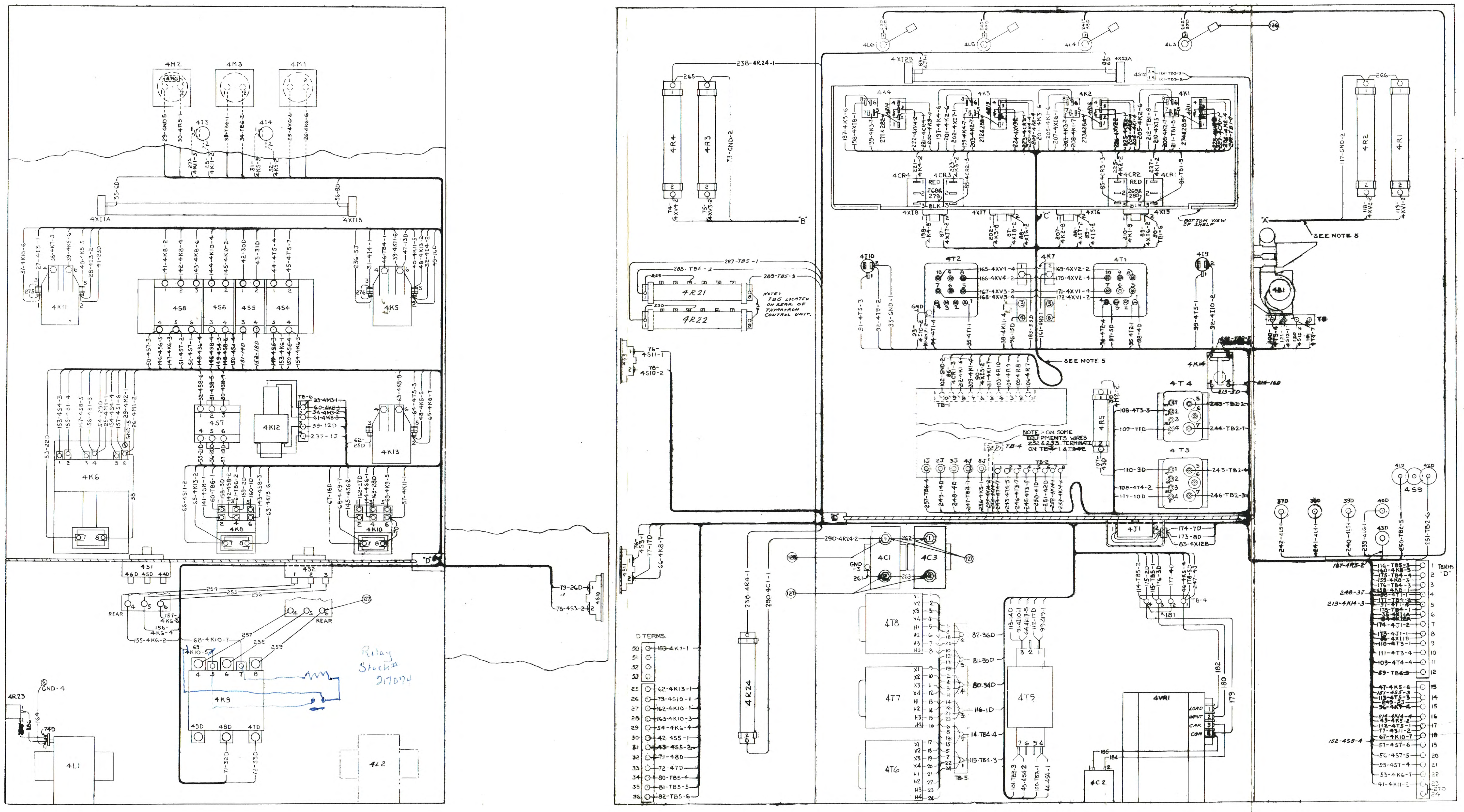
EC-311353-4

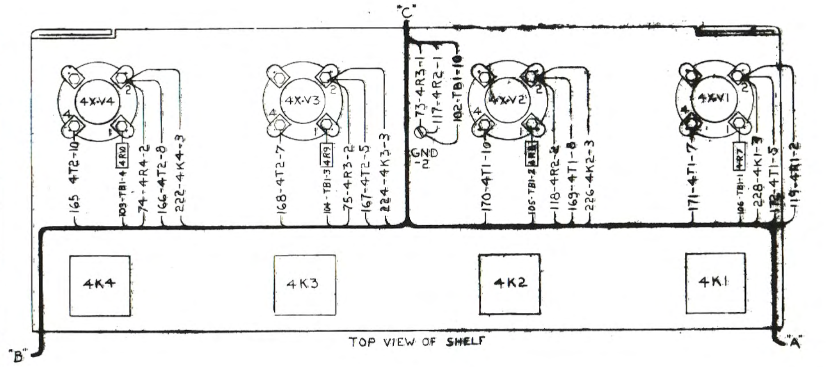
Figure 26. Connection Diagram, PA Unit (311353)



WIRE TABLE	
WIRE NUMBER	DESCRIPTION
1 TO 88 INCL. & 1037 INCL.	26/.010 BLACK
801 TO 1119 INCL. & 1227 TO 1286 INCL.	.0641 DIA TINNED COPPER
2011 TO 2239 INCL.	.0808 DIA TINNED COPPER
251 TO 259 INCL.	.1285 DIA TINNED COPPER
3011 TO 3044 INCL.	.0403 DIA TINNED COPPER
401	COAXIAL CABLE
351 TO 364 INCL.	65/.010 BLACK
386-397	BLK. TUBING
451 & 454	CABLE

Figure 27. Connection Diagram, Exciter Unit (311145)





WIRE TABLE	
WIRE NO.	DESCRIPTION
25 TO 121	P.S. 724-28 26/.010 BLACK
141 TO 186	P.S. 724-32 65/.010 BLACK
197 TO 214	P.S. 724-16 10/.010 BLACK
221 TO 230	P.S. 724-18 16/.010 BLACK
236 TO 253 286 TO 290	P.S. 728-18 40 KV. 19/0117 GRAY.
254 TO 259	P.S. 562 1/4 O.D. COPPER ROD. HD.
261 TO 263	P.S. 563 COPPER TUBING SOFT TEMPER 1/4 O.D. .032 WALL
265 TO 267	P.S. 105 .128 TINNED COPPER
268 TO 270	P.S. 105 .080 TINNED COPPER
271 TO 276	P.S. 105 .040 TINNED COPPER
279 TO 280	P.S. 722-7 .085 I.D. TUBING BLK.
282 TO 285	P.S. 722-5 .053 I.D. TUBING BLK.

NUMBERS IN WIRES REFER TO WIRE TABLE AND DESTINATIONS RESPECTIVELY EG; 98-4T1-10 INDICATES WIRE #98 IS CONNECTED TO #10 TERMINAL ON 4T1.

EE-311175-11

Figure 28. Connection Diagram, Rectifier and Control Unit (311175)

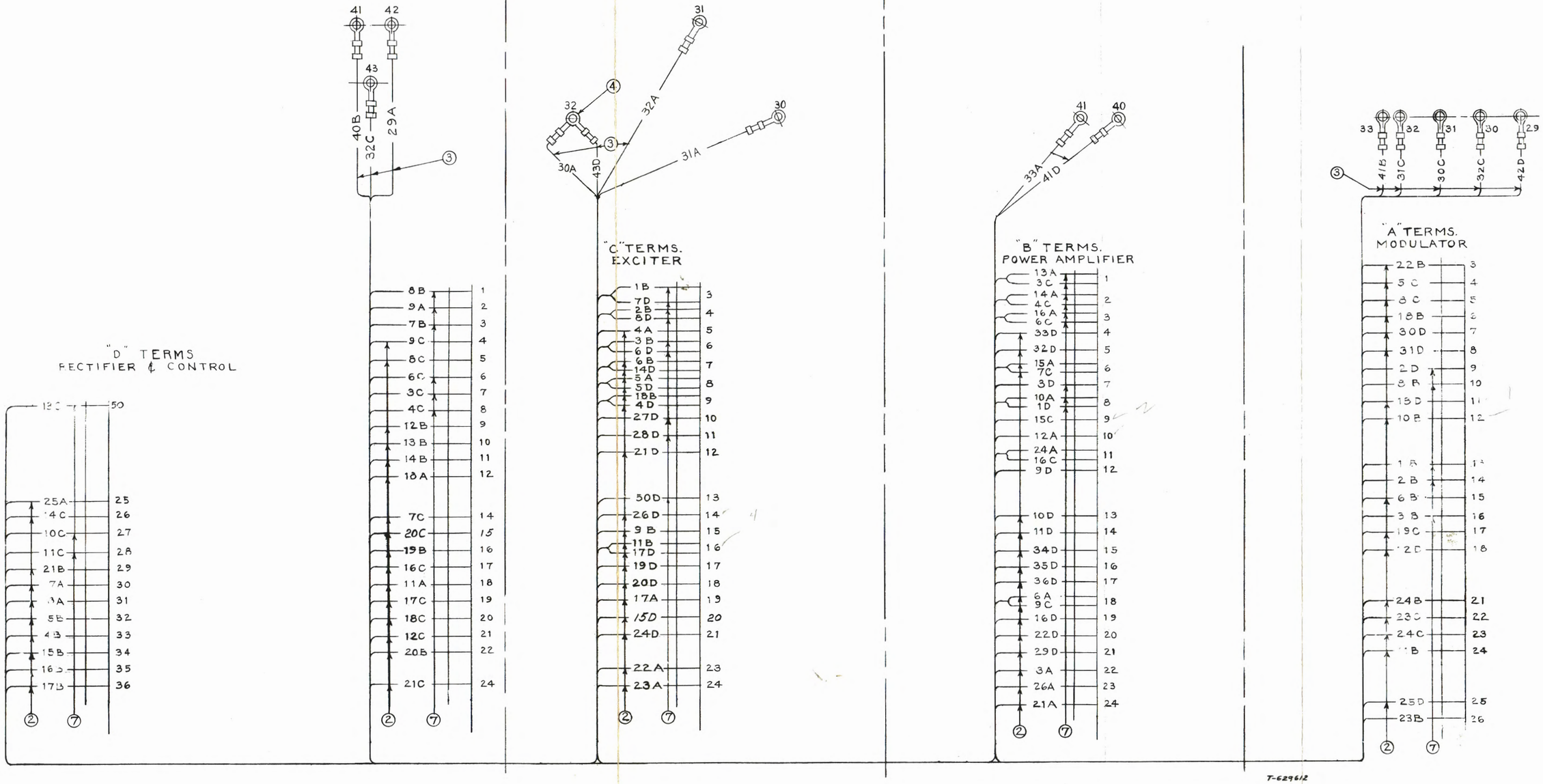
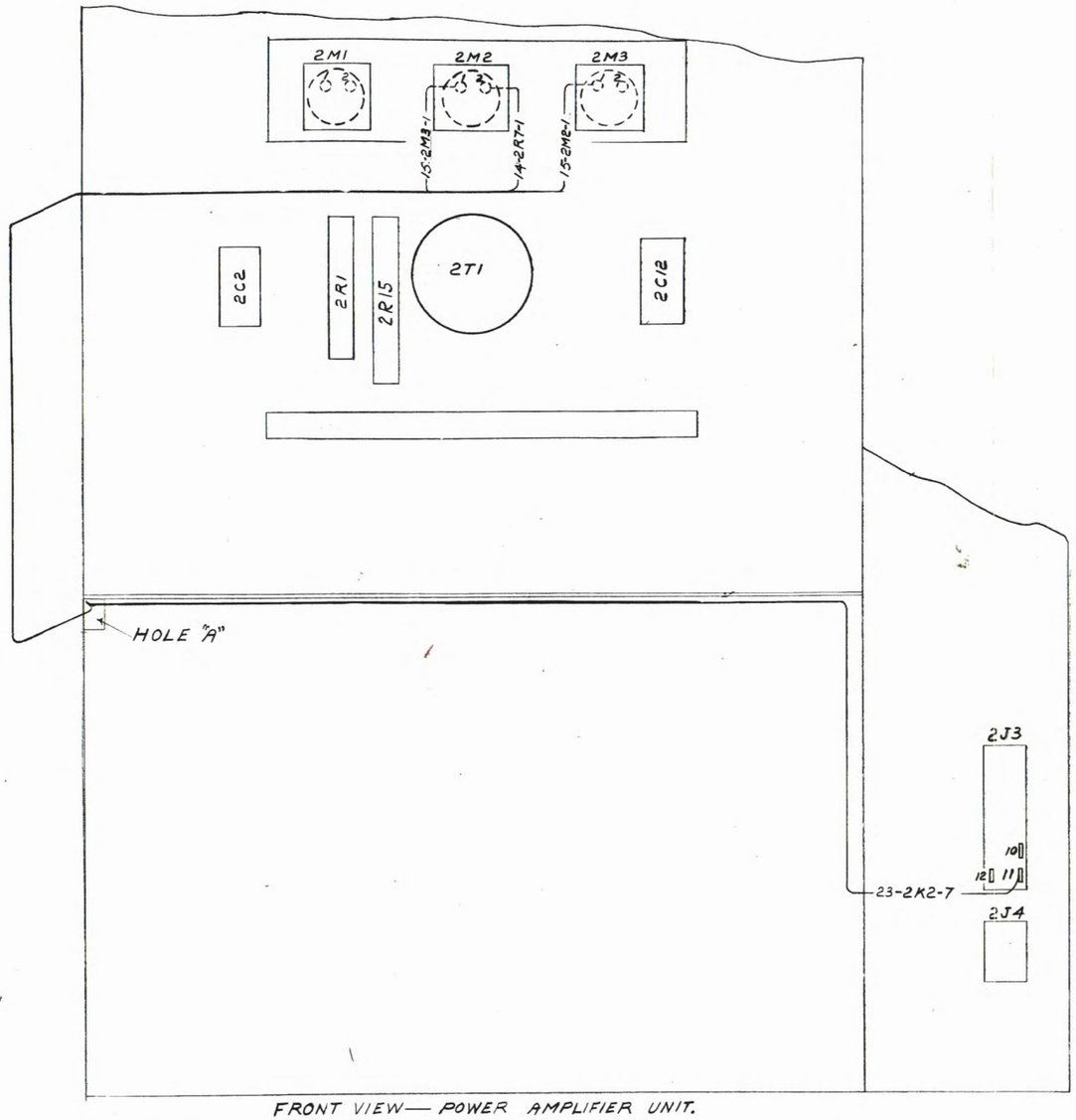
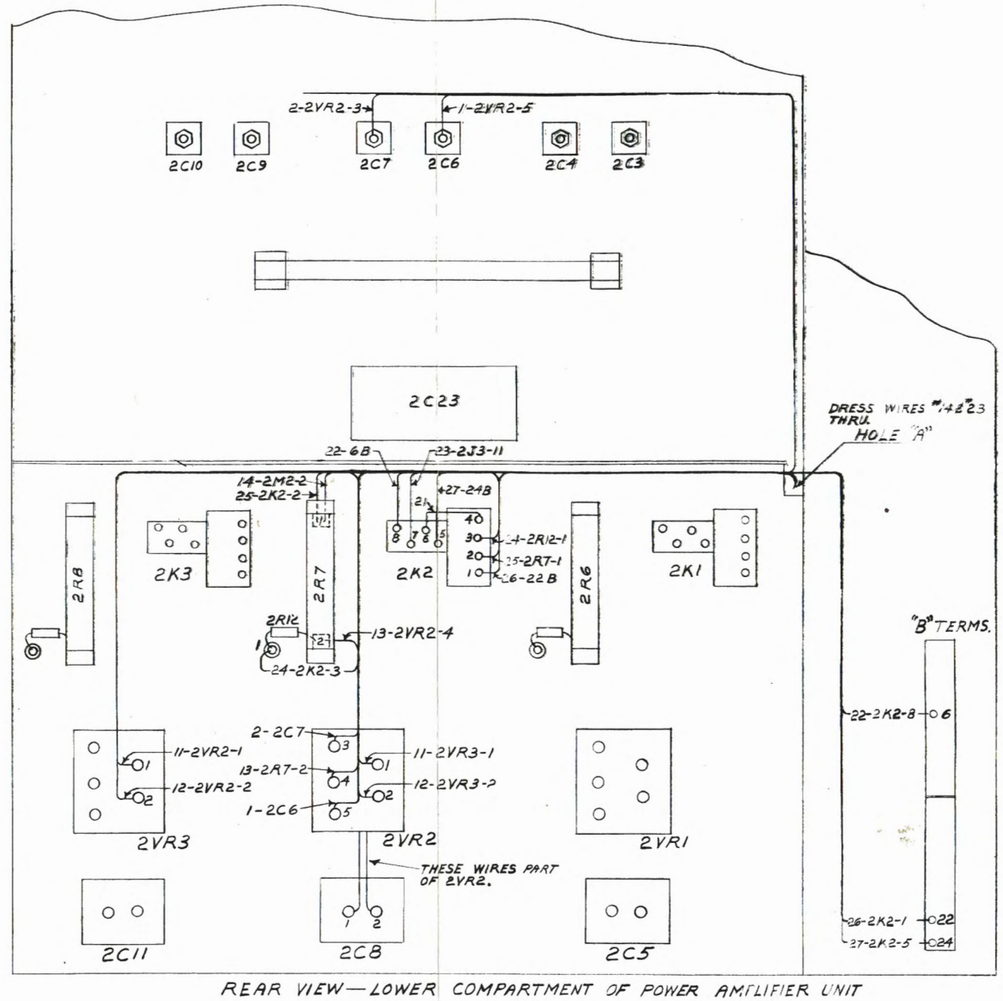


