

Western Electric

RADIO
TRANSMITTER

No. 6-B

INSTRUCTIONS
FOR USE

No. 6-B
RADIO TRANSMITTER

The equipment described in this Bulletin
was designed and developed for the

Western Electric Company

by

BELL TELEPHONE LABORATORIES

No. 6-B

RADIO TRANSMITTER

INSTRUCTIONS
FOR USE



Western Electric Company

Instruction Bulletin No. 409

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No. 6-B Radio Transmitter Assembly

No. 6-B RADIO TRANSMITTER

Instructions for Use

DESCRIPTION OF APPARATUS

INTRODUCTION

As the demand for better service to the broadcast listener has increased, the use of inadequate transmitting equipment has largely been discontinued. Between the extremes of too small power on the one hand and costly high-power installations on the other there is a field where the requirement is to serve well an area of moderate size. It is for this field that the No. 6-B Radio Transmitter is especially suitable; it has an output of 1,000 watts capable of complete modulation and requires a space comparable to previous 500-watt installations. Incorporated in its design are the latest improvements developed by Bell Telephone Laboratories for Western Electric Company.

The transmitter may be operated at any frequency from 500 to 1,500 kilocycles corresponding to wave lengths from 600 to 200 meters, respectively. The equipment is designed to operate from either alternating current supply of three-phase, 220 volts, 50 or 60 cycles or direct current supply of either 115 or 230 volts.

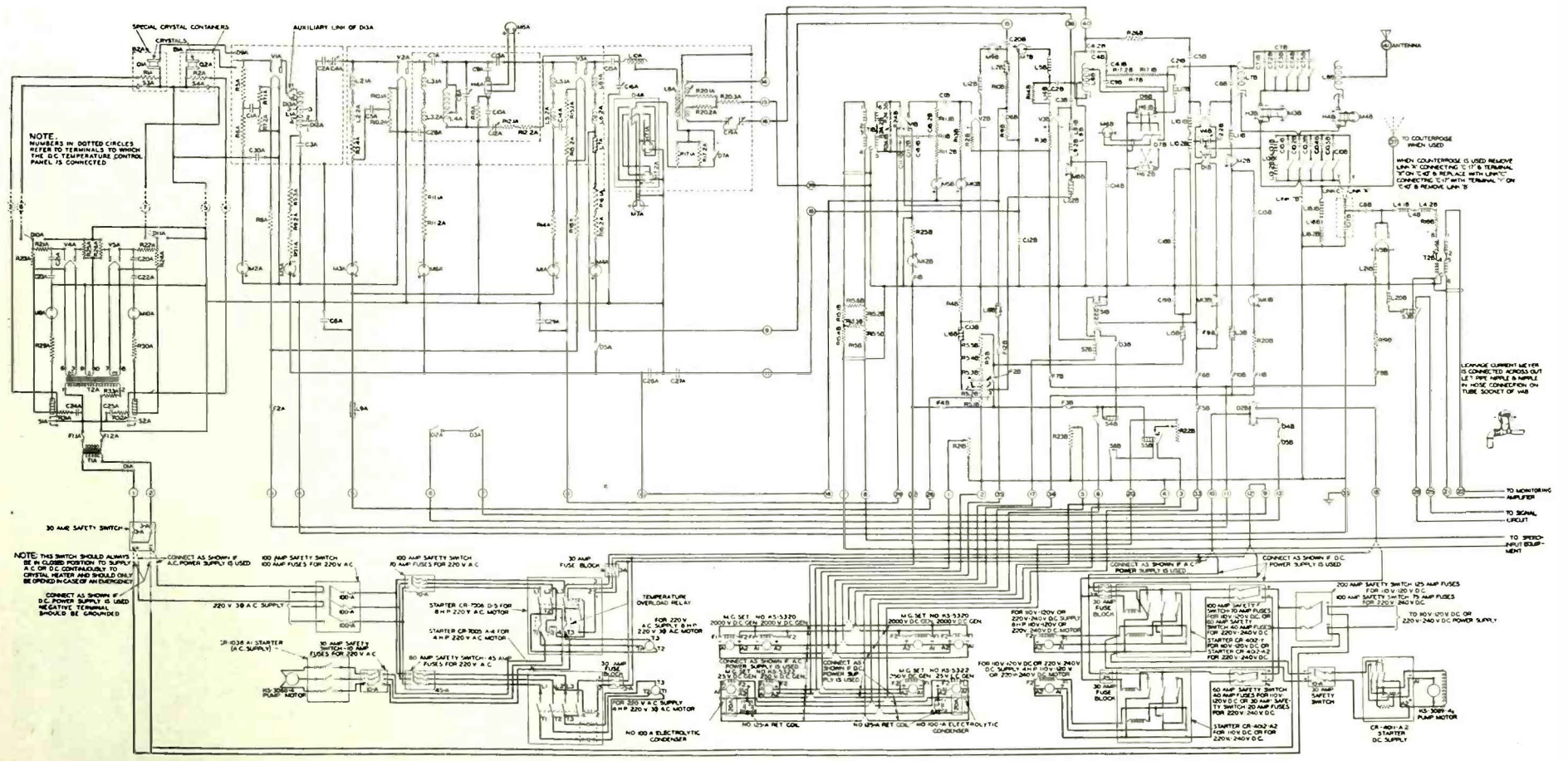
The piezo-electric crystal controlled master oscillator and associated equipment which is incorporated in the No. 6-B Radio Transmitter, provides a means for close maintenance of the assigned frequency at all times. The crystal is a small quartz plate ground with parallel faces to a thickness which is associated with the frequency of its mechanical vibration. Since this frequency is somewhat dependent on the temperature of the crystal the latter is held at an extremely constant temperature so that it is possible to maintain the frequency within very close limits.

The following instructions describe the transmitter, explain the functions of the various integral parts, the theory of operation, the proper method of adjustment, operation and maintenance, and methods of locating and correcting troubles.

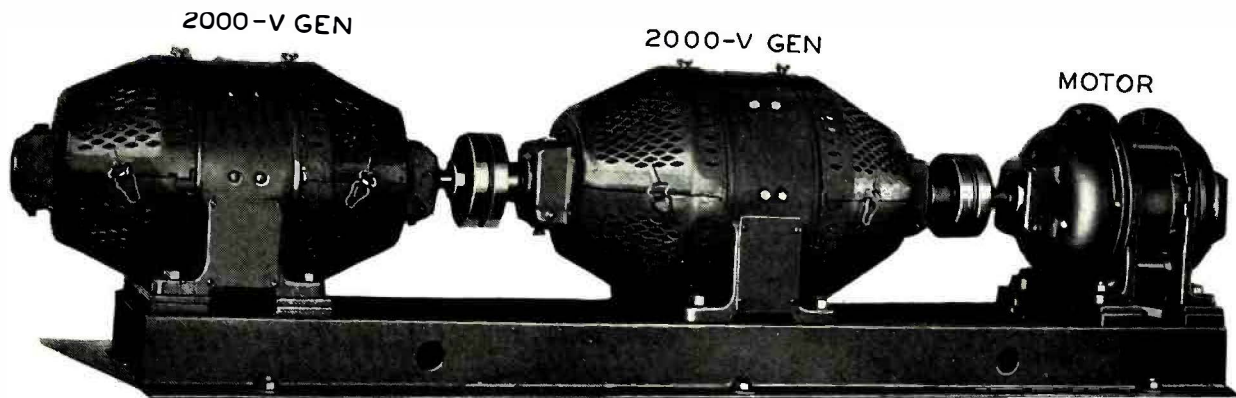
GENERAL DESCRIPTION OF APPARATUS

The No. 6-B Radio Transmitter consists of two units installed as shown on the preceding page and on page 3. The panel unit on the left-hand side facing the front of the transmitter contains the crystal oscillator with its associated circuits and temperature control equipment, and two stages of radio fre-

[4]



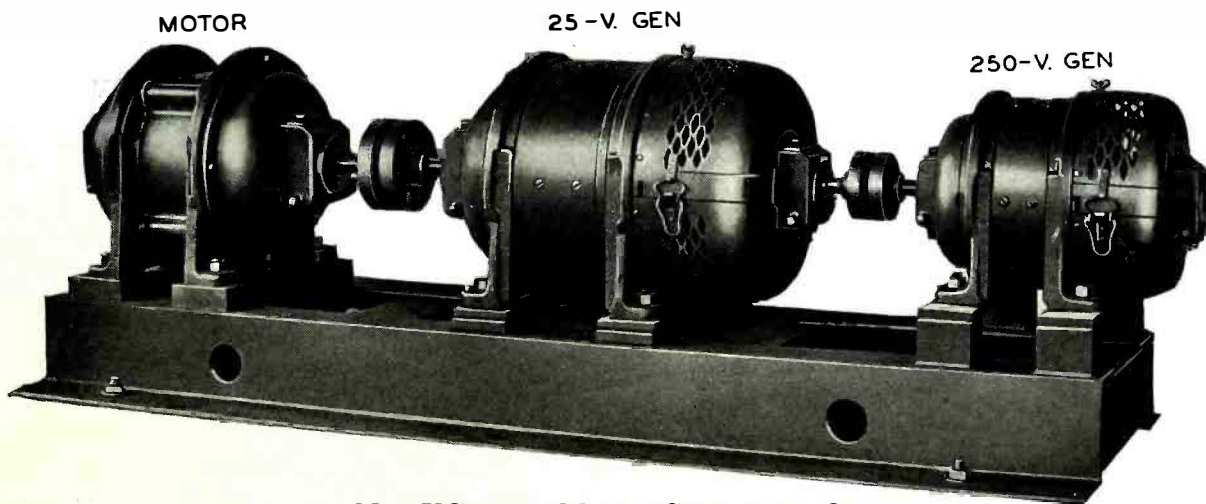
Schematic Diagram of the No. 6-B Radio Transmitter and Power Equipment



No. KS-5320 Motor Generator Set

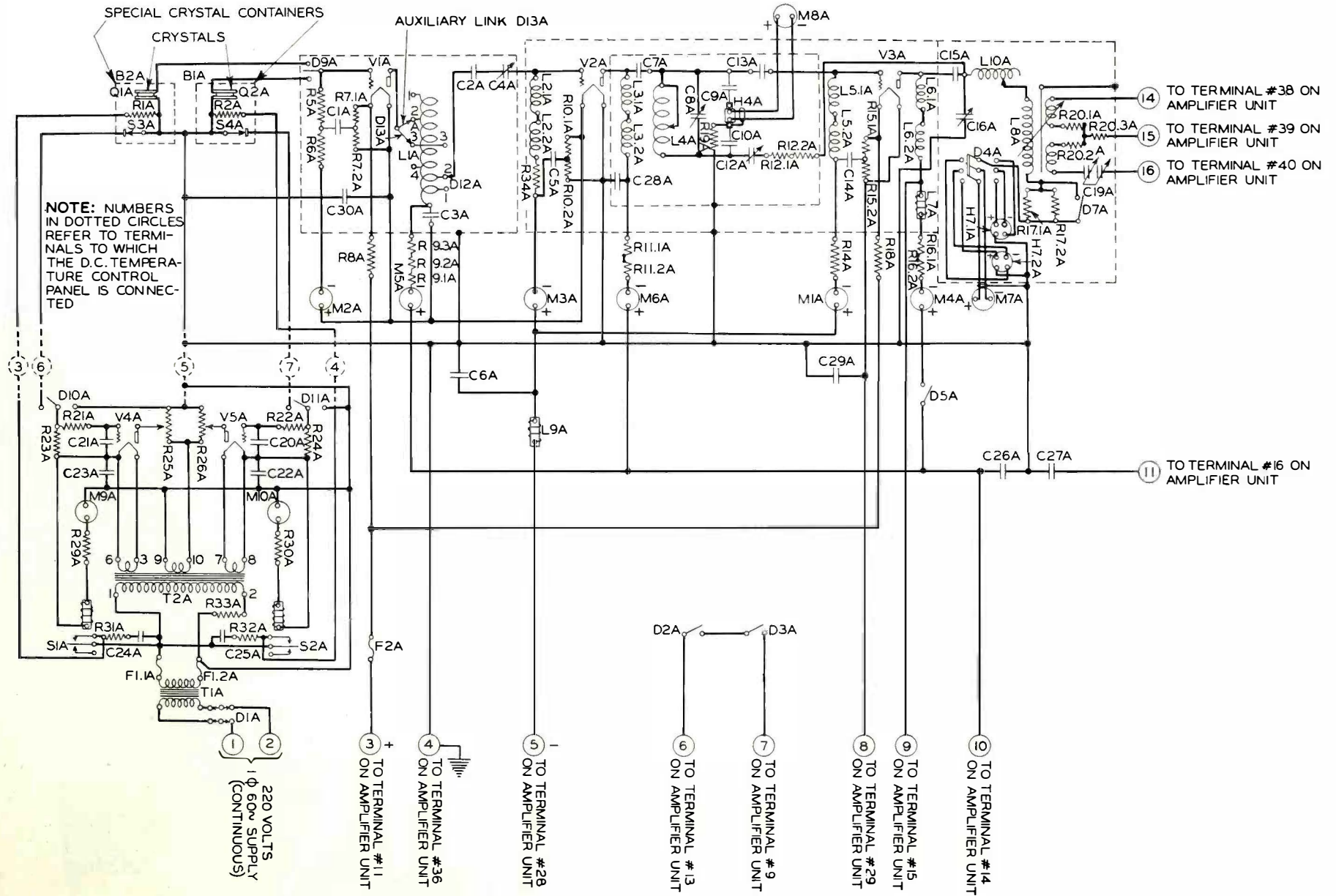
quency power is amplified by two successive stages of amplification and thence it is transferred by means of a suitable coupling circuit to the antenna system. Connection between the Oscillator and Amplifier Units is accomplished by a radio frequency transformer with variable coupling. This transformer, located in the Oscillator Unit, provides a convenient means of controlling the radio frequency input and, consequently, the output of the Amplifier Unit. Wiring and schematic diagrams of the No. 6-B Radio Transmitter and Power Equipment are shown on pages 73 (wiring) and 4 and 71 (schematic).