Figure 29. Interconnection Diagram, (Preformed Cable Assembly) (629612)



FRONT VIEW— POWER AMPLIFIER UNIT.



REAR VIEW—LOWER COMPARTMENT OF POWER AMPLIFIER UNIT

NUMBERS IN WIRES REFER TO WIRE TABLE AND WIRE DESTINATIONS RESPECTIVELY.
EXAMPLE;- 13-2R7-2, INDICATES WIRE #13 CONNECTS TO TERMINAL #2 OF COMPONENT 2R7.

WIRE MATERIAL TABLE	
WIRE NUMBER	DESCRIPTION
1 & 2	WIRE BLK #12 AWG
11 TO 15	WIRE BLK #16 AWG
21 TO 27	WIRE BLK #20 AWG
	TERMINAL #8 EYE TYPE
	TERMINAL #4 EYE TYPE
	TERMINAL #10 EYE TYPE
	SOLDER
	LACING CORD

Figure 30. PA Conversion Connections, BTA-5G to BTA-10G (627828)

MANUFACTURERS' BULLETINS

Component Symbol	Manufacturer's Bulletin	
	Maintenance	Replacement Parts
3V4, 3V5, 3V6, 3V7, 4V1, 4V2, 4V3, 4V4	B-59A	RCA Application Note AN-157 "Testing Mercury-Vapor Rectifier Tubes"
1S5		M-110
4K5, 4K11, 4K13		41-350
4K6		PL-702-50
4K7		GEF-3333
4K8		PL-702-37
4K9		P-16
		52-A
4S1, 4S2		29-060 (G Frame)
4S4, 4S5, 4S6		29-060 (E Frame)

TESTING MERCURY-VAPOR RECTIFIER TUBES

Because of the particular voltage-current characteristics of gas-filled electron tubes, a single pulse test can be used in the field to detect both complete failures and "marginal" tubes. This Note describes a basic circuit for making such a test.

Voltage-Current Characteristic of Gas Tubes

Hot-cathode gas tubes, like vacuum tubes, utilize oxide-coated cathodes which emit electrons copiously. In a vacuum tube, however, some of the emitted electrons are driven back into the cathode by a field of previously emitted electrons; the emission, therefore, is said to be space-charge limited. In a gas tube, on the other hand, electrons emitted from the cathode strike gas atoms and ionize them. The ions then neutralize the space charge around the cathode and thus remove the deterrent effect of the space charge on the current. As a result, most of the emitted electrons can reach the anode under the influence of a modest voltage.

Fig.1 shows a typical voltage-current characteristic curve for a gas-filled electron tube. The maximum voltage which can be applied to a gas tube before appreciable current flows is known as the starting or breakdown voltage, indicated in Fig.1 as E_b. After breakdown occurs, a gas tube needs only sufficient anode voltage to produce ionization of the gas, so long as the current drawn is within the emissive capabilities of the cathode. This voltage is about 9 volts for xenon-filled tubes, and about 12 volts for mercury-filled tubes. Because the current after breakdown increases rapidly without further increase in voltage, a series resistance is necessary to limit the current. In the typical rectifier circuit, this resistance is represented by the useful load. The operating point, A, is determined by drawing through the supply voltage, E_{bb}, a line with a slope equal to the reciprocal of the load resistance. The anode voltage across the tube, E_a, at a given current, I_a, is known as the tube drop.

TUBE DEPARTMENT
RADIO CORPORATION OF AMERICA, HARRISON, NEW JERSEY

1-53
Photolithographed
in U. S. A.

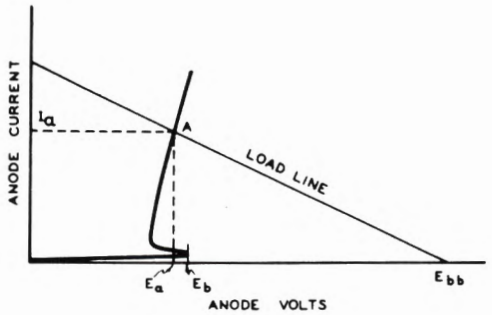


Fig. 1 - Typical Voltage-Current Characteristic for a Gas-filled Electron Tube.

Causes of Failure in Gas Tubes

Failure, or incipient failure, of gas tubes is usually evidenced by a decrease in the emissive capabilities of the cathode. The reduced emission, however, may be attributed to any one of several causes. The presence of a foreign gas such as oxygen or air in the tube may poison the cathode coating and reduce its emissive capabilities. This foreign gas, which may be introduced as a result of a leak in the glass envelope or through evolution of gas from parts within the tube, may also cause breakdown of the tubes on the inverse cycle of voltage if the ionization point of the foreign gas is lower than that of the original gas filling used in the tube.

Poor emission may also be caused by gas clean-up, which results when the cathode coating material in the tube sputters under the bombardment of the ions. The material thrown off from the cathode collects some of the gas atoms and is deposited on the tube walls. The decrease in emission results from both the damage to the cathode coating and the scarcity of ions.

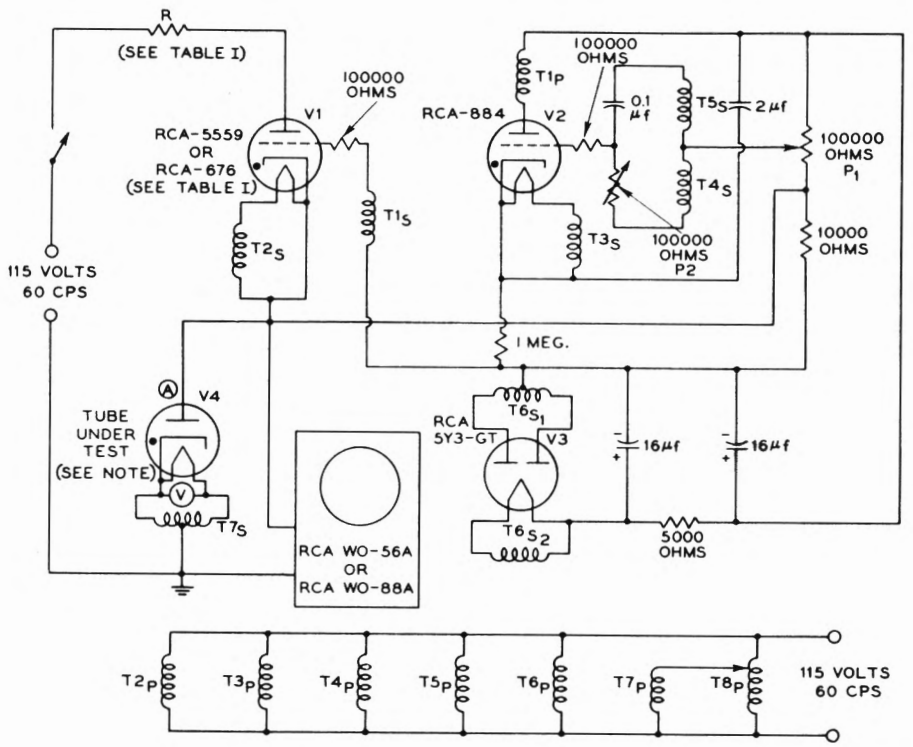
Poor emission or a complete lack of emission may also be caused by such defects as open filaments, improperly coated cathodes, and shorts. A suitable test of emissive capability, therefore, detects these defects as well as those mentioned above.

Methods of Test

A conventional method of testing gas tubes in the field is the measurement of breakdown voltage. This test is a fairly accurate indication of the emissive capabilities of the cathode in tubes in which the anode directly faces the cathode. In most gaseous rectifiers, however, a cathode shield employed to improve thermal efficiency breaks up the direct path between cathode and anode. This shield also acts as a grid which is made positive or negative with respect to the cathode by the action of the ac heater voltage and, therefore, affects the breakdown voltage of the tube. If the shield is negative with respect to the cathode when the anode swings positive, the breakdown voltage of the tube is considerably higher than if the shield and anode voltages are in phase. In such tubes, therefore, the starting voltage should not be taken as a measure of the emission.

Measurement of dc tube drop at rated average current is also used quite often in the field to determine the performance level of gas tubes. A gas discharge is somewhat self-compensating, however, and, therefore, an increase of a volt or two in tube drop can compensate for a considerable decrease in emission. If the cathode emits insufficient electrons to provide the current which would normally flow through the given load resistance, the tube drop increases. Because of this increased voltage drop, the positive ions strike the cathode with higher velocity, raising the cathode temperature and also increasing the secondary-emission yield, and, as a result, bringing the emission back to normal. Because of this compensation, little is learned about the condition of the cathode by measurement of the voltage drop with a dc anode supply and with average current flowing.