The power operating the No. 6-B Radio Transmitter is supplied by two motor-generator sets. One set (KS-5320), shown above, is composed of a motor driving two 2,000-volt generators. One generator supplies power at 2,000 volts which is reduced by means of suitable series resistances, to the proper operating voltages for the No. 248-A and No. 212-D Vacuum Tubes. The two 2,000-volt generators connected in series supply power at 4,000 volts to the No. 228-A Vacuum Tube. The other motor-generator set (No. KS5322), shown below, is composed of a motor driving one 25-volt generator and one 250-volt generator. The 25-volt generator furnishes filament power to all vacuum tubes except those associated with the temperature control equipment. The 250-volt generator supplies the constant grid bias voltage for the vacuum tubes, the excitation voltage for the 2,000-volt generators, and the voltage for some control circuits.



No. KS-5322 Motor Generator Set

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Schematic Diagram of the No. D-87738 Oscillator Unit with AC Temperature Control Panel

A filter circuit composed of one No. 125-A Retardation Coil (see page 25) and two No. 100-A Electrolytic Filter Condensers (see page 23) is inserted in the 25-volt generator supply circuit for the purpose of reducing the commutator ripple.

A closed water circulating system, shown schematically on page 50, is provided with the No. 6-B Radio Transmitter for dissipating the heat developed by the No. 228-A Vacuum Tube during operation. This water circulating system consists of a No. KS-3068 Water Circulating Pump (see page 51), a radiator, an expansion tank, control valves and the necessary piping to connect the system to the transmitter together with a No. 226-A Relay located in the Amplifier Unit (see page 49). The water circulating system, the 25-volt generator filter equipment and the two motor-generator sets are usually installed in a room separate from the transmitter, in order to facilitate maintenance of moving parts during operation, and to isolate the noise and vibration of the rotating machinery.

Adequate protection is afforded the operating personnel. The panels are of a dead-front type, and the apparatus mounted thereon is bakelite encased, or grounded. The opening of either the front window panels or the rear screen doors operates safety switches which function to shut down the motor-generator sets, thus removing all voltage from the transmitter. The vacuum tube circuits are protected by fuses, a water flow relay, a time delay relay, and an overload relay.

Control of the power supply to the entire transmitter is obtained by means of a "MASTER CONTROL" push button switch located on the amplifier panel. By operating this switch the circuits of the magnetic starters are energized and the motor-generator sets are started. The operation of the motor-generator sets energizes several relay circuits, and the various transmitter circuits are made operative in the proper sequence.

The preceding description indicates in a general way the essential equipment of the No. 6-B Radio Transmitter. The function and the operation of the various parts in the circuits of the Oscillator and Amplifier Units are outlined in detail in subsequent paragraphs.

NO. D-87738 OSCILLATOR UNIT

The Oscillator Unit, shown on pages 8 to 13 inclusive, houses the piezoelectric crystal oscillators mounted in heat insulated chambers, the temperature control equipment, the crystal oscillator vacuum tube with its associated circuits, and the first and second radio frequency amplifiers with their associated circuits. In describing this unit, reference is made to the schematic and wiring diagrams of the Oscillator Unit shown on pages 75 (wiring) and 6 and 74 (schematic).

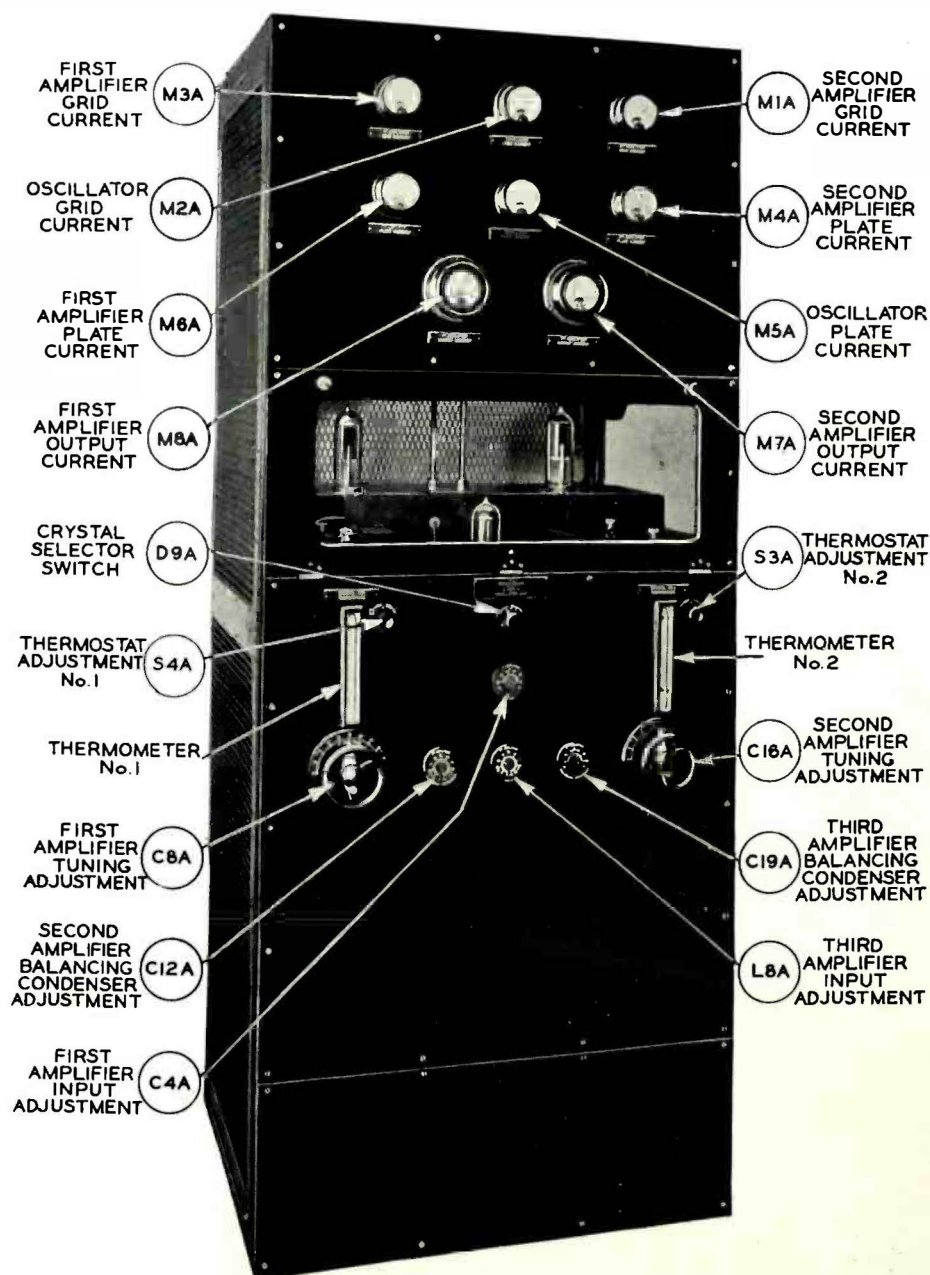
Filament Power Supply Circuits

The filaments of oscillator tube V1A and first amplifier tube V2A are connected in series, and the filaments of second amplifier tube V3A in the Oscillator

Unit and speech amplifier tube V1B in the Amplifier Unit are also connected in series. These two series circuits with the series filament resistances R8A and R18A are connected in parallel and receive their supply by connecting terminals 3 and 4 of the Oscillator Unit to terminals 11 and 36, respectively, of the Amplifier Unit.

The filaments of vacuum tubes V4A and V5A of the AC temperature control panel in the Oscillator Unit receive their power supply from the filament windings of transformer T2A.

The DC temperature control panel has the filament of vacuum tube V6A connected in series with the filament of V7A, the series resistances R36.1A, R36.2A, R37.1A, R37.2A, and the grid bias resistance R35A. This series circuit is connected through fuses F1.1A and F1.2A and snap switch D1A to terminals 1 and 2.