If, however, a gas tube under test delivers a peak current several times its rated current, the rise in peak voltage drop is appreciable and is indicative of the quantity of electrons emitted by the cathode.



T_1 = Audio transformer-turns ratio 1:1

T_2 = Filament transformer suitable for V_1

T_3, T_4, T_5 = Filament transformer - 6.3 volts, 1 ampere

T_6 = Power transformer - 500 volts, 60 milliamperes; 5 volts, 2 amperes

T_7 = Filament transformer suitable for V_4

T_8 = Variac

NOTE: When a thyratron is being tested, the connection at A is made to grid No.1 of the thyratron; no connection is made to the thyratron anode or grid No.2.

Fig.2 - Basic Circuit for Making Pulse Emission Tests on Gas Tubes.

Such a high current cannot be drawn continuously because the anode-dissipation rating of the tube would be exceeded. The desired information can be obtained, however, when the current is drawn in short pulses and with a relatively long inter-pulse period (low duty cycle).

Pulse Test Circuit

A basic circuit suitable for making pulse emission tests on gas tubes in the field is shown in Fig.2. This circuit causes the tube under test, V_4, to conduct about once a second, each conduction period lasting for only one half-cycle of the voltage from the 60-cycle supply. Such a low duty cycle permits high peak currents to be drawn without the dissipation limits of the tube being exceeded. The repetition rate is fast enough to permit observation of the tube drop on an oscilloscope.

In the circuit of Fig.2, thyratron V_1 serves as an electronic switch to pass the test current pulse through V_4. The value of the resistor R determines the amplitude of the current pulse. Suitable values of resistance for various types of gas tubes are given in Table I. Thyratron V_2 and its associated circuit comprise a relaxation oscillator which determines the repetition rate. The output of this circuit is coupled through transformer T_1 to the grid of thyratron V_1. The repetition rate is not critical; if desired, it can be adjusted with potentiometer P_1. The low-voltage windings of transformers T_4 and T_5 are connected in series aiding so that there is 12.6 volts across the outside leads. The trigger pulse applied to the grid of V_1 should occur at the beginning of a positive half-cycle of anode voltage on V_1. Potentiometer P_2 permits adjustment of the pulse phase over 180 degrees; it may also be necessary to reverse the transformer leads of both T_4 and T_5 to obtain the desired phasing. Rectifier V_3 supplies dc voltage for the relaxation oscillator and for the bias of thyratron V_1. The choice of thyratron V_1 depends upon the test current to be drawn; suggested thyratrons for use with various tube types under test are given in Table I. When the tube under test, V_4, is a thyratron, the connection at A is made to the grid No.1 of the thyratron; no connection is made to the thyratron anode or grid No.2.

Use of Pulse Test

The conditions of tube operation during test should be controlled in order to assure reproducible results. The correct cathode temperature is obtained if rated heater voltage is applied for rated heating time; five minutes is adequate for all standard types. (This time should be doubled if heater transformers having poor regulation are used). The heater voltage should be measured at the socket with a good meter; the socket and top-cap contacts should be clean and snug-fitting.

The tube drop of mercury-vapor tubes, in addition to being sensitive to heater temperature, is sensitive to changes of envelope temperature. The mercury-vapor pressure is determined by the temperature of a portion of the glass envelope half an inch long just above the base. The temperature of this portion of the envelope, sometimes called the condensed-mercury temperature, rises above the ambient temperature as the tube is operated. The rate of rise of the envelope temperature, as well as the operating temperature of the envelope, depends upon tube construc-

TABLE I

Tube Under Test	*Auxiliary Thyratron*	*Peak Test Current (amperes)*	*Resistor R (ohms)*
Rectifiers			
816	RCA 5559	2	70
866A	"	5	28
3B25	"	5	28
3B28	"	5	28
5558	"	5	28
872A	RCA 676	20	7
8008	"	20	7
4B26	"	20	7
575A	"	30	4.7
673	"	30	4.7
5561	"	30	4.7
869B	"	40	3.5
857B	"	80	1.7
Thyratrons			
5696	RCA 5559	0.2	700
884	"	1.0	140
885	"	1.0	140
2D21	"	2	70
502A	"	2	70
2050	"	2	70
629	"	1	140
5557	"	5	28
627	"	5	28
3D22	"	10	14
3C23	"	10	14
5559	"	15	9.4
5720/33	"	15	9.4
5728/67/1904	"	15	9.4
5560	RCA 676	30	4.7
672A	"	40	3.5
5563	"	30	4.7
105	"	80	1.7
172	"	80	1.7
677	"	30	4.7
676	"	80	1.7

tion and upon the power dissipated in the heater and anode. When the condensed-mercury temperature is below 20 degrees Centigrade, the mercury pressure is less than one micron and the tube drop is so high that the cathode coating may be damaged. When the condensed-mercury temperature is 25 degrees Centigrade or higher, each additional increase of five degrees results in a decrease in tube drop of approximately two volts. Although the time required for a mercury-vapor tube to reach "equilibrium" temperature may be from 10 to 30 minutes, a warm-up time of five minutes should be sufficient to heat the cathode and to stabilize the mercury pressure before measurement of pulse emission and peak tube drop.

The oscilloscope used to measure the tube drop must be equipped to amplify dc signals so that the instrument may be calibrated with dc voltage and a convenient and stable zero voltage axis may be established. The RCA WO-56A and RCA WO-88A oscilloscopes are suitable and directly usable for this purpose. If conventional ac oscilloscopes are to be used in this application, they must be converted for dc amplification. In ac oscilloscopes having one stage of amplification, the input coupling capacitor should be shorted and the output coupling capacitor replaced with a 180-volt bias battery (isolated from ground) and a 0.5-megohm potentiometer for vertical-centering control. If there is no common connection between any two of the four deflecting electrodes, the centering may be accomplished without the internal battery by applying a suitable dc voltage from a tap on the internal supply to the vertical deflecting electrode opposite the signal electrode.

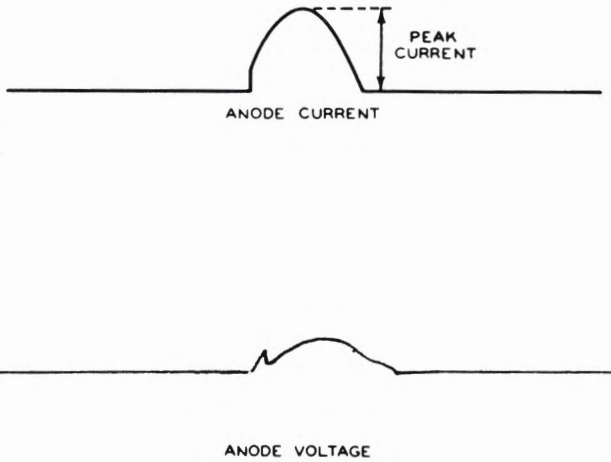


Fig.3 - Waveform Produced on Oscilloscope such as RCA WO-56A by a Gas Tube Under Test in the Circuit of Fig.2.

The waveforms produced on a suitable oscilloscope by the circuit of Fig.2 are shown in Fig.3. A single half-cycle of voltage appears across resistor R when V_1 fires. The peak current can be calculated after the peak voltage across R is measured. Because the tube drop is not sensitive to small variations in current, a fixed value of R may be used for any given tube type (see Table I). The tube drop is indicated on the oscilloscope by the perpendicular distance from the zero voltage axis to the point of the voltage wave form corresponding to maximum current flow. The value of the tube drop may be determined by substituting a dc voltage which produces the same amount of deflection on the oscilloscope.

When tubes having directly heated cathodes are tested, errors due to inclusion of the filament voltage in the reading can be eliminated by making all circuit returns to the center tap of the filament transformer. When tubes having indirectly-heated cathodes are tested, the return should be made to the cathode.

Evaluation of Test Results

A major advantage of a pulse test for gas tubes in the field is the ease of locating "marginal" tubes before failure. The operational

"danger zone" of tube operation, when failure may occur at any moment, can be avoided if the emission test described in this note is utilized. The tube drop of an average gas tube at the beginning of its life ranges from 8 to 16 volts depending upon the tube type and the test current. Tube drop may decrease slightly early in the service life, but it soon settles down to a nearly constant value for the major portion of the tube life. Toward the end of life, the tube drop rises, slowly at first but then at an increasing rate. A tube operating at 25 volts at normal current may fail at any moment. In equipment in which continuity of service is important, tubes having a drop of 25 volts under the test conditions shown in Table I should be taken out of service.

The peak test currents given in Table I are not critical; they may vary as much as ten per cent or more for the purposes of this test. These current values, however, are in excess of the rated peak currents for the tubes and are recommended only for pulse testing.

A suggested schedule of pulse tests in the field is at 100, 500, and 1000 hours, and at 1000-hour intervals thereafter. In general, this schedule will be sufficient to prevent excessive failure in operation; a modified schedule sometimes may be necessary to suit particular requirements.

INSTALLATION INSTRUCTIONS

FOR TYPES PQ, PQ-3, PQP, PQP-3, PQM and MQP MERCOID DIAPHRAGM PRESSURE CONTROLS

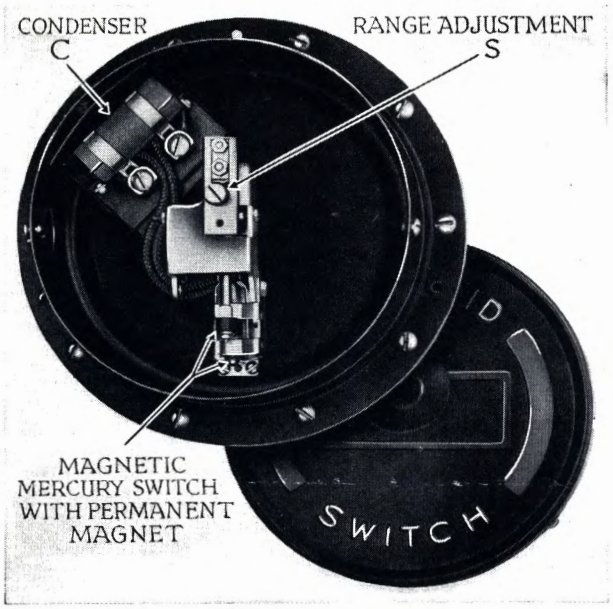


Illustration No. 3

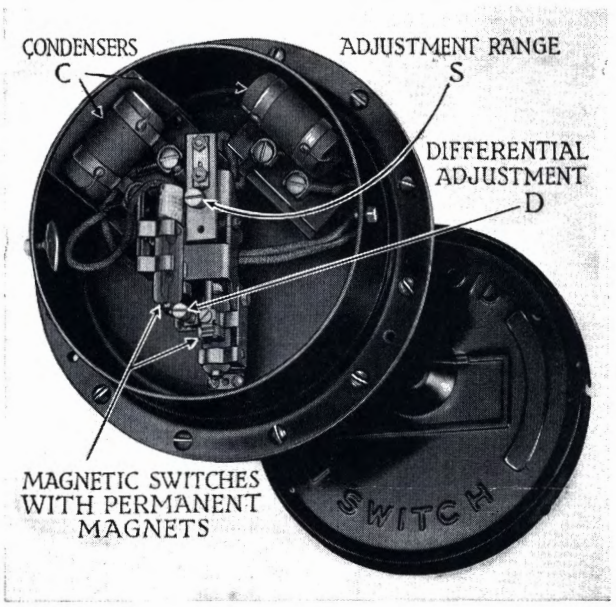


Illustration No. 4

Mounting: Mercoid Diaphragm pressure controls are extremely sensitive to small pressure changes and, therefore, require special consideration to avoid mechanical vibration and pressure pulsations. They must be secured firmly in a level position on a panel or even wall surface which is free from vibration. Place the ⅛" pressure connection at the bottom so that the conduit connection and terminal posts are to the left. **Use the mounting studs and do not attempt to support the control solely by the pressure connection.**

Orifices: Each control is shipped with a .028" orifice inside of the pressure connection. Four more are attached to the control in the following sizes: .025", .031", .036", and .040". On static heads of pressure, use one of the larger orifices, but with pressures which have a tendency to pulsate, one of the small sizes must be used to help dampen the surges. The orifice is located inside the pressure connection and can easily be changed by the use of a small screw driver.

Gases or liquids containing excess dirt or scale may close the orifice so that periodic servicing may be required.

Pressure Connection: When the control is piped, use a flexible connection to prevent undue strains from expansion and contraction. On any application on which the small orifices do not sufficiently check the pressure surges, the pulsations must be dampened by a capillary tube or pressure surge chamber, otherwise the instrument will follow the pulsations and cause contact fluttering.

Wiring and Electrical Capacity: These pressure controls are rated at a maximum of 20 watts - 115 volts or 230 volts; - 0.9 amperes - 24 volts AC; - 0.45 amperes - 24 volts DC; 0.3 amperes 115 volts AC; - 0.15 amperes 115 volts DC; - 0.15 amperes 230 volts AC; - 0.07 amperes 230 volts DC. **Be sure the electrical load does not** exceed these ratings and, if there is any question, use a Type V Relay.

Attach only flexible BX cable directly to the control case. If rigid conduit is employed, insert a short piece of BX cable between the conduit and control case to take up strain. Scrape all wires clean before attaching to the binding posts.

With Type PQP and PQM units, having two tubes, run the wires to the right side terminals over the top movement support so that they will not interfere with the free motion of the mechanism.

The condensers "C" (illustration 3 & 4) reduce the excess arcing and should not be removed.

Remove the tissue paper (used for shipping purposes only) holding the magnet assembly in place.

Range Adjustment for Types PQ and PQ-3: In order to accurately determine the points at which the control is being set to operate, a water column gauge is essential. It is advisable that a pressure tapping be provided for such a gauge at the time the control is piped.

To alter the range setting of the Type PQ and PQ-3, change the knurled screw "S" (see illustration No. 3). This is done by turning screw "S" to the left or counter clockwise to lower the operating point. To raise the pressure adjustment turn screw "S" clockwise.

Differential Adjustment for Types PQ and PQ-3: The differential is fixed and may not be changed.

Range Adjustment of Types PQP, PQP-3 and PQM: The range setting is governed by the screw "S" (see illustration No. 4. To raise the operating pressure, turn the knurled screw clockwise, and to lower the setting, turn screw "S" counter clockwise. As the range adjustment is varied, the differential between the two switches will remain relatively constant, but should be rechecked. With vacuum controls turn screw "S" clockwise to lower the vacuum setting and counter-clockwise to raise the setting.

Differential Adjustment for Types PQP, PQP-3, PQM and MPQ: The differential or pressure difference between the operation of the "high and low" switches can be adjusted within certain limits by the knurled screw "D". To widen the differential, turn screw "D" clockwise, to decrease, turn screw "D" counter clockwise. **Do not turn this screw too far in either direction,** otherwise the magnetic switch to the left will not operate in the proper sequence.

Sequence of Switch Operation—

Pressure Controls: On a pressure increase **"low"** pressure switch should operate first, and upon a further pressure increase **"high"** pressure switch should then operate. On decreasing pressure **"high"** switch operates, and upon a further decrease **"low"** switch operates.

Vacuum Controls: On a decrease in vacuum **"high"** vacuum switch operates first, and upon a further decrease **"low"** vacuum switch operates. On an increase in vacuum **"low"** vacuum switch operates, and upon a further increase in vacuum **"high"** vacuum switch operates.

Pressure Rating and Ambient Temperature: Excess pressure will damage the control. Do not exceed the maximum pressure rating stamped on the name plate. Since wide variations in ambient temperature may cause erratic operation, a reasonably constant ambient temperature should be maintained. Never use oil on movements.

MERCOID DIAPHRAGM PRESSURE CONTROLS

TYPES PQ, PQP, PQM, AND MQP

Mercoid Diaphragm Pressure Controls are intended for any low pressure applications for regulating the pressures of liquids or gases in inches of water, either pressure or vacuum. The standard instruments may be used with any pressure medium which does not affect steel or brass.

Large diaphragms actuate the magnetic mercury switches through compounding mechanism and, on a pressure increase, the magnets move away from the mercury switches to open the circuit in the Fig. 9-81 switch (see illustration No. 1), or to close the circuit in the Fig. 9-83 mercury switch.

(Following is a brief description of the various types of Diaphragm Controls available.)

Type PQ Diaphragm Pressure Control: This instrument is single pole and has an adjustable range with a fixed differential. The mercury switch opens on a rise of pressure.

Type PQ-3 Diaphragm Pressure Control: Identical to Type PQ except that the circuit closes on a rise of pressure. For ranges see table below.

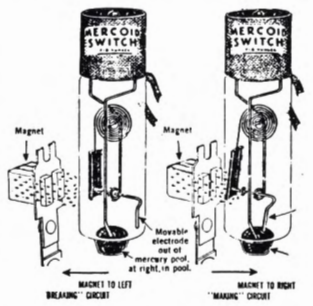
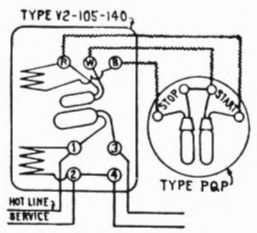


Illustration No. 1



HOOK-UP OF TYPE PQP WITH RELAY V2-105-140

Illustration No. 2

Type PQP Diaphragm Pressure Control: Equipped with two normally closed switches and two adjustments for varying the operating point of each switch.

With the switches in the normally closed position, an increase of pressure will open one circuit and a further increase to a predetermined pressure opens the second circuit. On a small decrease in pressure, the second switch will close and on a further decrease the first switch closes. One switch is adjustable as to range and the other adjustment will vary the differential or pressure difference between the operation of the two switches.

Generally, this type of diaphragm control is used with a Mercoid Type V2-105-140 Relay or similar unit in order to provide an adjustable differential. (See illustration No. 2.)

Closing the "start" circuit will energize the relay and close the "load" circuit. A small pressure rise will open the "start" circuit though the relay circuit remains closed. When the pressure reaches the high setting, the "stop" circuit opens and deenergizes the relay to open the "load" circuit. The relay cannot again operate until the pressure drops to the low setting of the "start" circuit.

Type PQP-3 Diaphragm Pressure Control: Identical to the type PQP, except that both mercury switches are normally open and close on an increase of pressure or decrease of vacuum.

Type PQM Diaphragm Pressure Control: Equipped with two switches and adjustments for varying the operating points. At a predetermined pressure, both switches are open (neutral). The two switches give the effect of a single pole-double throw contact with a neutral position. Assuming that one circuit has just closed, a slight pressure change in the reverse direction will open the circuit. A further change in pressure will close the other circuit while a slight pressure change in the reverse direction will open the contact. This unit is commonly used with reversing type regulating motors requiring floating contacts. If the control contacts are not of sufficient capacity to handle the motor directly, each individual mercury switch should be wired to a Type V2-3 Relay which in turn will control the motor load.

In the table of ranges and differentials, the minimum differential represents the difference in pressure between "on" and "off" for each individual switch. The maximum differential figures represent the maximum adjustable spread of the pressures between the contact operation.

Type MQP Diaphragm Control: Identical to the Type PQM, except at a predetermined pressure, both switches are closed (neutral).

For ranges and adjustable differentials see table below.

(See Opposite Side for Installation Instructions.)

ADJUSTABLE RANGES AND DIFFERENTIALS

Types PQ, PQ-3 Controls
With Range Adjustments Only--No Differential Adjustment

RANGE NUMBER	RANGE ADJUSTMENT (INCHES OF WATER)	DIFFERENTIAL ADJUSTMENT (INCHES OF WATER)	MAX. PRSS. OR VAC. (INCHES OF WATER) MUST NOT EXCEED
x1	0 to .1" PRESS.	.01"	.2"
x2	.1 to 1" PRESS.	.03"	2.0"
x3	1"to 30" PRESS.	.1" to .2"	45.0"
x4	0 to .1" VAC.	.01"	.2"
x5	.1 to 1" VAC.	.01" to .02"	2.0"
x6	1" to 30" VAC.	.1" to .2"	45.0"

Types PQP, PQP-3, PQM and MQP Controls
With Both Range and Differential Adjustment

RANGE NUMBER	RANGE ADJUSTMENT (INCHES OF WATER)	DIFFERENTIAL ADJUSTMENT (INCHES OF WATER)		MAX. PRSS. OR VAC. (INCHES OF WATER) MUST NOT EXCEED
		MINIMUM	MAXIMUM	
x1	0 to .1" PRESS.	.01"	.05"	.2"
x2	.1 to 1" PRESS.	.05"	.3"	2.0"
x3	1"to 30" PRESS.	.1" to .2"	3.0"	45.0"
x4	0 to .1" VAC.	.01"	.05"	.2"
x5	.1 to 1" VAC.	.01" to .02"	.3"	2.0"
x6	1" to 30" VAC.	.1" to .2"	3.0"	45.0"

THE MERCOID CORPORATION, 4201 Belmont Ave., Chicago 41, Illinois

3M—May, 1951

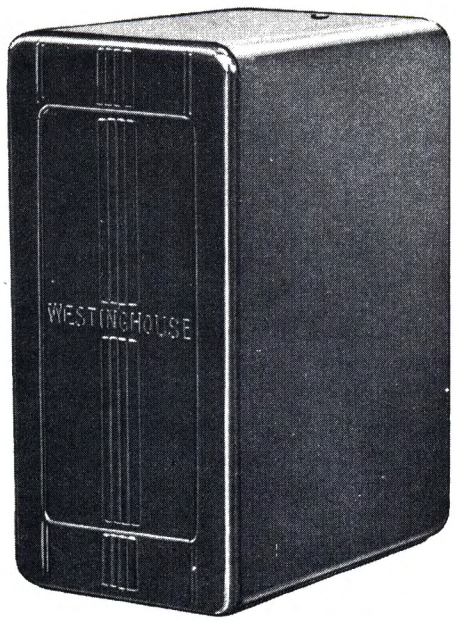
Form B-59A

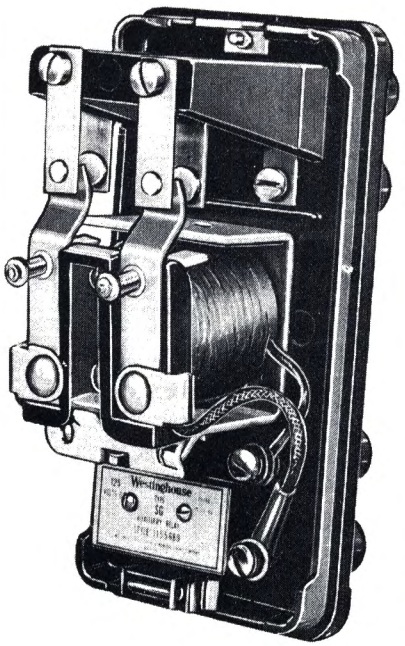
SWITCHES AND CLIPS USED IN MERCOID CONTROLS

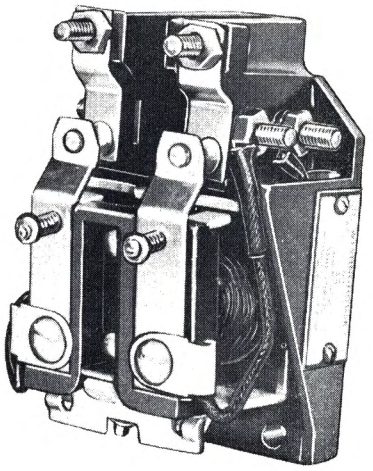
INSTRUMENT FIGURE or TYPE NO.		MERCOID SWITCH	SWITCH CLIP
122, 122-3, 123, 123-3		121-83 — **	7-158
122, 122-3, 123, 123-3	440V	9-51051R	7-158
122-4, 122-54, 123-4, 123-54		121-9-A67	7-39
122-4, 122-54, 123-4, 123-54	440V	9-A67052R	7-39
122-103, 123-103	Upper	9-51051R	7-160
	Lower	9-51051R	7-59
122-103, 123-103	440V Upper	9-51051R	7-59
	440V Lower	9-51051R	7-158
122-127, 123-127	Upper	9-51051R	7-161
	Lower	9-51051R	7-158
122-127, 123-127	440V Upper	9-51051R	7-161
	440V Lower	9-51051R	7-158
122-153, 123-153		121-9-A64	7-39
122-153, 123-153	440V	9-A64052R	7-39
122-156, 123-156	Upper	9-51051R	7-160
	Lower	9-51051R	7-158
122-156, 123-156	440V Upper	9-51051R	7-59
	440V Lower	9-51051R	7-158
125 - 2520, 2521		121-83 — **	7-161
125 - 2522	Upper	121-140 — **	7-57
	Lower	121-139 — **	7-161
125 - 2523	Upper	121-141 — **	7-161
	Lower	121-139 — **	7-161
132F, 132F-3, 132T, 132T-3		121-83 — **	7-161
133, 133-3, 133Q, 133Q-3		121-83 — **	7-161
133QB, 133QB-3		121-83 — **	7-161
337, 337-3, 437, 437-3		118-9-51-***	7-59
337-153, 437-153		118-9-A64***	7-39
380		104-9-A51	104-41 — Circ. 104-42 — Limit
PQ, PQM		97-9-8104-1/2-2S	7-57
PQ-3, MQP		97-9-8304-1/2-2S	7-57
PQP, PQP-3		97-9-8104-1/2-2S 97-9-8304-1/2-2S	7-57
M CONTROLS			
M41, M43		118-9-51 — ***	7-59
M41-153		118-9-A64 ***	7-39
M51, M52, M53, M55, M57		84-9-51	7-59
M51-153, M52L		84-9-A64	7-39
M61, M62, M63		84-9-51	7-59
M80, M82, M84, M86, M88		104-9-A51	104-41 — Fan 104-42 — Limit
STOKER CONTROLS			
THV, TV2		94-9-51	7-59
T2		9-51051R	7-161
JMV	Relay Switch	94-9-51	7-59
	Timer Switch	9-65030S	7-151
	Outfire Switch	9-61072R	7-57
GAS - POWERSTAT			
GA, GB		101-9-81B	7-57