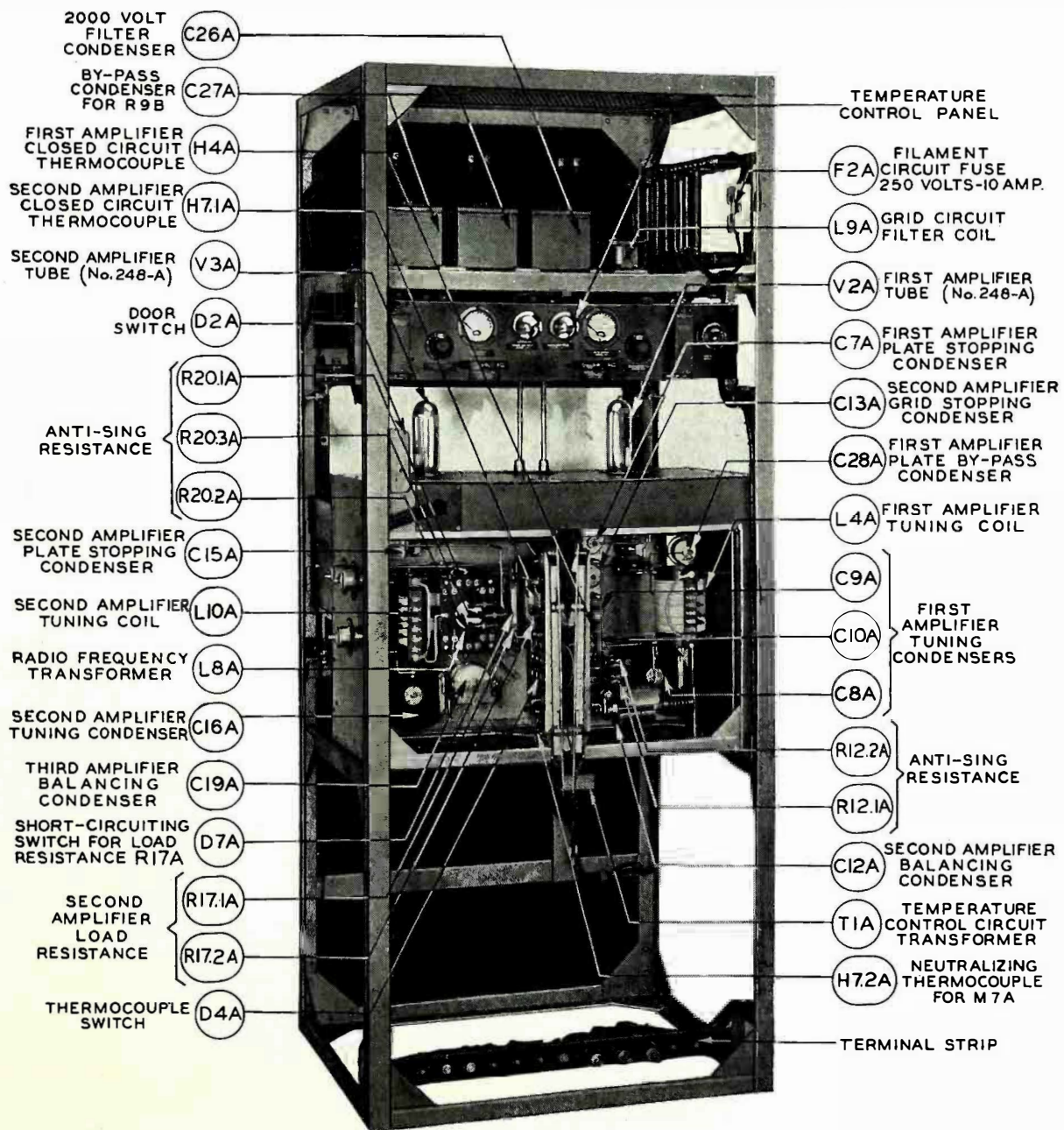
No. D-87738 Oscillator Unit—Front View

Grid Bias Supply Circuits

The grid bias voltage for the Oscillator Unit is obtained from grid bias potentiometer R5B in the Amplifier Unit. Connection is effected to this potentiometer through terminal 5 on the Oscillator Unit and terminal 28 on the Amplifier Unit. A filter consisting of retardation coil L9A and condenser C6A is connected in the supply lead from terminal 5 to the grid circuits of the vacuum tubes in the Oscillator Unit.

Plate Power Supply Circuits

The high voltage for the Oscillator Unit is obtained from the high voltage generators supplying the Amplifier Unit. This voltage is made available by

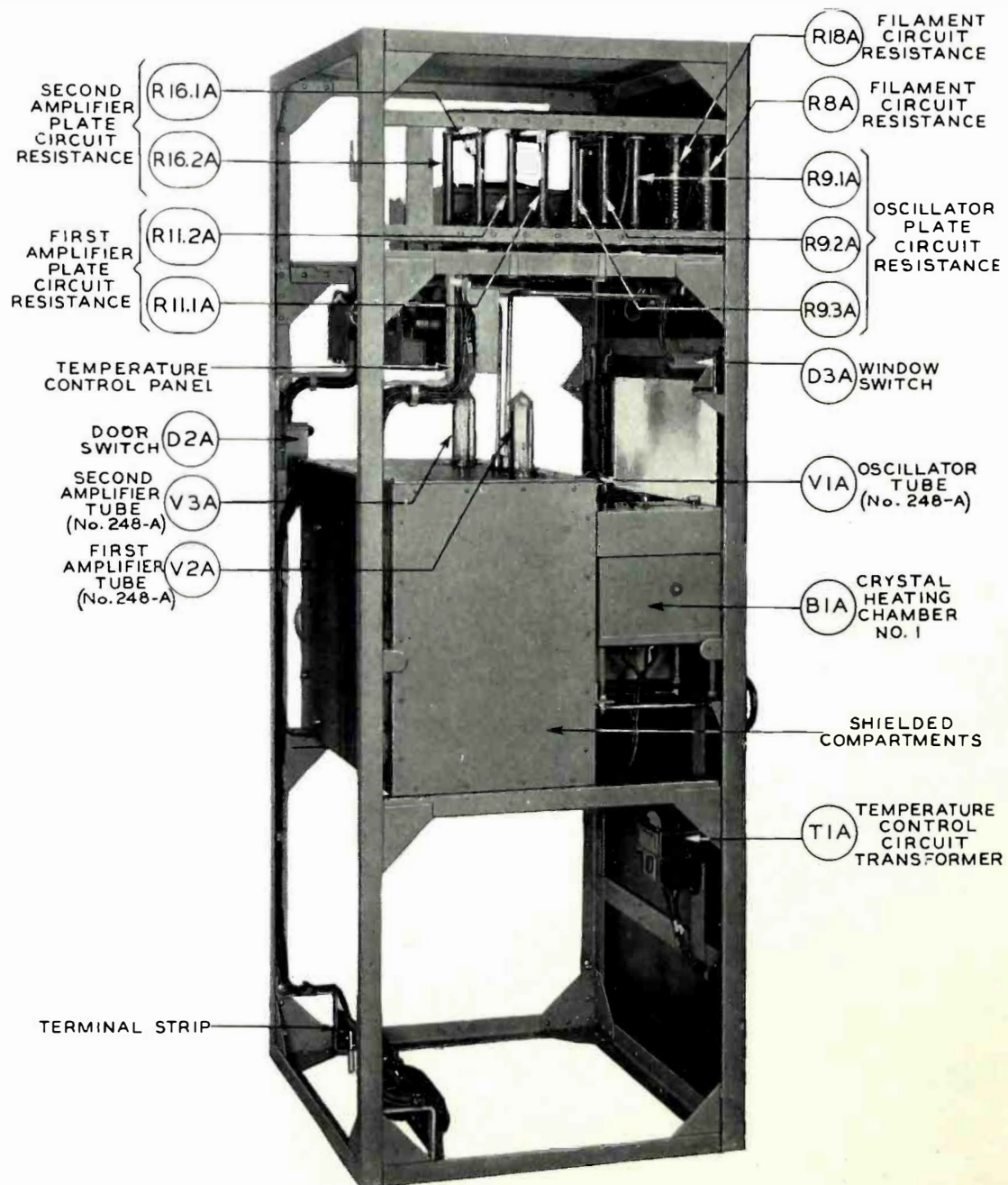


No. D-87738 Oscillator Unit—Rear View

connecting terminals 10 and 4 of the Oscillator Unit to terminals 14 and 36, respectively, of the Amplifier Unit. Condenser C26A is a high voltage (2,000-volt) filter condenser.

Protection

In order to protect the operating personnel, door switches D2A and D3A are provided in the Oscillator Unit and are connected in series with the control circuits of the Amplifier Unit. When the rear screen door or the front window panel is opened, the motor-generator sets are shut down, thus removing all voltage from the Oscillator Unit.



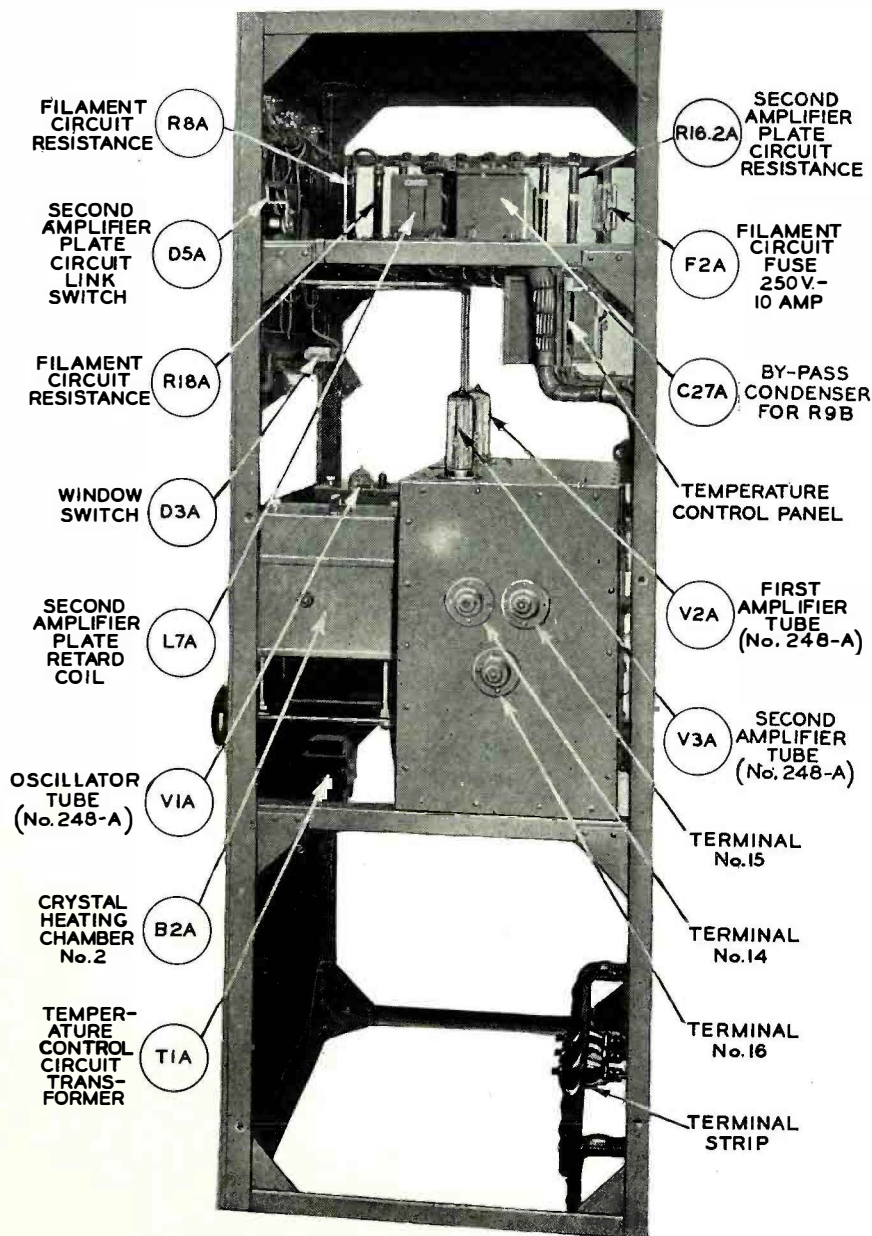
No. D-87738 Oscillator Unit—Left Side View

The filament circuit is protected by fuse F2A connected in the filament supply lead between terminal 3 and the filaments of the vacuum tubes in the Oscillator Unit.

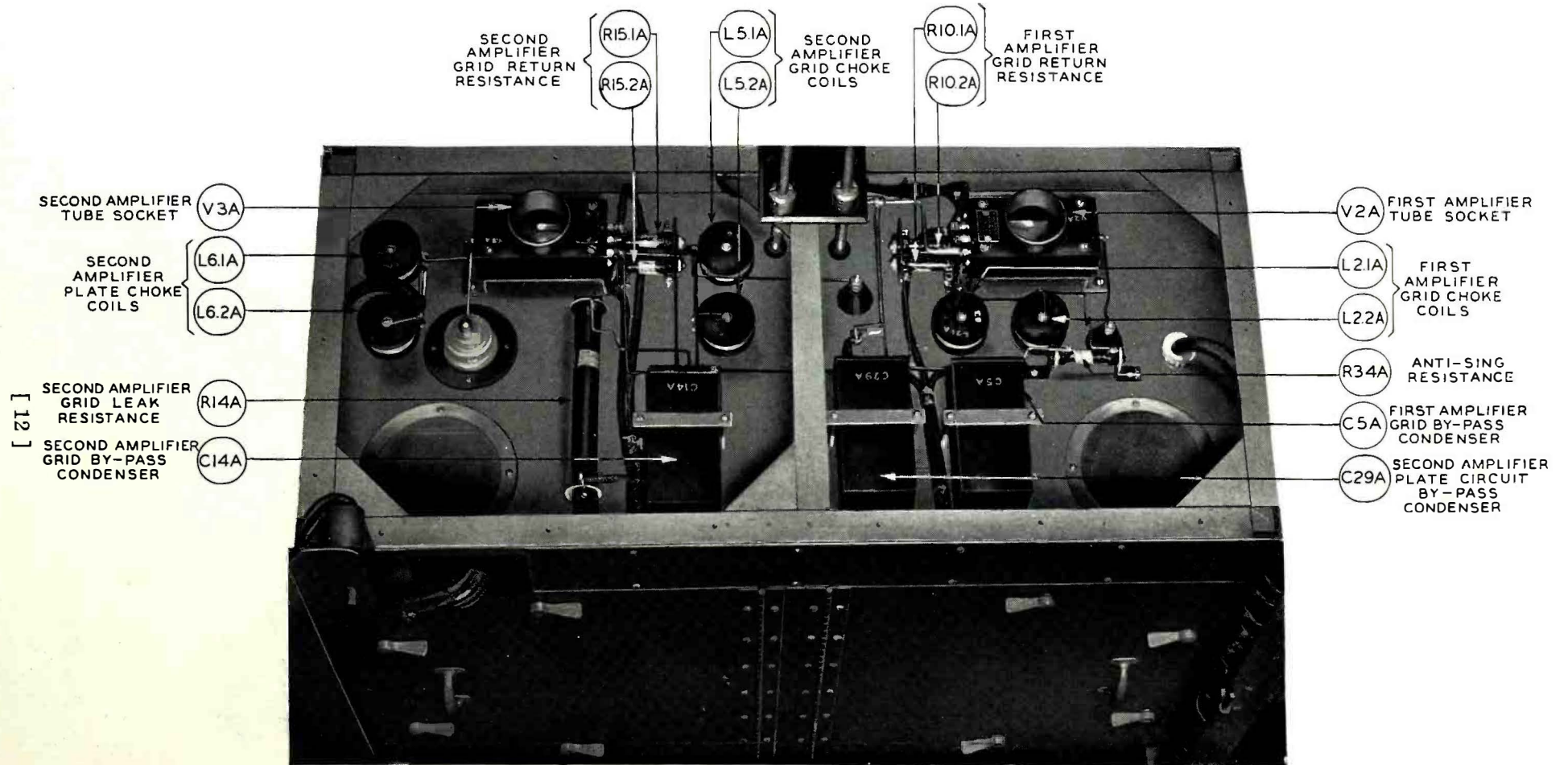
The high voltage supply circuit for the Oscillator Unit is protected by fuse F12B located in the Amplifier Unit.