TYPE SG AUXILIARY RELAY

Closed and Open Type for A-C or D-C Use







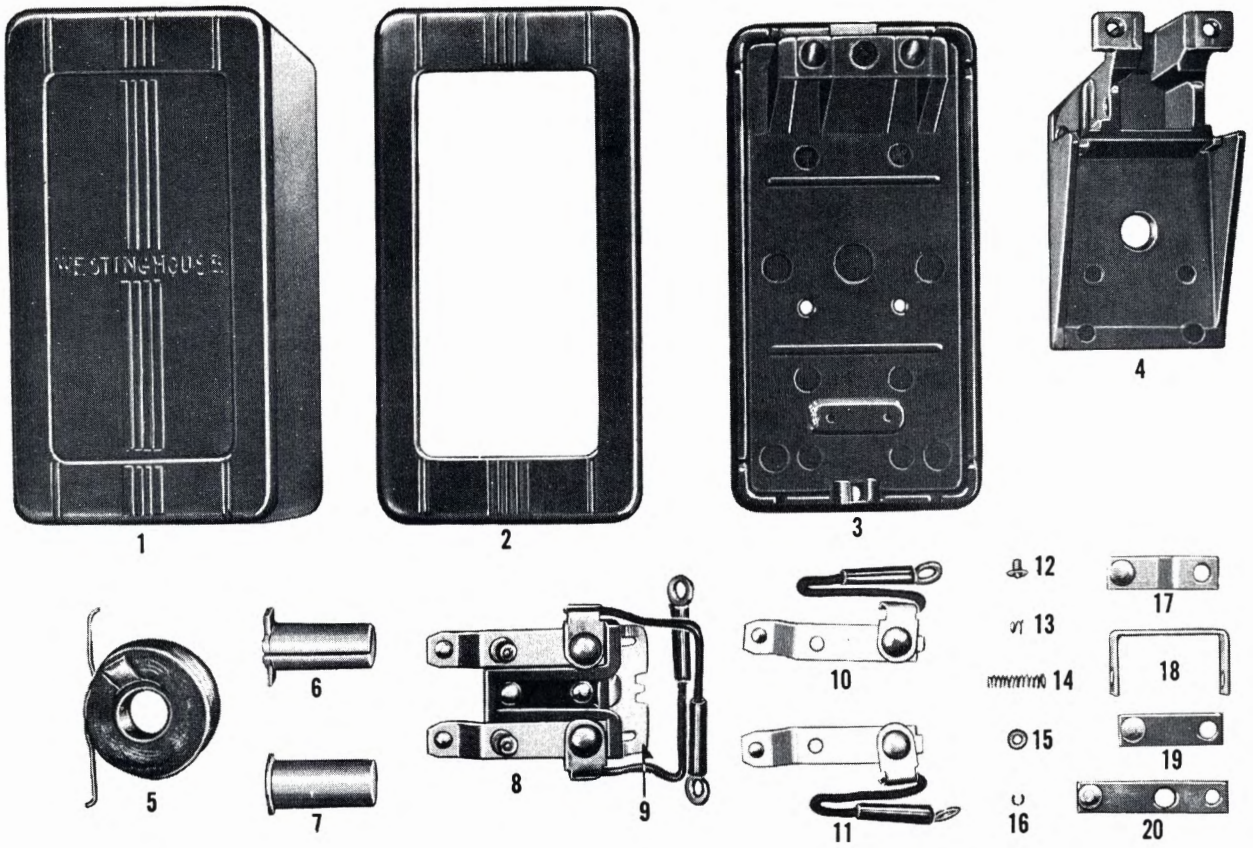
Amperes	Volts	Cycles	COMPLETE RELAY STYLE				
			Switchboard Type		Open Panel Type		Operating Coil
			MOULDED COVER	COVER WITH GLASS			
			2-Make 2-Break	2-Make 2-Break	2-Make	2-Make 2-Break	
			Style Number	Style Number	Style Number	Style Number	Style Number
1		DC	1 157 848	1 162 959	1 157 852	- -	1 059 282
3		DC	1 157 849	1 162 960	1 157 853	- -	1 059 284
5		DC	1 157 850	1 162 961	1 157 854	- -	1 059 286
	24	DC	1 155 687	1 162 950	1 059 231	1 205 620	1 008 517
	48	DC	1 155 688	1 162 951	1 008 534	1 205 612	1 008 520
	125	DC	1 155 689	1 162 952	1 008 535	1 161 540	1 008 524
	%250	DC	1 155 690	1 162 953	1 008 536	1 205 613	1 008 524
	115	50 and 60	1 155 693	1 162 956	1 008 539	1 205 616	1 008 517
	230	50 and 60	1 155 694	1 162 957	1 008 540	1 205 617	1 008 520
	460	50 and 60	1 155 695	1 162 958	1 008 541	1 205 618	1 008 523

% External Resistor S#1009014 must be used

Note: - For 25 cycle Relay, Specify "Simto" 60 cycle style, except for 25 cycle

SG AUXILIARY RELAY

Details



Ref No.	DESCRIPTION OF PART	SWITCHBOARD TYPE		OPEN PANEL TYPE	
		Style Number	No. Req	Style Number	No. Req
1	Cover (Solid moulded front)	876 718	1	-	
2	Cover (with glass window)	876 270	1	-	
3	Base only (with cover clips)	1 102 938	1	-	
4	Base only	-		821 999	1
5	Coil (see table)	Page 1		Page 1	
6	Core (AC)	1 008 225	1	1 008 225	1
7	Core (DC)	1 008 224	1	1 008 224	1
8	Armature complete with contacts	1 163 647	1	1 163 647	1
9	Armature only (Less contact arms)	1 008 712	1	1 008 712	1
10	Moving contact and arm (right hand)	1 008 710	1	1 008 710	1
11	Moving contact and arm (left hand)	1 008 709	1	1 008 709	1
12	Bushing for contact arm guide	1 008 223	2	1 008 223	2
13	Spring, Under contact arm	1 001 025	2	1 001 025	2
14	Spring, Over contact arm	1 000 826	2	1 000 826	2
15	Cup washer	1 000 824	2	1 000 824	2
16	Clip washer	1 003 864	2	1 003 864	2
*	Armature spring	1 156 399	1	1 000 998	1
*	Armature spring (2-Make - 2-break)	-		1 156 399	1
17	Stationary reversible contact assembly (2 Make)	-		1 008 711	2
18	Stationary make contact assembly	1 102 942	2	-	
19	Stationary break contact assembly	1 102 943	2	-	
20	Stationary make contact assembly (2 make - 2 break)	-		1 098 558	2
20	Stationary break contact assembly (2 make - 2 break)	-		1 002 172	2

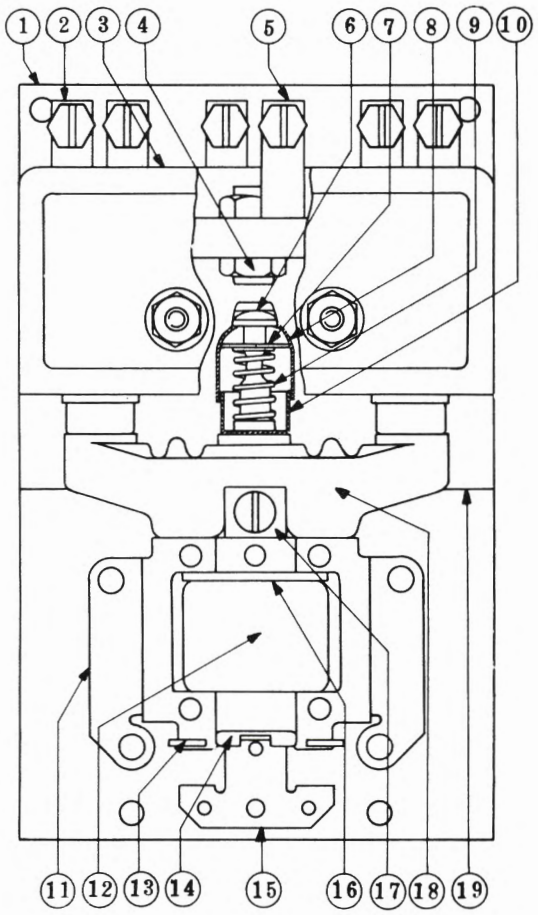
* Not Illustrated

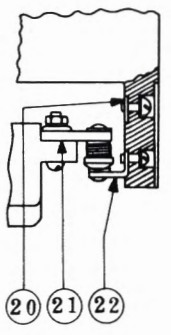
MILWAUKEE, **Allen-Bradley Co.** WISCONSIN

BULLETIN 702

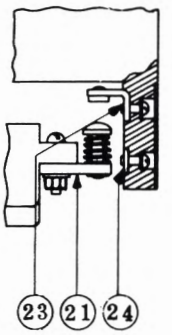
REPAIR PART LIST

SIZE 2





Normally Closed Auxiliary Contact



Normally Open Auxiliary Contact

Item	Part No.	Description of Part	Price
1	X-42960	Solenoid Base Assembly (1 & 2 Pole)	$10.30
	X-40561	Solenoid Base Assembly (3 Pole)	10.50
	X-40560	Solenoid Base Assembly (4 Pole)	10.60
2	G-4089	Terminal (with Terminal Screw)(1)	.20
3	F-11059	Arc Hood Cover (1-2 & 4 Pole)(2)	.50
	F-10771	Arc Hood Cover (3 Pole)	.65
4	X-36702	Stationary Contact	.50
	M-437	Stationary Contact Nut	.05
5	G-4095	Terminal (with Terminal Screw)(1)	.20
	M-1801	Terminal Screw	.02
6	X-36670	Movable Contact	.90
7	M-2070	Special Washer	.10
8	B-8236	Upper Cup	.15
9	E-5356	Contact Spring(1-2-3 Pole)	.10
	B-11602	Contact Spring (4 Pole)	.10
10	B-8235	Lower Cup	.10
11		Same as item 1	
12	RC-36 ?	Solenoid Coil(3)	3.00
13	E-9769	Shading Coil each	.20
14	E-7718	Plunger Guide each	.50
15	X-49723	Plunger	3.30
16	E-9645	Coil Clamp	.50
17	B-8232	Clamping Plate	.10
18	X-39288	Cross Bar only(1 & 2 Pole)	.90
	X-49480	Cross Bar complete(1 & 2 Pole)	4.00
	X-36158	Cross Bar only(3 Pole)	1.90
	X-49476	Cross Bar complete(3 Pole)	6.25
	X-39289	Cross Bar only(4 Pole)	3.00
	X-49477	Cross Bar complete(4 Pole)	8.50
19	F-11058	Arc Hood Base(1-2 & 4 Pole)(2)	.65
	F-10770	Arc Hood Base(3 Pole)	.80
	F-11060	Contact Block only(1-2 & 4 Pole)(2)	.65
	X-39554	Contact Block complete(1-2 & 4 Pole)(1-2)	3.00
	F-10772	Contact Block only(3 Pole)	.80
	X-37853	Contact Block complete(3 Pole)(1)	4.50
20	X-42877	Auxiliary Contact(4)	.35
	X-40297	Auxiliary Contact(5)	.35
21	X-68450	Auxiliary Contact Lever	.80
22	X-42876	Auxiliary Contact(4)	.35
	X-40296	Auxiliary Contact(5)	.35
23	X-40296	Auxiliary Contact(6)	.35
	X-42876	Auxiliary Contact(7)	.35
24	X-40297	Auxiliary Contact(6)	.35
	X-42877	Auxiliary Contact(7)	.35
25A		Cabinet complete (Nema type 1)	4.50
		Cabinet Cover (Nema type 1)	2.00
		Cabinet Base (Nema type 1)	2.50

(1) Unless terminal markings are specified these parts will be furnished without markings.
(2) Two of these parts are used on 4 Pole Switches.
(3) Specify Voltage and Frequency when ordering.
(4) For Right Hand Normally Closed Auxiliary Switch Z-2113
(5) For Left Hand Normally Closed Auxiliary Switch Z-2115
(6) For Right Hand Normally Open Auxiliary Switch Z-2112
(7) For Left Hand Normally Open Auxiliary Switch Z-2114

CABINETS
SEE ITEM 25

Information Required: Your order cannot be entered unless the following information is given; Part number, description of Part and the Series Number of the Contactor.

Prices are F.O.B. Milwaukee and subject to change without notice.

Our minimum charge on any order will be $1.00 net.

This repair part list applies also to the above contactor when used on control apparatus listed under other bulletin numbers.

Supersedes PL-702-50, dated November 1, 1939

RENEWAL parts

TYPE PJC INSTANTANEOUS OVERCURRENT RELAY

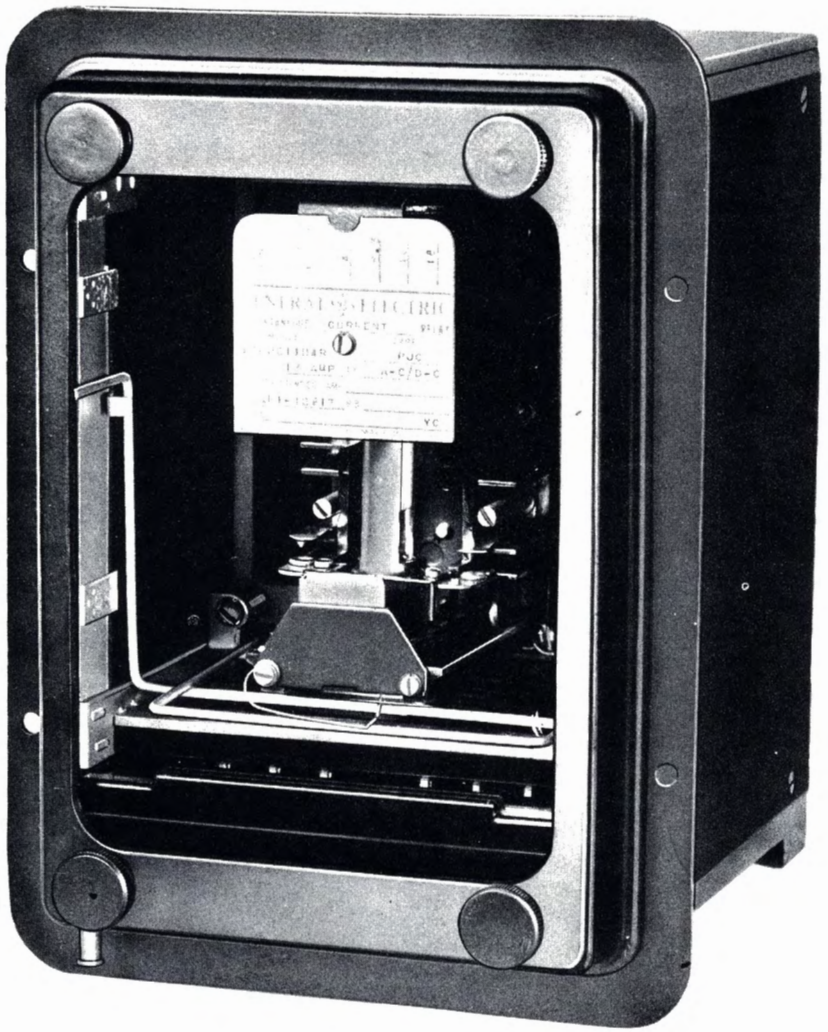


Fig. 1. Type PJC instantaneous overcurrent relay-drawout construction

ORDERING INSTRUCTIONS

1. Always specify the model number of the relay.
2. Specify the quantity, catalog number (if listed), reference number (if listed), description of part, and this bulletin number.
3. CAUTION - When local facilities for relay recalibration are not available, springs should not be replaced. For repair, the relay should be forwarded to the nearest G-E Service Shop, or to the General Electric Company, 6901 Elmwood Avenue, Philadelphia, Pa.
4. Standard hardware (such as screws, bolts, nuts, washers, etc.) is not listed in this bulletin. Such items should be purchased locally, if feasible. Special hardware, although not listed, will be billed at current prices.

TYPE PJC INSTANTANEOUS OVERCURRENT RELAY

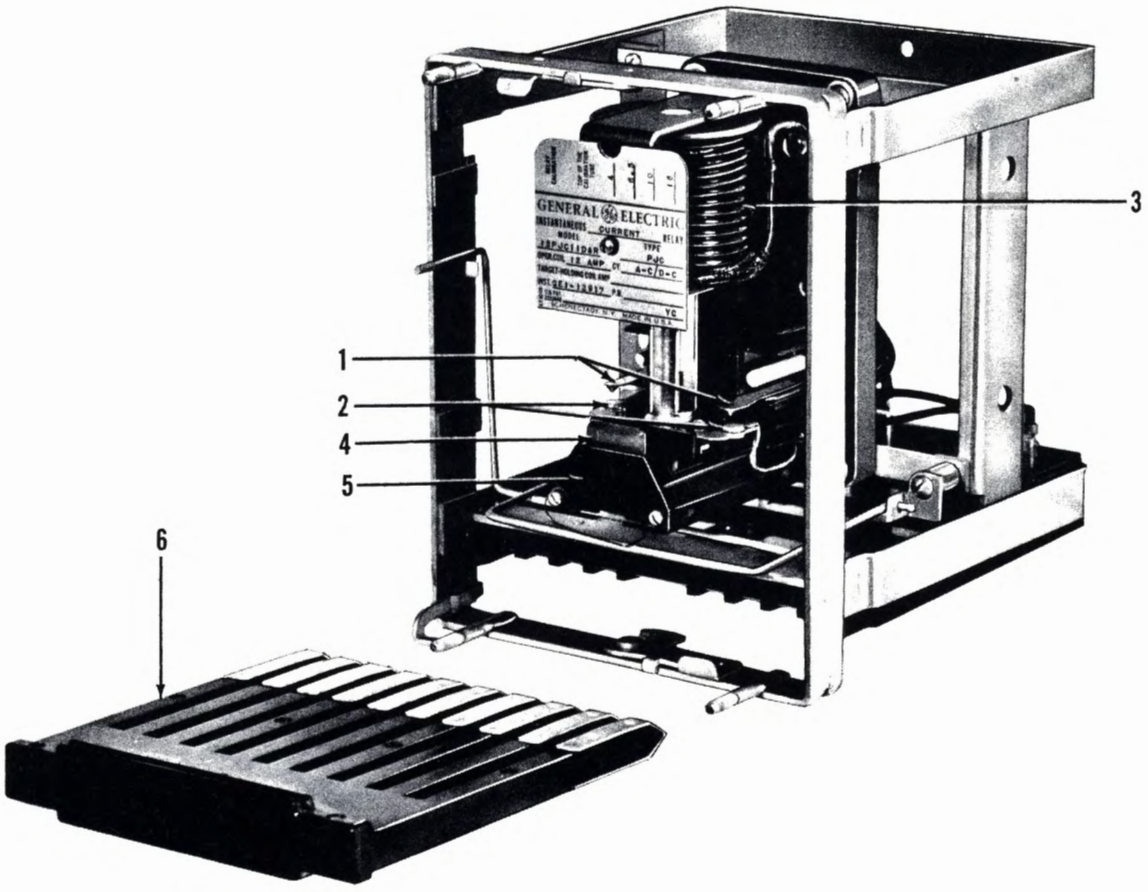


Fig. 2. Type PJC relay drawout construction-removable element

TYPE PJC INSTANTANEOUS OVERCURRENT RELAY

The following parts constitute those which are recommended for normal maintenance.

Reference No.	Catalog No.	Description
1	6174439G1	Stationary contact
2	6174440G1	Movable contact
3	+	Operating coil

The following parts are seldom required.

Reference No.	Catalog No.	Description
4	6140614	Target
5	6174438G2	Target shield
6	6118736G1	Connection plug
7	6054979G2	Cover with glass window
8	6178589P1	Glass window only
9	On Application	Case
10	6242045	Knurled stud for fastening cover
11	+	Outer contact block

+ Identified by Model No. of the Relay (see nameplate)

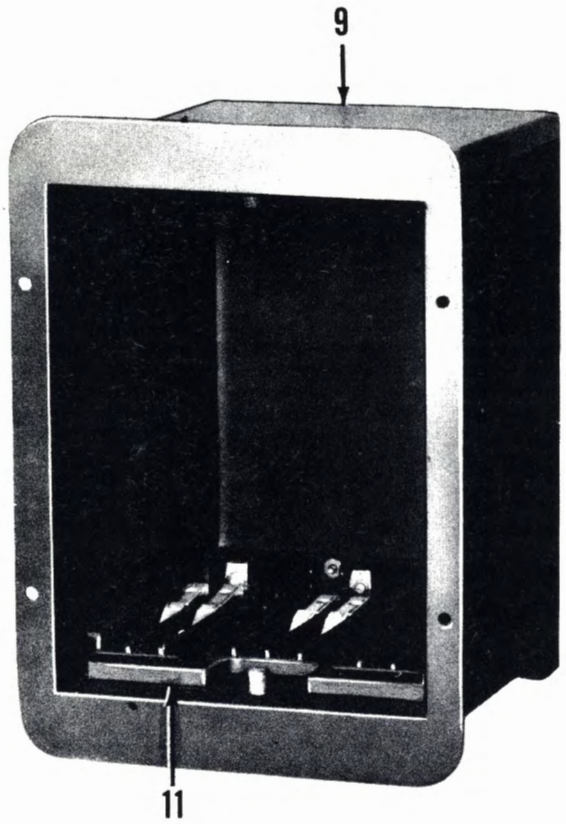


Fig. 3. Relay case

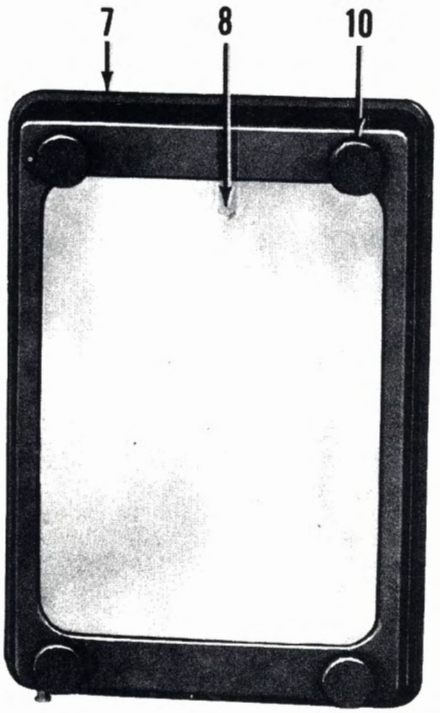
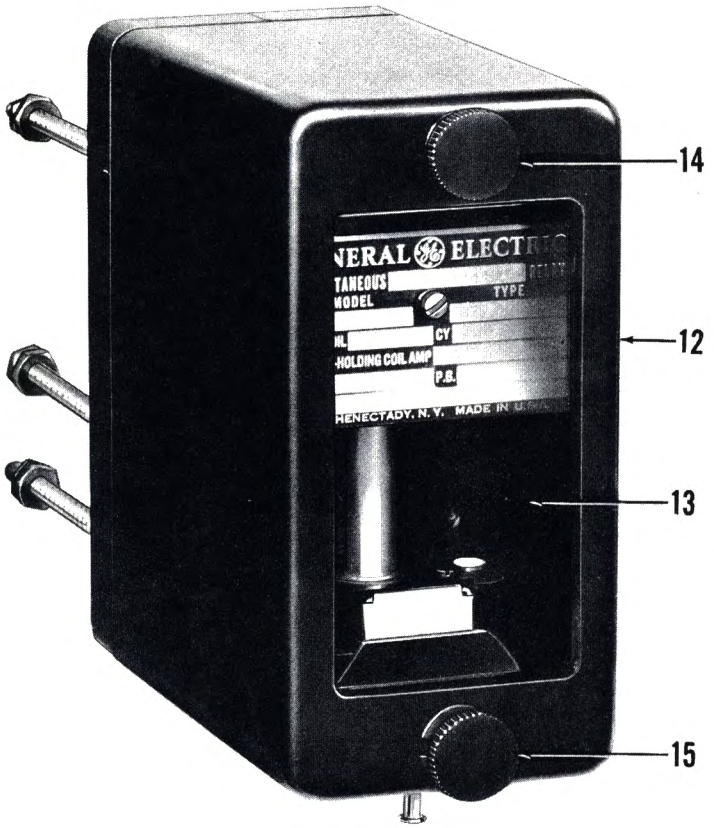


Fig. 4. Relay cover



Ref. No.	Cat. No.	Description
12	6174437G2	Moulded cover
13	6118588P3	Glass window for cover
14	6242162	Upper knurled stud for fastening cover
15	6140629P1	Lower knurled stud for fastening cover