The AC temperature control equipment is protected by fuses F1.1A and F1.2A connected in the primary circuit of transformer T2A. Transformer T1A is protected by the connection of its primary winding through snap switch D1A and through terminals 1 and 2 to a fused safety switch.

The DC temperature control equipment is protected by fuses F1.1A and F1.2A which connect to snap switch D1A. The connection between terminals 1 and 2 of the Oscillator Unit and the source of power supply is protected by a fused safety switch.



No. D-87738 Oscillator Unit—Right Side View



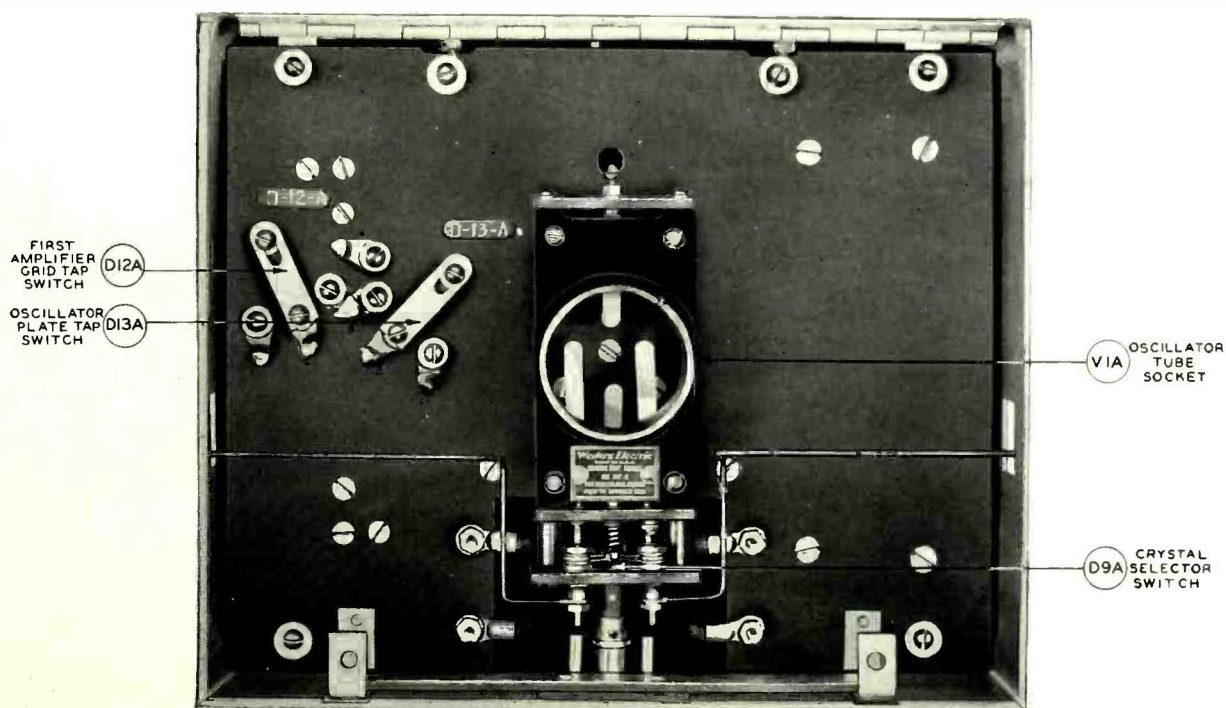
No. D-87738 Oscillator Unit—View of Upper Shielded Compartment

Piezo-electric Crystal Oscillator

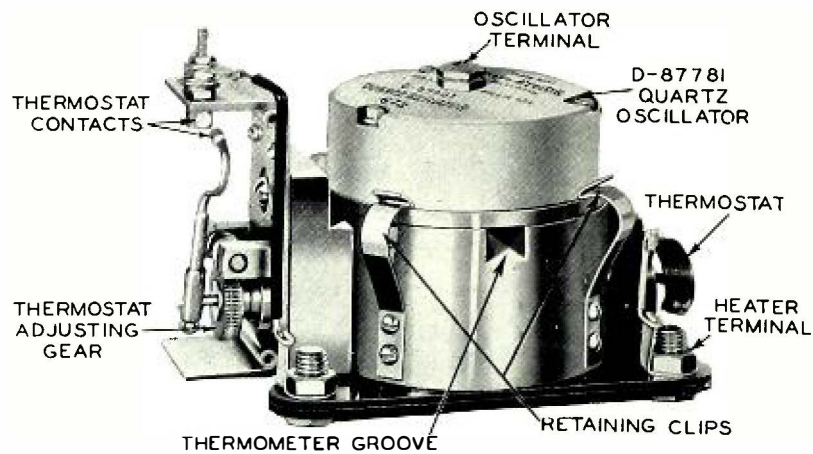
The crystal oscillator has one of two piezo-electric quartz crystals having the same frequency, connected in the grid circuit of the No. 248-A Oscillator Vacuum Tube designated as V1A. The other crystal remains in readiness for operation so that in the event of failure occurring in the first crystal, the second can be connected in the circuit by means of "CRYSTAL SELECTOR" switch D9A controlled from the front of the oscillator panel. These crystals are mounted in heat insulated chambers located on either side of the shielded compartment housing the oscillator circuit. Each chamber is capable of being maintained at a constant temperature by means of the temperature control equipment provided. In parallel with the crystal there is connected the circuit consisting of grid leak resistance R5A, filter resistance R6A, and grid current meter M2A. The direct current flowing in the grid circuit is indicated by Meter M2A marked "OSCILLATOR GRID CURRENT."

The plate circuit of V1A receives its DC supply from the 2,000-volt generator through plate current meter M5A, plate feed resistances R9.1A, R9.2A, and R9.3A, and inductance coil L1A. This voltage is reduced to the proper value by series plate feed resistances R9.1A, R9.2A, and R9.3A. The plate current supplied to the crystal oscillator vacuum tube is indicated by meter M5A marked "OSCILLATOR PLATE CURRENT."

An untuned circuit is used as the output circuit of the crystal oscillator. Taps are provided on the output coil which permit an adjustment to be made for satisfactory operation of the crystal oscillator. The radio frequency grid voltage for the first amplifier is obtained directly from the output coil by means of taps. Access to the plate and input taps on the output coil is obtained through the panel window on the Oscillator Unit.



No. D-87738 Oscillator Unit—Top View of Oscillator Compartment



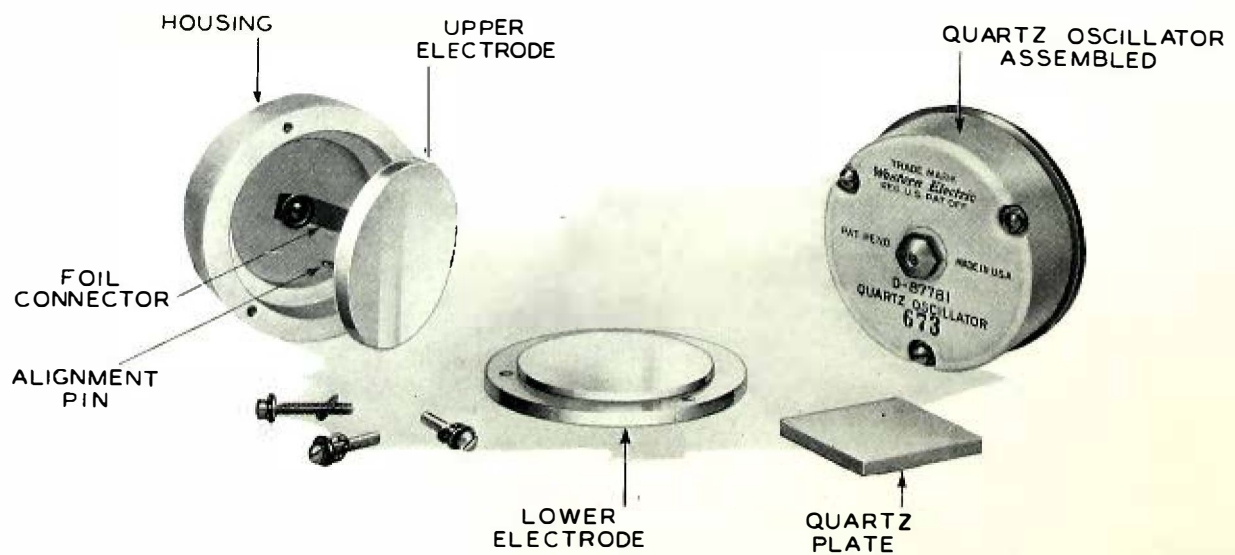
Thermal Element with a No. D-87781 Quartz Oscillator Mounted

No. D-86767 Crystal Heater Unit

The chambers in which the piezo-electric crystals are mounted, are designed so that the temperature of the crystals is maintained within close limits, thus assuring constancy of the carrier frequency.

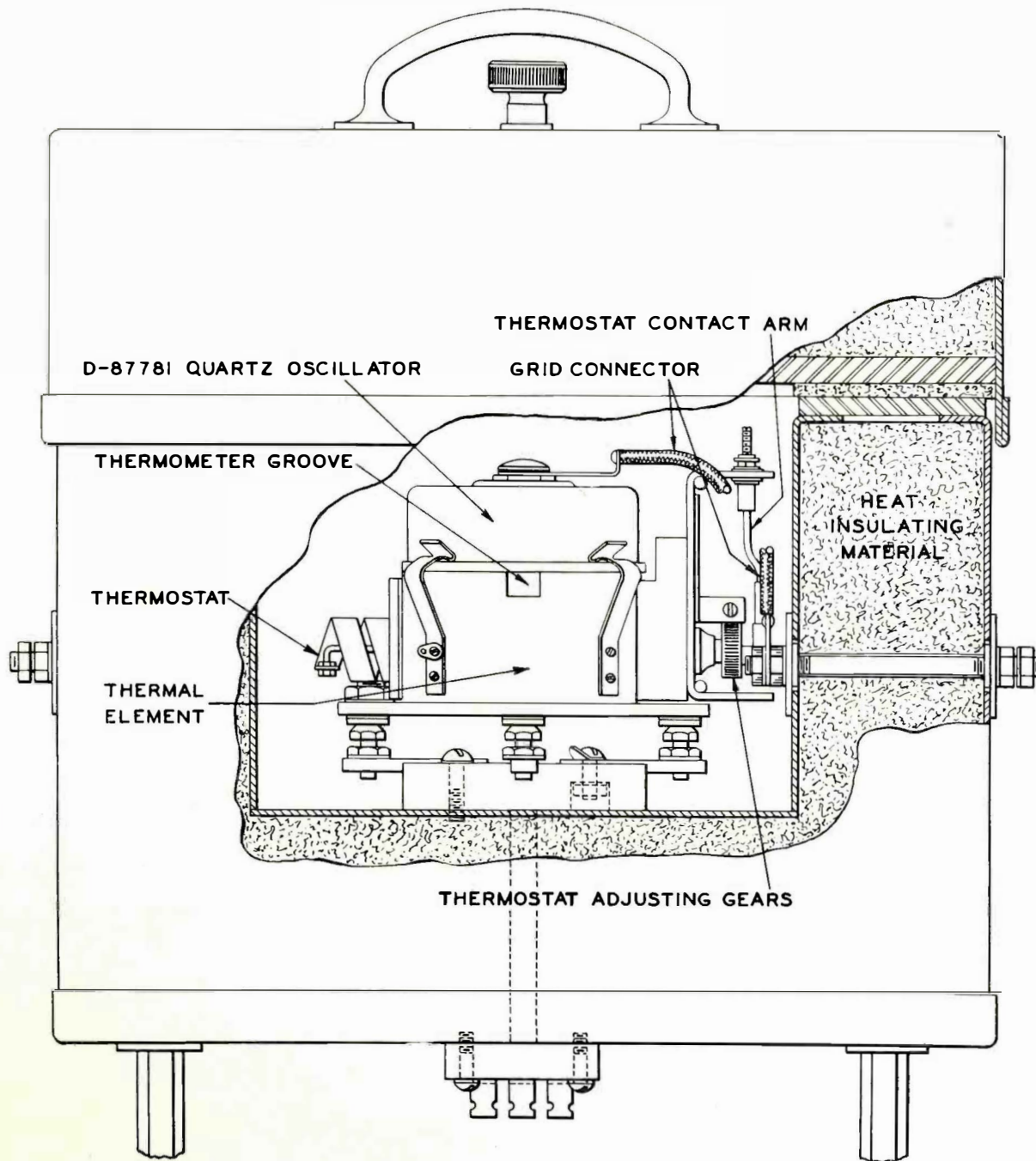
Each crystal is placed between two electrodes, indicated as the upper and lower electrode (see below). A housing retains the two electrodes and the crystal in place. The upper electrode, which connects to the oscillator terminal by means of copper foil, is prevented from rotating by the alignment pin. The lower electrode fastens to the housing by means of the three assembly screws. This assembly is known as the No. D-87781 Quartz Oscillator and is shown in the illustration at the top of the page.

The No. D-87781 Quartz Oscillator is held securely to a metal mounting block by means of metal retaining clips which fasten to the protruding edge of the lower electrode. If the retaining clips do not have sufficient tension they should be squeezed towards the center of the metal block. DO NOT BEND THE

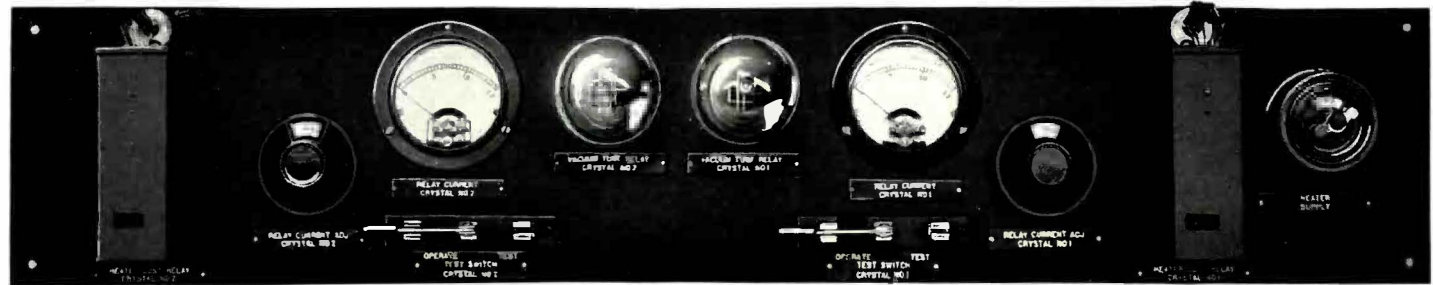


No. D-87781 Quartz Oscillator

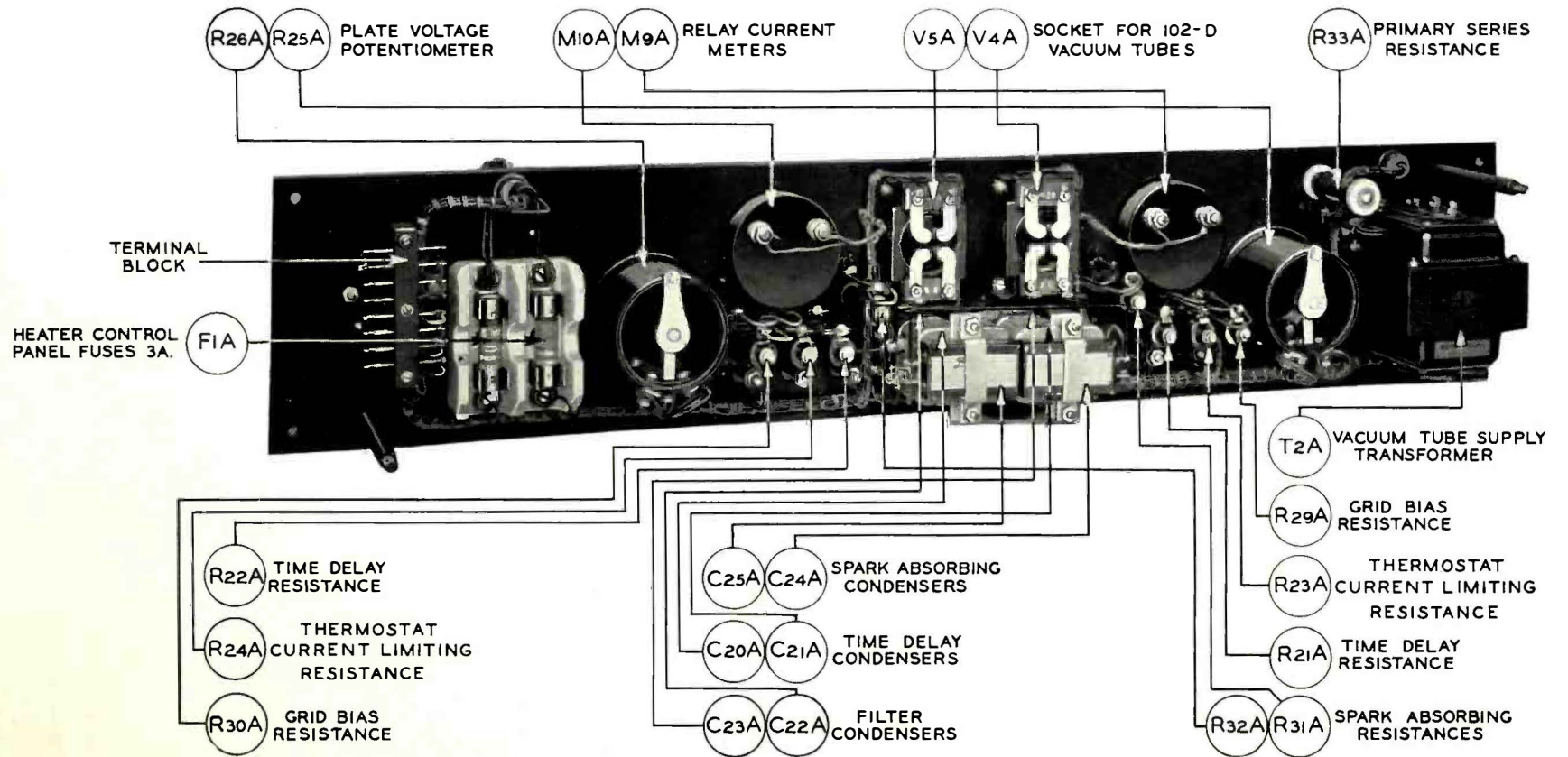
CLIPS. The metal mounting block contains a heater and thermostat. The assembly consisting of the heater, the thermostat and the metal block is known as the Thermal Element. The thermal element together with the No. D-87781 Quartz Oscillator may be removed from the heat insulated chamber as a unit, and is mounted inside of the chamber, as shown below, by means of jack pins which provide connection to circuits external to the chamber. The assembly consisting of the heat insulated chamber, the thermal element, and the No. D-87781 Quartz Oscillator, is known as the No. D-86767 Crystal Heater Unit and is shown assembled on page 14. The thermostat operates in conjunction with the temperature control equipment which opens or closes the heater circuits, depending upon the temperature of the metal mounting block. This



No. D-86767 Crystal Heater Unit Assembly



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AC Temperature Control Panel

temperature is indicated by a thermometer inserted in a groove in the metal mounting block. The thermometer, which has a right angle bend and extends through to the front panel of the Oscillator Unit.

Temperature Control Panel (see page 16)

In the No. D-86767 Crystal Heater Unit the thermostat controls the heater current through the aid of a Vacuum Tube Relay. This arrangement permits of sensitive thermostatic temperature control. The vacuum tube relay is essentially a vacuum tube with a sensitive relay connected in its plate circuit. The thermostat is so arranged that as it opens and closes, it changes the negative grid bias of the vacuum tube. This changes the plate current sufficiently to operate a relay whose contacts are inserted in series with the heater circuit.

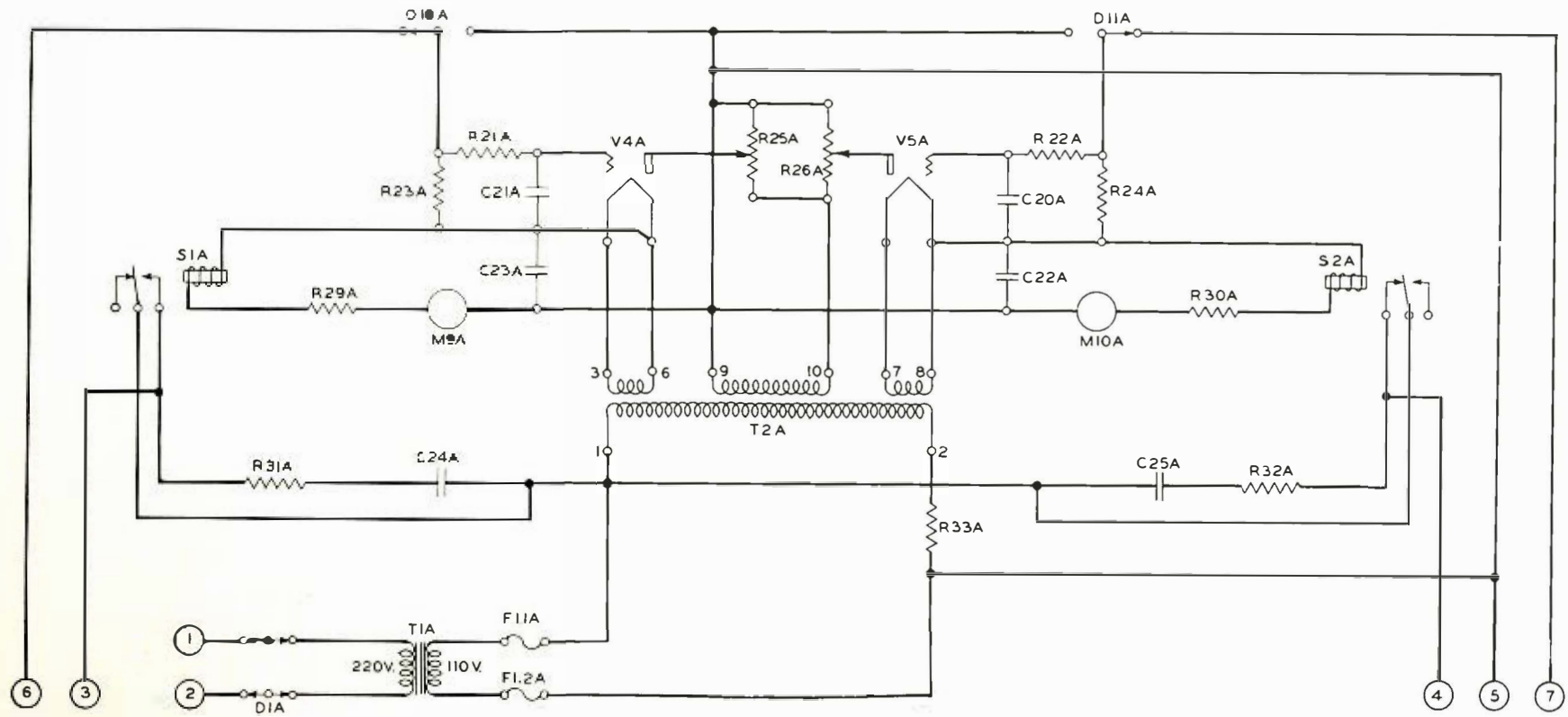
With the exception of the No. D-86767 Crystal Heater Unit and the thermometer, the temperature control equipment is mounted on a panel in the rear of the Oscillator Unit. This equipment is furnished for either alternating current or direct current power supply. The AC panel receives its power supply from terminals 1 and 2 through snap switch D1A, transformer T1A, and fuses F1.1A and F1.2A. The DC panel receives its power supply from terminals 1 and 2 through snap switch D1A and fuses F1.1A and F1.2A. Terminals 1 and 2 are connected to either a continuous source of 220-volt, 50- or 60-cycle, single-phase AC power supply, 115-volt DC power supply, or 230-volt DC power supply. This connection provides power supply to the temperature control circuits at all times, regardless of whether or not the transmitter is in operation. Continuous operation of the temperature control equipment is necessary, as a period of several hours is required for the crystals to attain constant operating temperatures.