Fig. 5. Type PJC relay-nondrawout construction

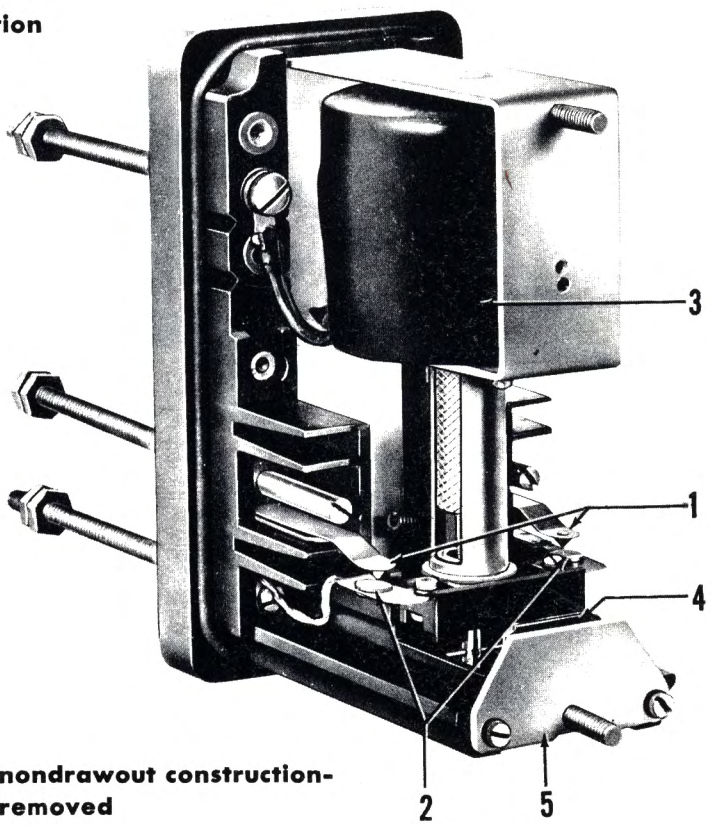
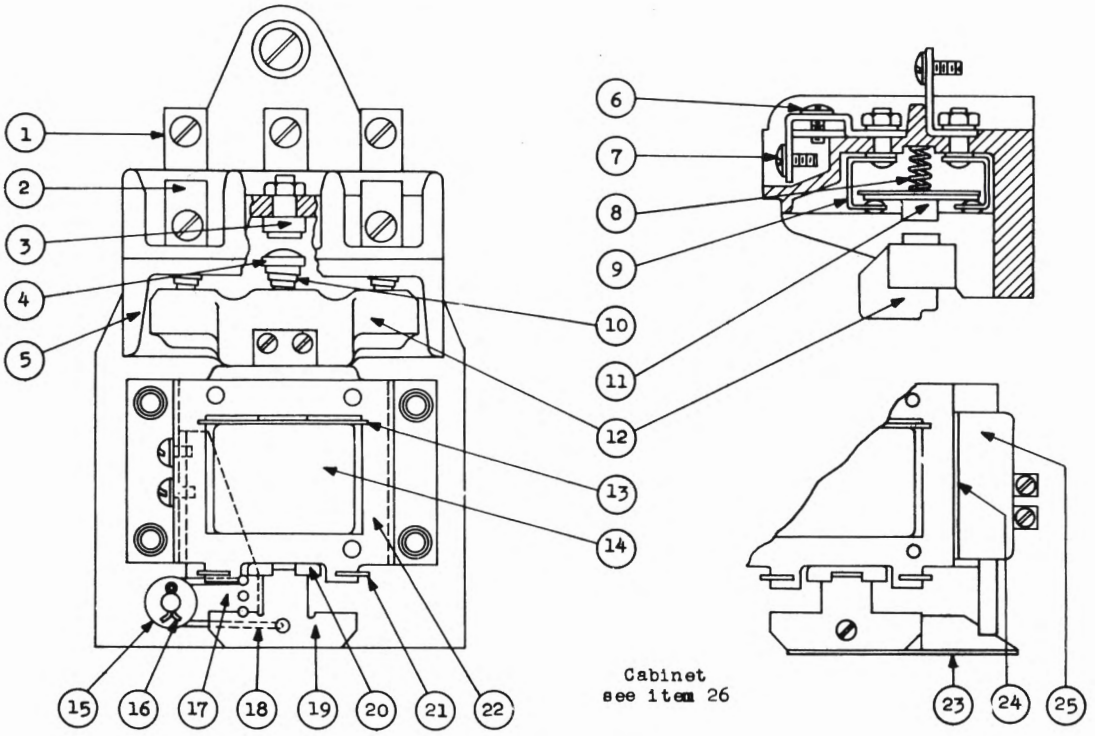


Fig. 6. Type PJC relay-nondrawout construction-cover removed

Note: For identification of parts, and Cat. Nos. for Ref. Nos. 1 to 5 inclusive, see tabulation on Page 3.

REPAIR PART LIST



Item	Part No.	Description of Part	Price
1	G-3848	Terminal (with Terminal Screw) (2)	$ .10
2	G-4488	Terminal (with Terminal Screw) (2)	.10
3	X-33519	Front Stationary Contact	.25
	X-35163	Rear Stationary Contact	.25
	M-1891	Stationary Contact Nut	.02
4	X-33552	Movable Contact	.35
5	F-12446	Contact Block only (2 Pole)	.50
	X-62265	Contact Block complete (2 N.O.)	1.90
	X-62399	Contact Block complete (1 N.O. - 1 N.C.)	3.00
	F-11610	Contact Block only (3 Pole)	.60
	X-49654	Contact Block complete (3 N.O.)	2.25
	X-49571	Contact Block complete (2 N.O. - 1 N.C.)	3.75
	F-11611	Contact Block only (4 Pole)	.75
	X-49661	Contact Block complete (4 N.O.)	3.50
	X-49573	Contact Block complete (3 N.O. - 1 N.C.)	5.00
	F-11612	Contact Block only (5 Pole)	1.00
	X-49662	Contact Block complete (5 N.O.)	4.50
	X-49575	Contact Block complete (4 N.O. - 1 N.C.)	6.00
6	M-1856	Terminal Screw	.01
7	M-1552	Terminal Screw	.01
8	B-10408	Spring	.10
9	X-47359	Terminal Assembly	.50
10	B-7615	Contact Spring	.10
11	X-47939	Contact Unit	.75
12	X-45125	Cross Bar only (2 N.O.)	.60
	X-50460	Cross Bar complete (2 N.O.)	1.50
	X-58675	Cross Bar only (1 N.O. - 1 N.C.) (1)	.60
	X-50456	Cross Bar complete (1 N.O. - 1 N.C.) (1)	1.00
	X-32836	Cross Bar only (3 N.O.)	.75
	X-35452	Cross Bar complete (3 N.O.)	2.00
	X-58671	Cross Bar only (2 N.O. - 1 N.C.) (1)	.75
	X-50455	Cross Bar complete (2 N.O. - 1 N.C.) (1)	1.65
	X-32377	Cross Bar only (4 N.O.)	1.00
	X-35453	Cross Bar complete (4 N.O.)	2.50
	X-58681	Cross Bar only (3 N.O. - 1 N.C.) (1)	1.00
	X-50458	Cross Bar complete (3 N.O. - 1 N.C.) (1)	2.25
	X-37025	Cross Bar only (5 N.O.)	1.50
	X-40604	Cross Bar complete (5 N.O.)	3.50
	X-58690	Cross Bar only (4 N.O. - 1 N.C.) (1)	1.50
	X-50462	Cross Bar complete (4 N.O. - 1 N.C.) (1)	3.25
	M-2225	Cross Bar Screw (with 1 M-1090 Washer)	.02
13	E-8676	Coil Clamp	.35
14	RC-34	Solenoid Coil (3)	2.50
15	B-11103	Bushing	.05
	M-1155	Iron Washer	.01
16	M-1112	Cotter Pin	.01
17	B-11802	Spring Pin Support (with 1 E-10301 Pin)	.70
18	B-11801	Spring	.30
19	X-62599	Plunger	1.75
20	E-8675	Plunger Guide	.75
21	E-9257	Shading Coil	.10
22	X-50278	Solenoid Base (with Vibration Dampers)	1.80
	X-32375	Solenoid Base (without Vibration Dampers)	1.70
	X-40657	Solenoid Base with Mounting Plate (with Vibration Dampers)	4.00
23	E-8370	Operating Angle (for Contactor with Right Hand Auxiliary Switch)	.20
	E-10248	Operating Angle (for Contactor with Left Hand Auxiliary Switch)	.20
	E-9387	Operating Angle (for Contactor with both Left & Right Hd. Aux. Switch)	.40
24	F-11053	Insulation	.10
25	X-44024	Right hand normally closed auxiliary switch	2.00
	X-44033	Left hand normally closed auxiliary switch	2.00
	X-44040	Right hand normally open auxiliary switch	2.00
	X-44050	Left hand normally open auxiliary switch	2.00
26		Cabinet Cover (Nema type 1)	.75
		Cabinet Base (Nema type 1)	1.40

N.O. Normally Open
N.C. Normally Closed
(1) These Cross Bars are the same as the standard Normally Open Cross Bars except that for the Normally Closed Auxiliary contact the metal insert on the extreme right has been cut off.
(2) Unless the terminal markings are specified, these parts will be furnished without markings.
(3) Specify Voltage and Frequency when ordering.

INFORMATION REQUIRED: Your order cannot be entered unless the following information is given; part number, description of part and the series or serial number of the contactor.

Prices are F.O.B. Milwaukee and subject to change without notice.

Our minimum charge on any order will be $1.00 net.

This repair part list applies also to the above contactor when used on control apparatus listed under other bulletin numbers.

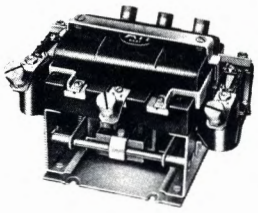
Supersedes PL-702-37, dated May 1, 1939

Parts for Magnetic Starters and Contactors

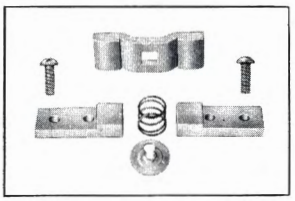
DISCOUNT SCHEDULE "MS"

SIZE 3

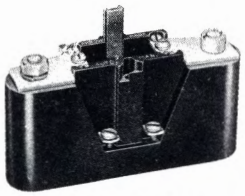
For Types "RA" and "RAC"



Starter



No. 38640-301



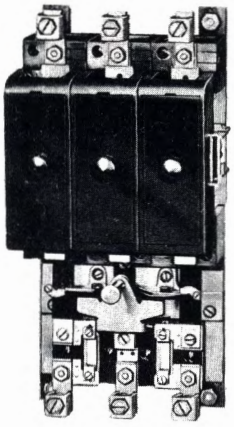
No. 38640-309

Catalog Number	Description
38640-301	Contacts, 1 Pole Set
38640-339	Tie Rod and Washer complete
38640-340	Terminal complete
37640-303	Auxiliary Switch
38640-309	Thermal Overload Relay Block

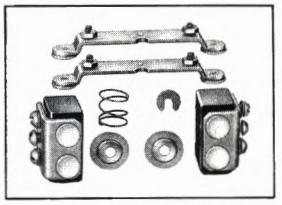
COILS

Catalog Number	Volts	Cycles
38640-501	110	50-60
38640-502	220 110	50-60 25
38640-503	440 220	50-60 25
38640-504	550 440	50-60 40
38640-505	110	40
38640-506	220	40
38640-507	550	40
38640-508	440	25
38640-509	550	25
38640-511	208	50-60

For Types "MC" and "CM"



Starter



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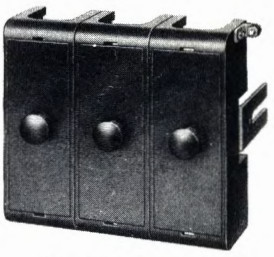

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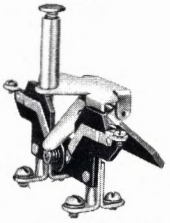


No. 28640-307

Catalog Number	Description
28640-313	Contacts, 1 Pole Set
28640-302	Hood
28501-303	Auxiliary Switch
28640-305	Contact Carrier, 3 Pole
28640-306	Contact Carrier, 4 Pole
28640-307	Reset Button
28640-309	Thermal Overload Relay Block, Left
28640-310	Thermal Overload Relay Block, Right

COILS

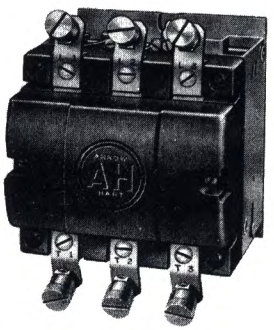
Catalog Number	Volts	Cycles
28640-80	110	50-60
28640-81	220 110	50-60 25
28640-82	440 220	50-60 25
28640-83	550 440	50-60 40
28640-236	550	25

A.C. Magnetic Contactors, Type "RAC"

DISCOUNT SCHEDULE "MS"

SIZE 3
RATINGS

Volts	Maximum H. P. 110	220	440-550	Amperes, Non-Inductive With Enclosure	Without Enclosure
Single Phase	7½	15	25	90 Amps. per circuit	100 Amps. per circuit
Polyphase	15	30	50		



No. 38675-U

The new Type "RAC" (Right Angle) Contactors incorporate these new and exclusive features: Patented Right-Angle Balanced Mechanism. • Shock and vibration resistant. • Hardened roller-bearing joints. • Smallest size 3 Contactor available. • Has the largest size contacts. • Ample line contact capacity. • Contacts fully enclosed—keeps out dirt and dust. • Front accessible terminals and contacts. • Low wattage operation. • Air Cooled construction.

This new, improved design combines all the benefits of gravity release solenoid, and horizontal action type controls in a single compact unit incorporating the advantages listed above.

This new design provides quick, easy hook-ups, long life and low maintenance cost. The patented mechanical design is compact, sturdy and dependable, both mechanically and electrically.

WITH ENCLOSURE

Catalog Number 50-60 Cycles	Volts	Poles	Box No.	Weight Each
38670 **38674**	110	2 3	179 NEMA Type 1	26
38671 **38675**	220	2 3		
38672 **38676**	440	2 3		
38673 **38677**	550	2 3		

WITHOUT ENCLOSURE

Catalog Number 50-60 Cycles	Volts	Poles	Weight Each
38670-U **38674-U**	110	2 3	16
38671-U **38675-U**	220	2 3	
38672-U **38676-U**	440	2 3	
38673-U **38677-U**	550	2 3	

3-Wire Instrument Control—Will be supplied on order. Add "P" to the catalog number. Voltage must be specified. See general price list for addition.