Each type of temperature control equipment is provided in duplicate, one for each of the heat insulated chambers, hence, only one circuit of each type will be described.

AC Temperature Control Panel

(Wiring Diagram, page 79, and Schematic Diagram, pages 18 and 78.)

The AC temperature control panel has the filament of V4A supplied by the filament winding of transformer T2A. An AC voltage obtained from the plate winding of transformer T2A is impressed across potentiometer R25A. This provides a variable AC voltage for the plate of V4A. The vacuum tube relay consists essentially of the No. 102-D Vacuum Tube designated V4A and relay S1A in its plate circuit. The DC plate circuit is completed from one terminal of potentiometer R25A through DC meter M9A marked "RELAY CURRENT," grid bias resistance R29A and relay S1A to the filament of V4A. A spark absorbing circuit consisting of condenser C24A and resistance R31A is connected across the contacts of relay S1A. Condenser C23A is a filter condenser used to smooth out the rectified AC. The grid of V4A is connected through resistances R21A and R23A to its filament. To prevent chattering and irregular operation of the relay,



Schematic Diagram of the AC Temperature Control Panel.

the time delay circuit composed of condenser C21A and resistance R21A is connected in the grid circuit. Resistance R23A is a current limiting resistance for thermostat S3A. The heater Unit R1A, located in the heat insulated chamber, receives its power supply from the secondary of transformer T1A. The single-pole double-throw switch marked "TEST SWITCH" is used for testing and adjusting the operation of the control circuits. The adjustment of the AC temperature control circuit is outlined on page 36.

DC Temperature Control Panel

(Wiring Diagram, page 81, and Schematic Diagram, pages 20 and 80.)

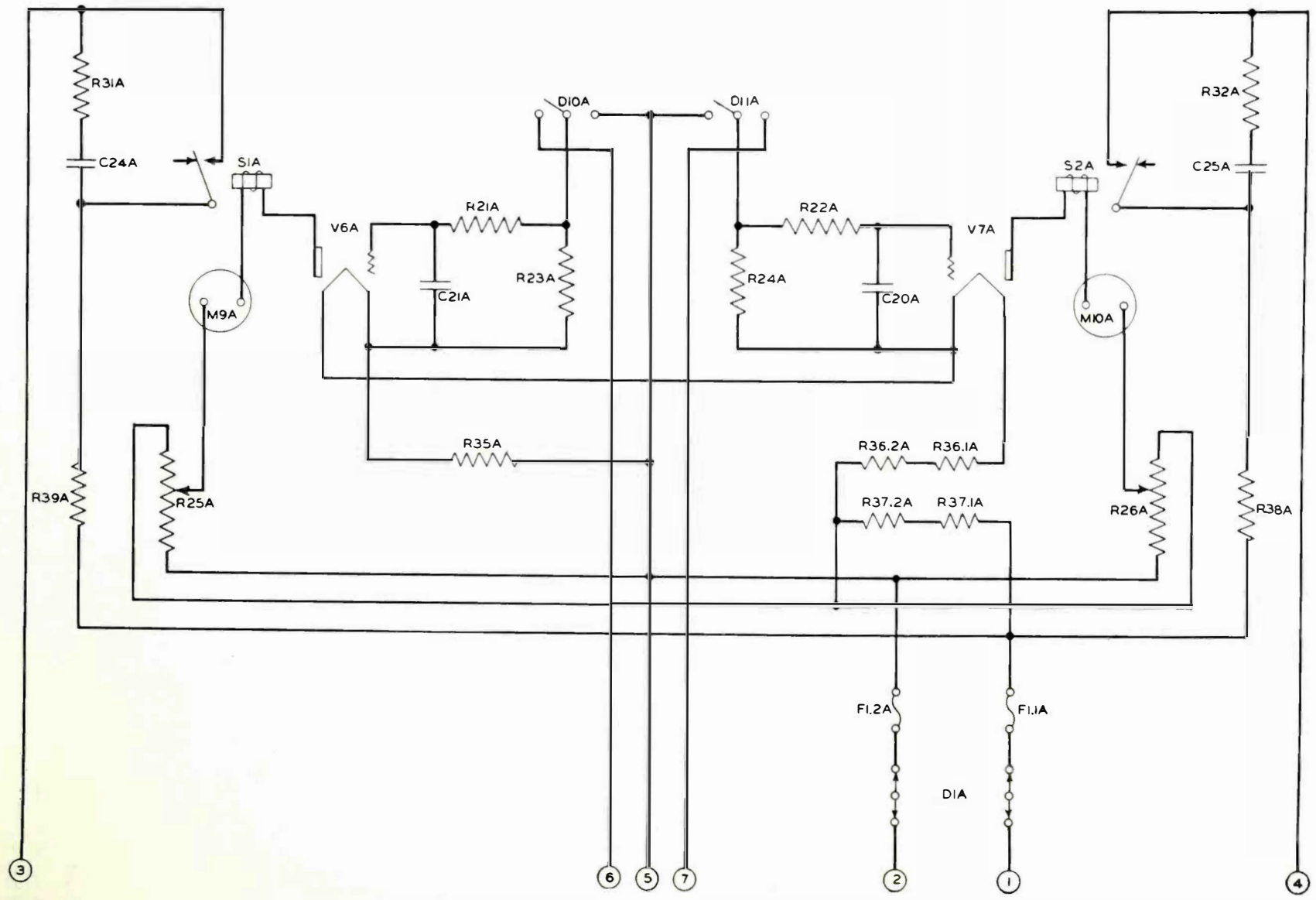
The DC temperature control panel has the filament of V6A connected in series with the filament of V7A, the resistances R36.1A, R36.2A, R37.1A, R37.2A, and grid bias resistance R35A. This series circuit is connected through fuses F1.1A and F1.2A and snap switch D1A to terminals 1 and 2. For 115-volt operation, resistances R37.1A, R37.2A, R38A and R39A are short-circuited. The potential drop across resistance R35A provides the grid bias voltage for vacuum tubes V6A and V7A. A variable DC voltage ranging from 0 to 115 volts is obtained from potentiometer R25B, the movable contact arm of which connects through relay S1A to the plate of V6A. A spark absorbing circuit consisting of condenser C24A and resistance R31A is connected across the contacts of relay S1A. The Grid of V6A is connected through resistances R21A and R23A to its filament. To prevent chattering and irregular operation of the relay, the time delay circuit composed of condenser C21A and resistance R21A is connected in the grid circuit. Resistance R23A is a current limiting resistance for thermostat S3A. The heater unit R1A located in the heat insulated chamber receives its power supply directly from the terminals of the DC supply source through resistance R39A, which is short-circuited for 115-volt operation. The single-pole double-throw switch marked "TEST SWITCH" is used for testing and adjusting the operation of the control circuits. The adjustment of the DC temperature control circuit is outlined on page 36.

First Amplifier

The radio frequency input voltage to the first stage of radio frequency amplification is supplied by the oscillator output coil through condensers C2A and C4A to the grid of the No. 248-A Vacuum Tube designated V2A. This input voltage is adjustable by condenser C4A, whose control is marked "FIRST AMPLIFIER INPUT." The proper grid bias voltage is obtained from grid bias potentiometer through terminal 5, retardation coil L9A, grid current meter M3A, resistance R34A, and radio frequency choke coils L2.1A and L2.2A. The direct current that flows in the grid circuit is indicated by M3A marked "FIRST AMPLIFIER GRID CURRENT."

The plate circuit of V2A receives its DC supply from the 2,000-volt generator through meter M6A, series plate feed resistances R11.1A and R11.2A which reduce the voltage to the proper value, and radio frequency choke coils

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Schematic Diagram of the DC Temperature Control Panel

L3.1A and L3.2A. The plate current is indicated by M6A marked "FIRST AMPLIFIER PLATE CURRENT."

The amplifier output circuit receives its power from V2A through condenser C7A. The output circuit is a closed resonant circuit consisting of inductance L4A in parallel with variable condenser C8A and a fixed capacitance composed of condenser C9A in series with C10A. This circuit is tuned approximately by the taps on inductance coil L4A, and is tuned finally from the front of the oscillator panel by means of the handwheel marked "FIRST AMPLIFIER TUNING." Resonance is indicated by a minimum reading on plate current meter M6A.

Second Amplifier

The output circuit of the first radio frequency amplifier is connected directly through the grid blocking condenser C13A to the grid of the second amplifier No. 248-A, Vacuum Tube designated V3A. The input voltage to this amplifier is regulated by adjusting the grid input condenser C4A. The grid circuit of the second amplifier consists of the radio frequency choke coils L5.1A and L5.2A connected in series with grid leak resistance R14A and grid current meter M1A to terminal 5 which connects to the grid bias potentiometer. The direct current that flows in the grid circuit of V3A is indicated by M1A marked "SECOND AMPLIFIER GRID CURRENT."