Separate Coil Circuit—Specify "For Separate Coil Circuit" and give coil voltage.

Dimensions and Knockouts: Length 13⅛", Width 11⅛", Depth 6 5/16". Knockouts: Back, four; Two ½" and Two 1¼"-1½"; Top and Bottom, three; Two ½"-1¼"-1½" and One 1½"-2"; Sides, Two each, ½"-1¼"-1½".

Coils for Magnetic Contactors, Type "RAC"

DISCOUNT SCHEDULE "MS"

SIZE 3

Catalog Number	Volts	Cycles
38640-501	110	50-60
38640-502	220 110	50-60 25
38640-503	440 220	50-60 25
38640-504	550 440	50-60 40
38640-505	110	40
38640-506	220	40
38640-507	550	40
38640-508	440	25

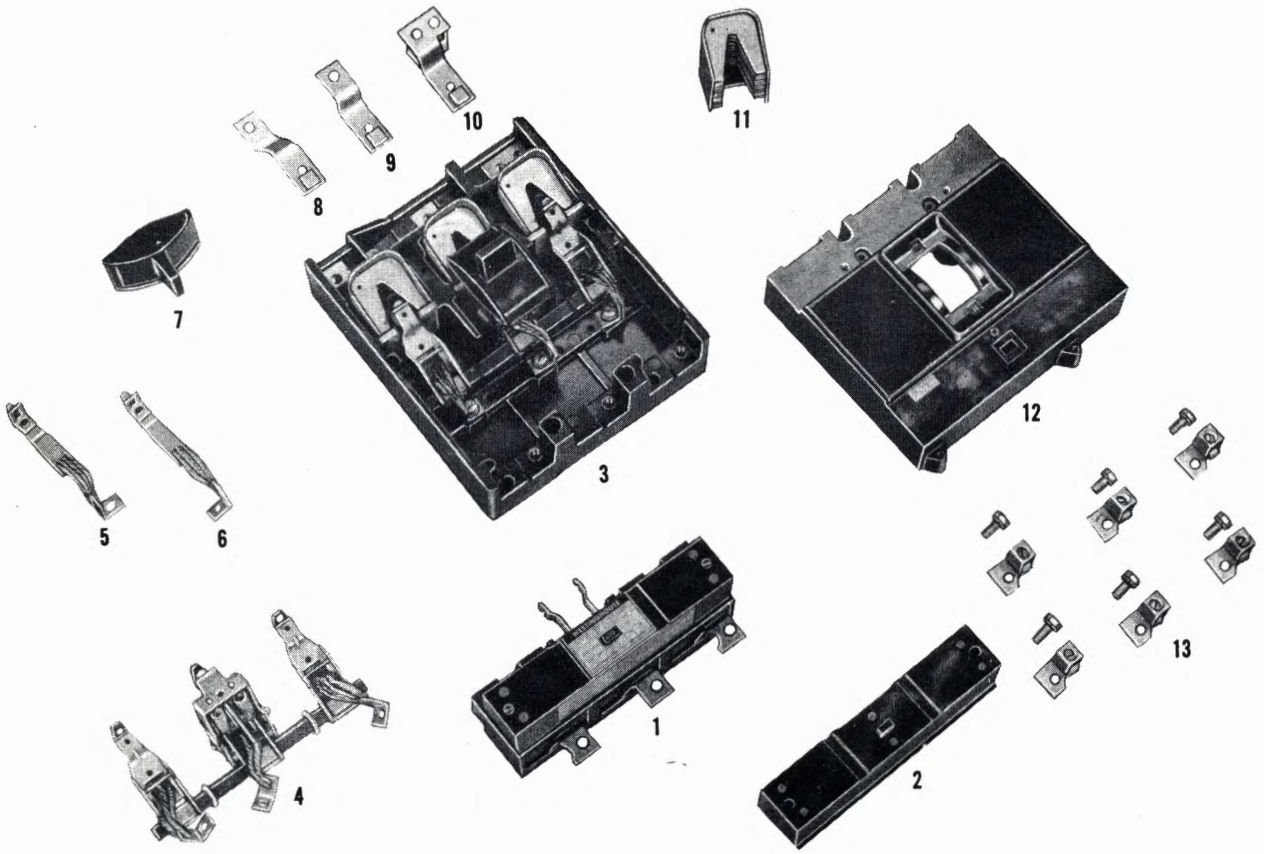
TYPE AB NOFUZE "DE-ION" AIR CIRCUIT BREAKERS

100 AMPERE G FRAME

Front Connected

MANUALLY OPERATED—MAGNETIC OR THERMAL—MAGNETIC TRIP OR NON-AUTOMATIC

Three Pole



NOTE: Underwriters seal must be broken when Breaker is repaired in the field.

TYPE AB NOFUZE "DE-ION" AIR CIRCUIT BREAKERS
100 AMPERE G FRAME
Front Connected
MANUALLY OPERATED—MAGNETIC OR THERMAL—MAGNETIC TRIP OR NON-AUTOMATIC
Three Pole

Continuous Ampere Rating	Volts A-C	Volts D-C	Breaker Complete Style Number	Volts A-C	Volts D-C	Breaker Complete Style Number	Adjustable Magnetic Trip Setting	Trip Unit Type	Trip Unit Style
35*	250	125/250	999 135	600	250	999 175	250-600	Thermal-magnetic	999 195
50	250	125/250	999 136	600	250	999 176	250-600	Thermal-magnetic	999 196
70	250	125/250	999 137	600	250	999 177	280-800	Thermal-magnetic	999 197
90	250	125/250	999 138	600	250	999 178	330-1000	Thermal-magnetic	999 198
100	250	125/250	999 139	600	250	999 179	350-1100	Thermal-magnetic	999 199
100 non-auto	250	125/250	999 110	600	250	999 112	none	Non-automatic	1107 234
100	250	125/250	999 130	600	250	999 170	250-600	Magnetic	999 190
100	250	125/250	999 131	600	250	999 171	350-1100	Magnetic	999 191
100	250	125/250	999 114	600	250	999 103	650-2200	Magnetic	999 113

* Not listed with Underwriters Laboratories

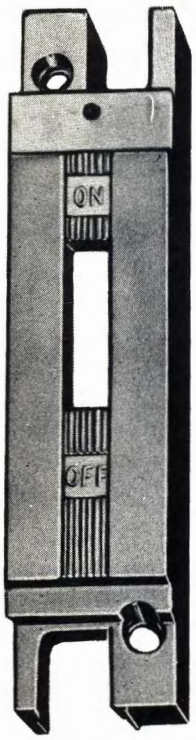
Ref No.	Description of Part	Style Number 250 Volt A-C or 125/250 Volt D-C	Style Number 600 Volt A-C or 250 Volt D-C	No. Req
	Breaker Complete.	See Table	See Table	1
1	Trip Unit Complete	See Table	See Table	1
2	Trip Unit Cover (Magnetic & Thermal-Magnetic)	894 048	894 048	1
3	Breaker Frame Complete with Trip Unit and Terminals.	1072 244	1072 019	1
4	Three-pole Moving Contact Assembly. . .	1072 443	1072 443	1
5	Moving Contact and Shunt - Left-Hand.	1072 445	1072 445	1
6	Moving Contact and Shunt - Center	1072 498	1072 498	1
6	Moving Contact and Shunt - Right Hand	1072 498	1072 498	1
**	Moving Contact Spring.	1072 255	1072 255	
7	Moulded Handle.	1020 604	1020 604	1
8	Stationary Conductor with Arcing Contact - Left Hand	894 176	894 176	1
9	Stationary Conductor with Arcing Contact - Center.	894 177	894 177	1
10	Stationary Conductor with Arcing Contact - Right Hand.	894 175	894 175	1
11	Arc Chamber	1400 198	1400 197	3
12	Cover Complete.	1107 324	1107 324	1
13	Set of Solderless Terminals (Pressure Type Connectors)	1107 229	1107 229	1

** Not Illustrated.

Parts indented are included in the part under which they are indented.

ORDER PARTS BY DESCRIPTION AND STYLE NUMBER AND GIVE COMPLETE NAMEPLATE READING.

TYPE AB NOFUZE "DE-ION" AIR CIRCUIT BREAKERS
50 AMPERE E FRAME
Front Connected
MANUALLY OPERATED—OVERLOAD TRIP
Three Pole



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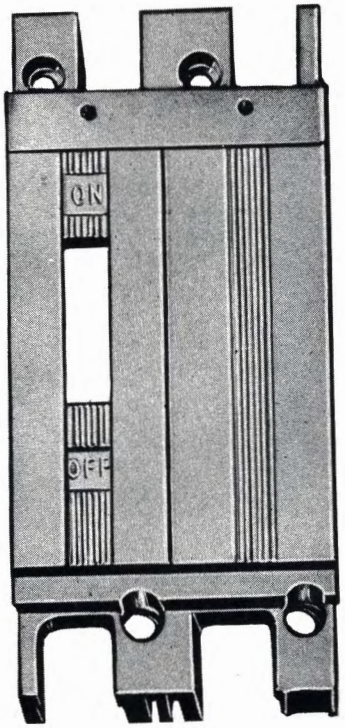

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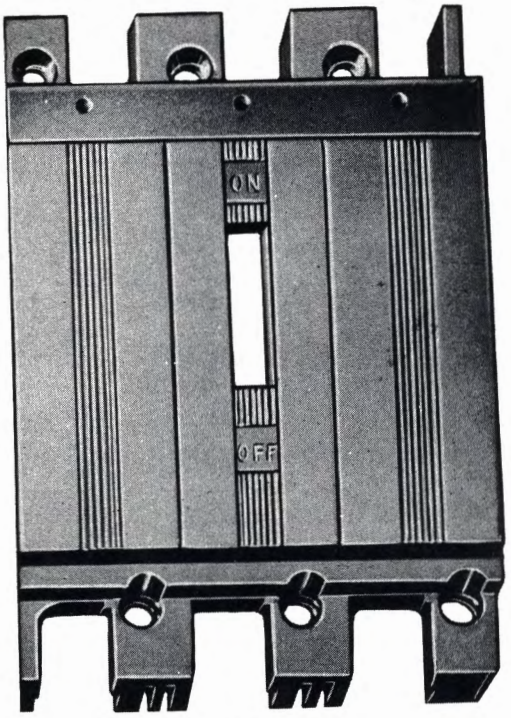

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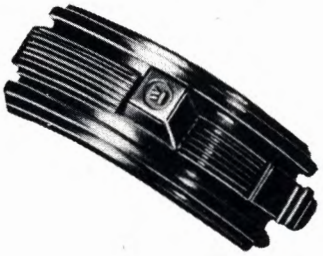
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NOTE: Underwriters seal must be broken when Breaker is repaired in the field.

TYPE AB NOFUZE "DE-ION" AIR CIRCUIT BREAKERS

50 AMPERE E FRAME

Front Connected

MANUALLY OPERATED—OVERLOAD TRIP

Three Pole

Ampere Rating	Single Pole Complete Breakers			Two Pole Complete Breakers			Three Pole Complete Breakers		
	Volts		Style Number	Volts		Style Number	Volts		Style Number
	A-C	D-C		A-C	D-C		A-C	D-C	
* 5	125	125	998 998	250	125/250	998 995	250	125/250	998 999
* 8	125	125	999 061	250	125/250	998 996	250	125/250	999 062
*10	125	125	999 001	250	125/250	999 081	250	125/250	999 021
15	125	125	999 002	250	125/250	999 082	250	125/250	999 022
15	277	125	999 092	--	--	--	--	--	--
20	125	125	999 003	250	125/250	999 083	250	125/250	999 023
20	277	125	999 093	--	--	--	--	--	--
25	125	125	999 004	250	125/250	999 084	250	125/250	999 024
30	125	125	999 008	250	125/250	999 088	250	125/250	999 028
35	125	125	999 005	250	125/250	999 085	250	125/250	999 025
50	125	125	999 006	250	125/250	999 086	250	125/250	999 026
50 Non-auto	250	125	1107 736	250	125/250	1107 737	250	125/250	1107 738
*70	125	125	999 007	250	125/250	999 087	250	125/250	999 027
*70 Non-auto	--	--	--	--	--	--	600	250	1420 086

* Not listed with Underwriters Laboratories

Ref No.	Description of Part	Style Number	Number Required
	Breaker Complete.	See Table	1
1	Cover (Single Pole)	970 773	1
1†	Cover (Single Pole)	††	1
2	Cover (Two Pole).	1020 613	1
3	Cover (Three Pole).	970 775	1
4	Eyelet to attach Cover. . .	971 103	2 Per Pole
5	Handle.	970 781	1

† Used only on 277 Volt A-C, 125 Volt D-C breakers

†† Not styled - when ordering give style of complete breaker

Parts indented are included in the part under which they are indented

ORDER PARTS BY DESCRIPTION AND STYLE NUMBER AND GIVE COMPLETE NAME PLATE READING.

RADIO CORPORATION OF AMERICA

ENGINEERING PRODUCTS DIVISION CAMDEN, N. J.