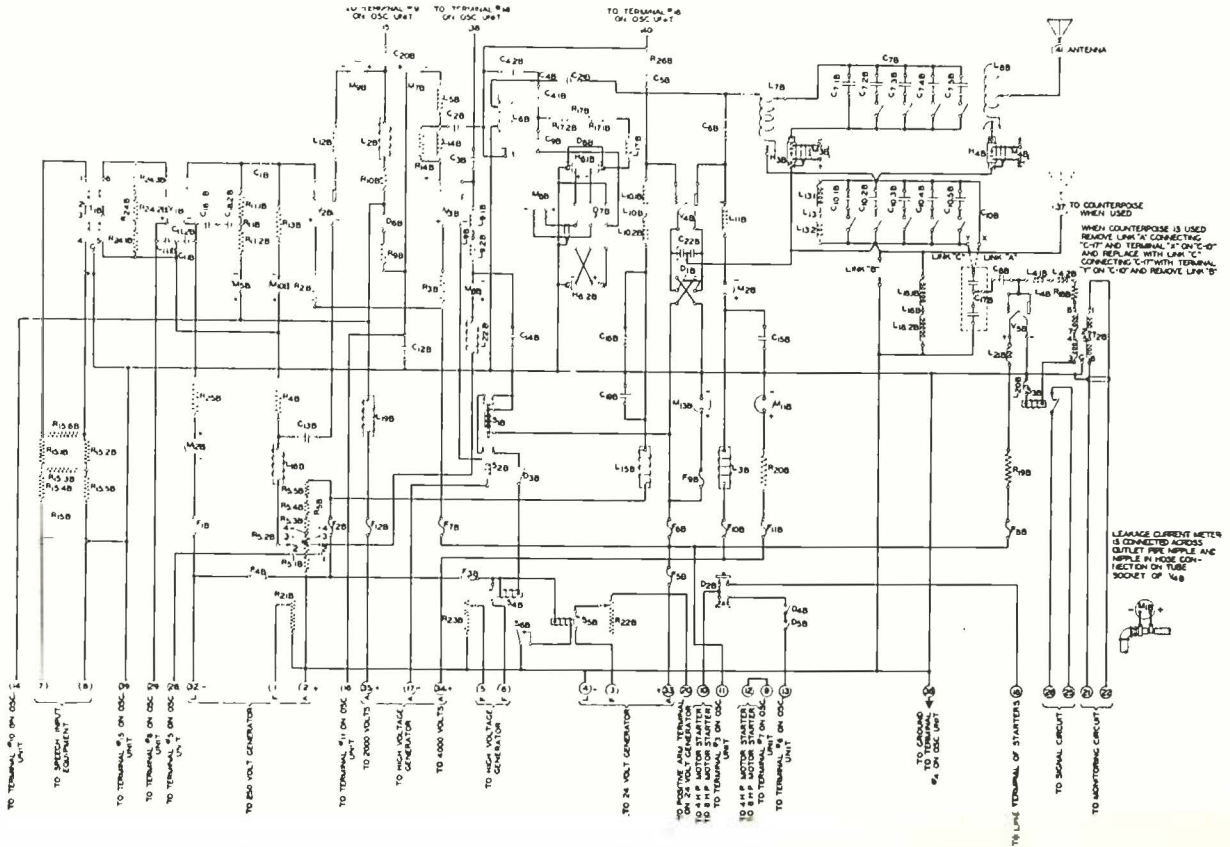
The DC plate supply for V3A is supplied by the 2,000-volt generator through link switch D5A, plate current meter M4A, plate feed resistances R16.1A and R16.2A, retardation coil L7A, and radio frequency choke coils L6.1A and L6.2A. This voltage is reduced primarily by resistances R16.1A and R16.2A. The plate current is indicated by meter M4A marked "SECOND AMPLIFIER PLATE CURRENT."

The output circuit receives its power from V3A through condenser C15A. This circuit is a closed resonant circuit consisting of the variable condenser C16A shunted by the series circuit composed of inductance L10A, the rotor of transformer L8A, and load resistances R17.1A and R17.2A. This circuit is tuned approximately by adjusting the taps on inductance coil L10A. The final tuning is performed from the front of the oscillator panel by adjusting the handwheel marked "SECOND AMPLIFIER TUNING" until resonance is shown by a minimum indication of plate current meter M4A.

The second amplifier is neutralized by condenser C12A, which is adjusted by the control marked "SECOND AMPLIFIER BALANCING CONDENSER." During the neutralizing operation, which will be described later, link switch D5A is opened, change-over switch D4A is placed in the position that connects low current thermocouple H7.2A in the closed circuit, and load resistance R17A is short-circuited by link switch D7A. The neutralized condition is indicated by meter M7A marked "SECOND AMPLIFIER OUTPUT CURRENT."

NO. D-87739 AMPLIFIER UNIT

The Amplifier Unit, shown on pages 26 to 32 inclusive, contains the audio frequency amplifiers with their associated circuits, the radio frequency power amplifiers with the associated circuits, and the antenna coupling and tuning circuits. The function and operation of the various parts in the circuits are described in detail in the following paragraphs. The schematic and wiring diagrams of the No. D-87739 Amplifier Unit are shown on pages 85 (Wiring) and 22 and 83 (Schematic).



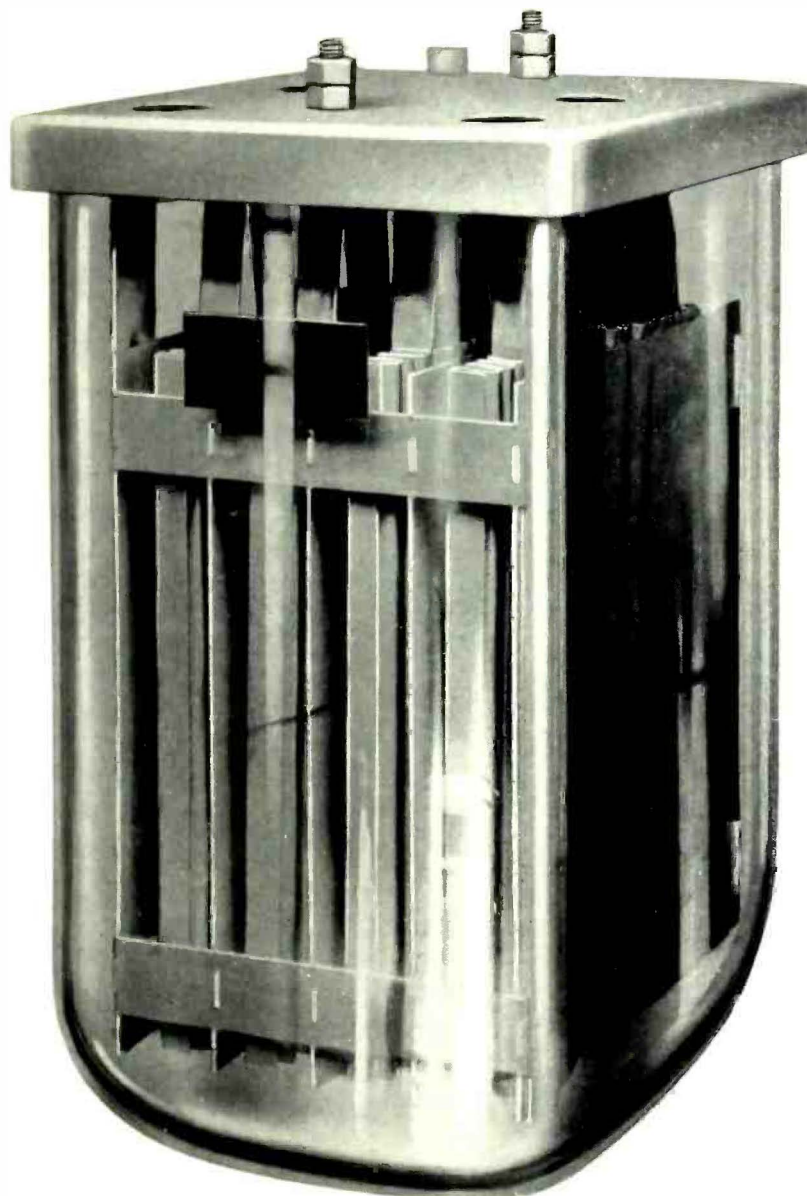
Schematic Diagram of the No. D-87739 Amplifier Unit

Filament Power Supply Circuits

The power supply for the filament of the No. 228-A Power Amplifier Vacuum Tube designated V4B in the Amplifier Unit, is supplied at terminals 4 and 33. The filament voltage of V4B is held constant at 22 volts and is indicated by meter M13B marked "FILAMENT VOLTAGE." The filaments of No. 212-D Modulator Vacuum Tube V2B, the No. 212-D Third Amplifier Vacuum Tube V3B, and the No. 205-D Monitoring Rectifier Vacuum Tube V5B, are operated with suitable series resistances, in parallel with the filament of V4B. The filament voltage is adjusted by means of field rheostat R22B which is controlled by the handwheel marked "24 VOLT GENERATOR."

The filament of the No. 248-A Speech Amplifier Vacuum Tube designated V1B in the Amplifier Unit, is connected in series with the filament of the second amplifier tube V3A in the Oscillator Unit. This connection is effected through terminal 29 of the Amplifier Unit and terminal 8 of the Oscillator Unit.

A filter composed of one No. 125-A Retardation Coil and two No. 100-A Electrolytic Filter Condensers is connected between terminal 33 of the Amplifier Unit and the positive armature terminal of the 25-volt generator. This filter reduces the commutator ripple in the current supplied to the filaments of the vacuum tubes, thus reducing the noise in the carrier from this source.



No. 100-A Electrolytic Filter Condenser

No. 100-A Filter Condenser

The No. 100-A Condenser (shown above) is of the electrolytic type. This type is used on account of the large capacity obtained in a relatively small amount of space.

The condenser consists of a glass jar filled to a specified level with condenser fluid, in which are submerged two aluminum electrodes mounted rigidly on a porcelain cover which insulates the electrode and terminal posts from each other. A layer of oil covers the condenser fluid to prevent evaporation.

The No. 100-A Condenser owes its high capacity to a thin film which is formed electro-chemically on the positive corrugated aluminum electrode. This film maintains itself when the aluminum electrode is in the anode in a suitable condenser fluid. The electrostatic capacity is obtained from the film which serves as a dielectric between the contacting condenser fluid on one side and the metal of the aluminum electrode on the other. The flat negative electrode serves only as a means of passing current into and from the condenser fluid.

These condensers must operate only on direct current and at a potential of not more than 33 volts.

Complete and specific information for the installation of these condensers is furnished with them and should be followed carefully when placing the condensers in service for the first time or when removing the condenser fluid. This information is summarized on page 56.

No. 125-A Retardation Coil

The No. 125-A Retardation Coil (page 25) is used in the filament supply circuit of the vacuum tubes for the purpose of suppressing ripples in the DC supply. The coil has a laminated silicon steel core of the shell type, and cast iron end housings to protect the windings and provide suitable means for mounting.

The coil consists of two conductors wound alongside of each other, the flexible terminals of which are brought out through bushings in one of the end plate housings.

As installed, the coils are connected in parallel by strapping terminals 1 and 3 and terminals 2 and 4, which are in turn connected between terminal 33 of the Amplifier Unit and the positive armature terminal of the 25-volt generator.

Grid Bias Supply Circuits

The grid bias voltage of 250 required for the No. 228-A Vacuum Tube is obtained directly from the 250-volt generator through terminals 2 and 32. This voltage is indicated by meter M12B marked "GRID VOLTAGE." The grid voltage is kept constant by field rheostat R21B which is controlled by the handwheel marked "250 VOLT GENERATOR."

The grid bias voltage required for other vacuum tubes is obtained from potentiometer R5B which is connected across the terminals of the 250-volt generator.

Two sets of four taps each are provided on potentiometer R5B. One set is marked "MODULATOR TUBE," and the other set is marked "THIRD AMPLIFIER TUBE." These taps are provided so that a slightly different grid bias voltage may be supplied when modulator and third amplifier tubes having different plate-filament impedances are used. The No. 212-D Vacuum Tubes are divided into four classes, numbered 1 to 4, depending on the plate-filament impedance classification into which they fall. This classification of tubes is not in any way a gradation of quality and no one of these classes has advantages over another.

Plate Power Supply Circuits

The power supply for the plate circuit of the No. 228-A Vacuum Tube is obtained from the 4,000-volt terminals 17 and 34. This voltage is indicated by meter M11B marked "PLATE VOLTAGE." The power supply for the plate circuits of the other vacuum tubes is obtained from the 2,000-volt terminals 17 and 35. The voltages of both 2,000-volt generators are controlled simultaneously by means of rheostat R23B, the handwheel of which is marked "4000-VOLT GENERATOR." Consequently, when M11B indicates 4,000 volts, 2,000 volts will be available at terminals 17 and 35 and 4,000 volts at terminals 17 and 34. These generators obtain their field excitation from the 250-volt generator through terminals 5 and 6.

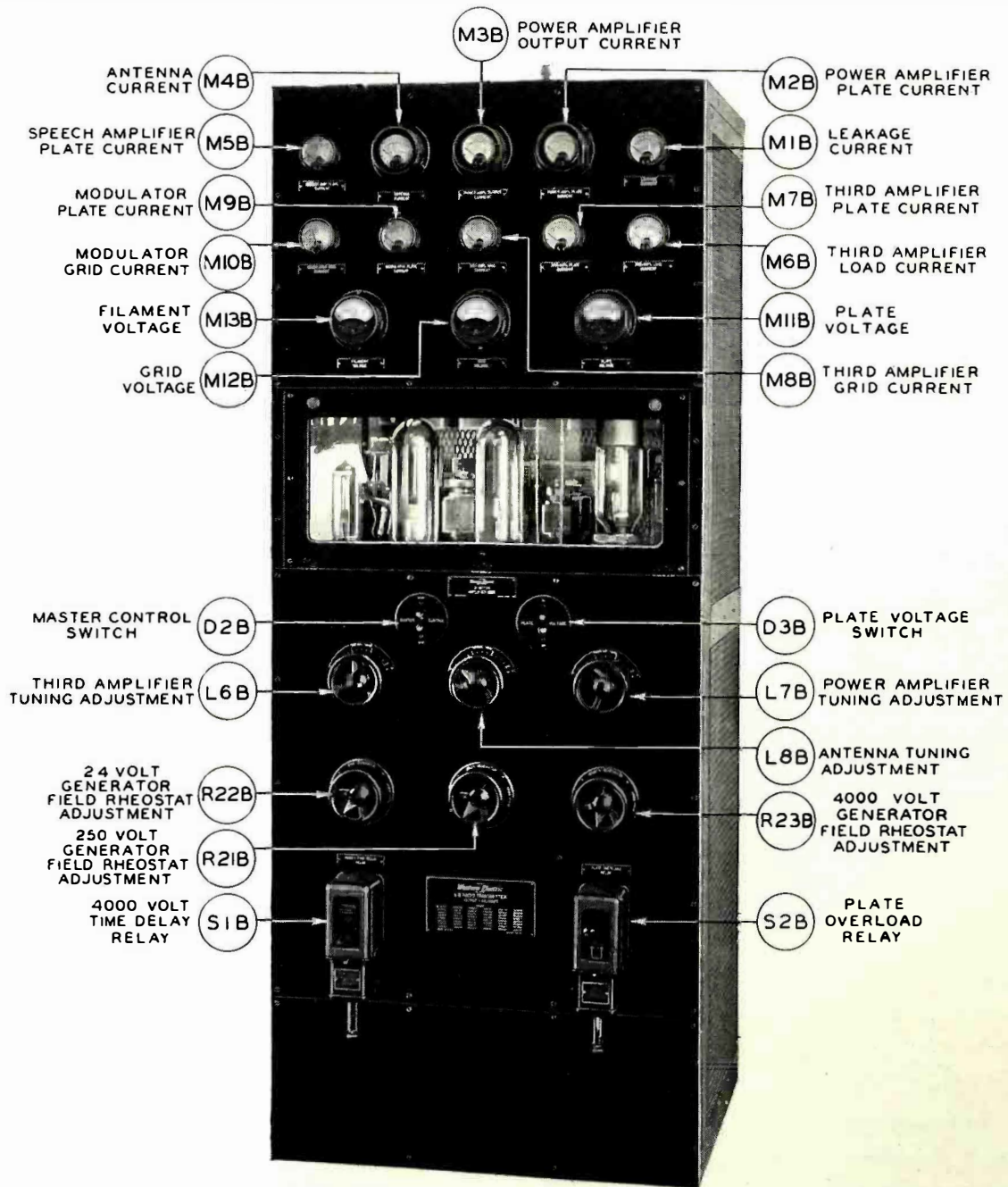


No. 125-A Retard Coil

A filter composed of retardation coil L3B and condenser C15B is connected in the positive lead of the 4,000-volt supply. Another filter composed of retardation coil L19B and condenser C27A is connected in the positive lead of the 2,000-volt supply. Both filter circuits reduce the commutator ripple in the plate voltage supply to the vacuum tubes.

Protection

In order to protect the operator, switches D4B and D5B are provided which function to shut down the motor-generator sets whenever the rear door or front window panel is opened.

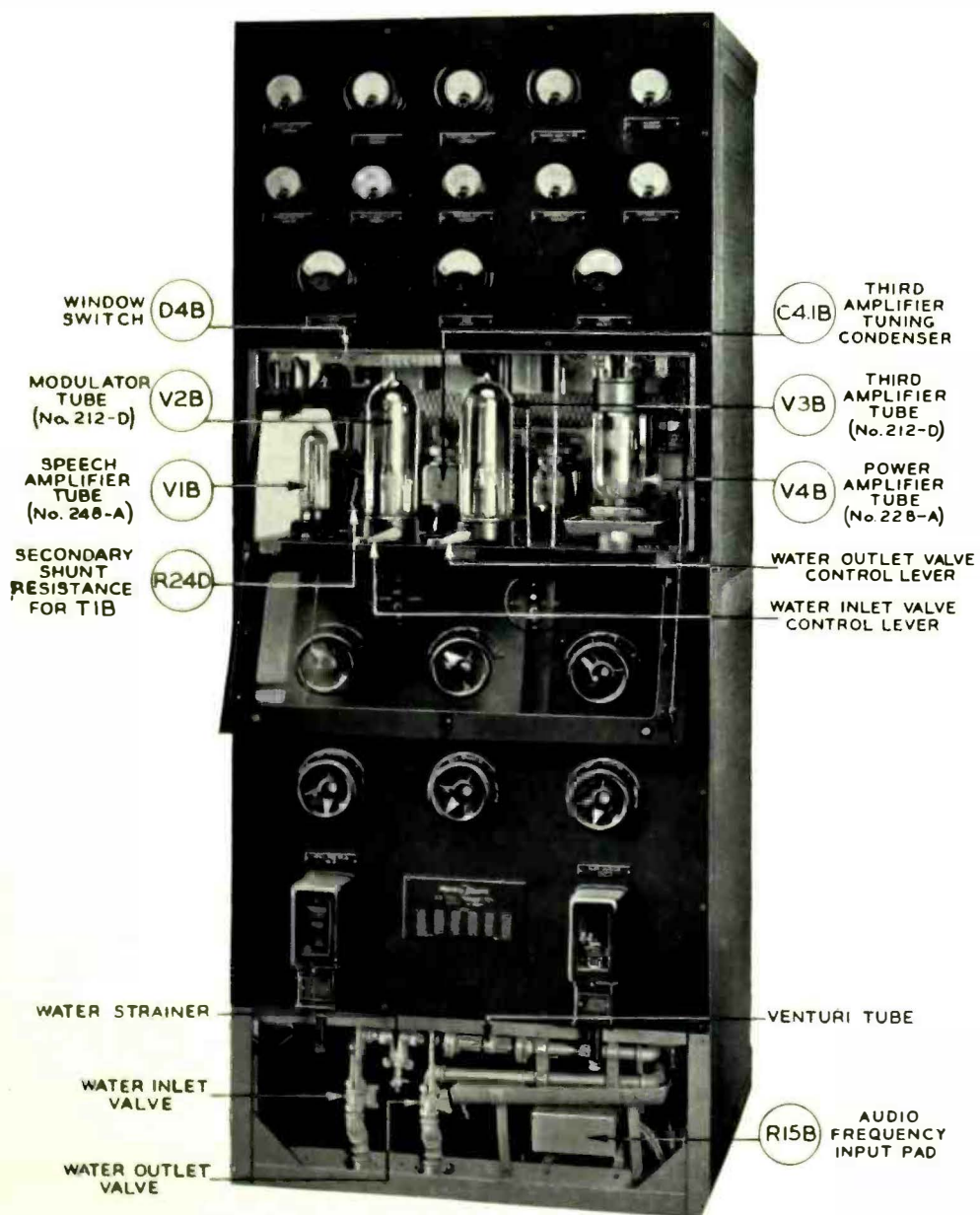


No. D-87739 Amplifier Unit—Front View—Window Panel Closed

For the protection of the vacuum tubes a number of relays are provided and the circuits are interlocked as follows:

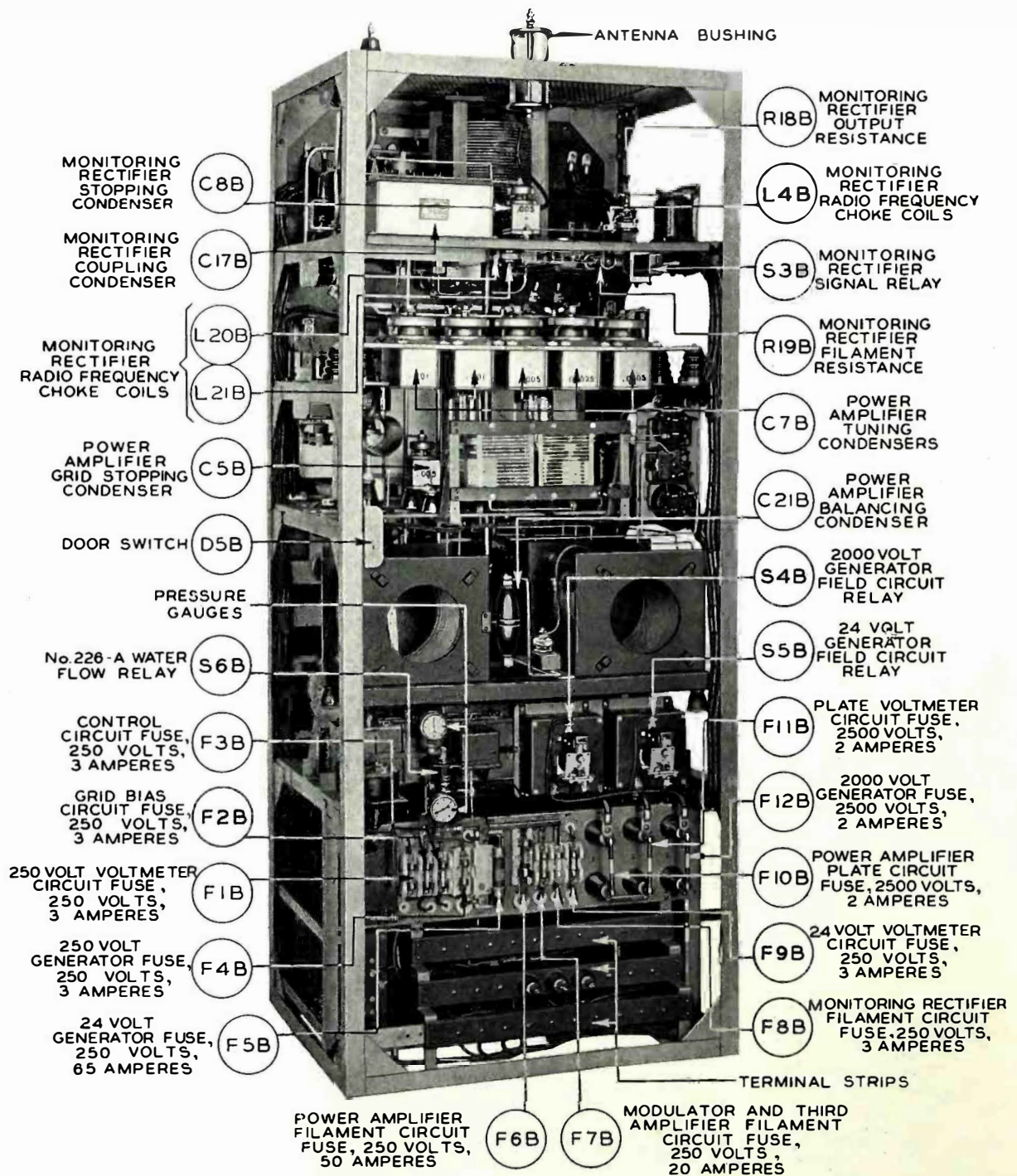
The relays S4B and S5B are mounted in the rear of the Amplifier Unit just above the fuse blocks. The contacts of relay S1B control the field circuit of the high voltage generators. The contacts of relay S5B control the field circuit of the 25-volt generator. Both relays are operated from the 250-volt supply. Consequently, if the 250-volt generator is not supplying voltage to the radio transmitter, it would be impossible to close relays S4B and S5B, so the danger of applying plate voltage to tubes without having a grid bias voltage is obviated.

It is necessary also to protect against applying power to the No. 228-A Water-cooled Vacuum Tube without having cooling water circulating around the anode. This is accomplished by the operation of relay S5B through the con-



No. D-87739 Amplifier Unit—Front View—Window Panel Open

tacts of relay S6B which is controlled by the rate of water flow in the circulating system. If the rate of flow varies abnormally due to obstructions in the intake, discharge or other portion of the circulating system, relay S6B will function to operate S5B. The contacts of relay S5B will open the field circuit of the 25-volt generator, thus removing the voltage from the filament circuits. With the removal of the filament voltage, the time delay relay S1B will be de-energized and its contacts will open the operating coil circuit of S4B. The contacts of S4B will open the field circuit of the high voltage generators, thus

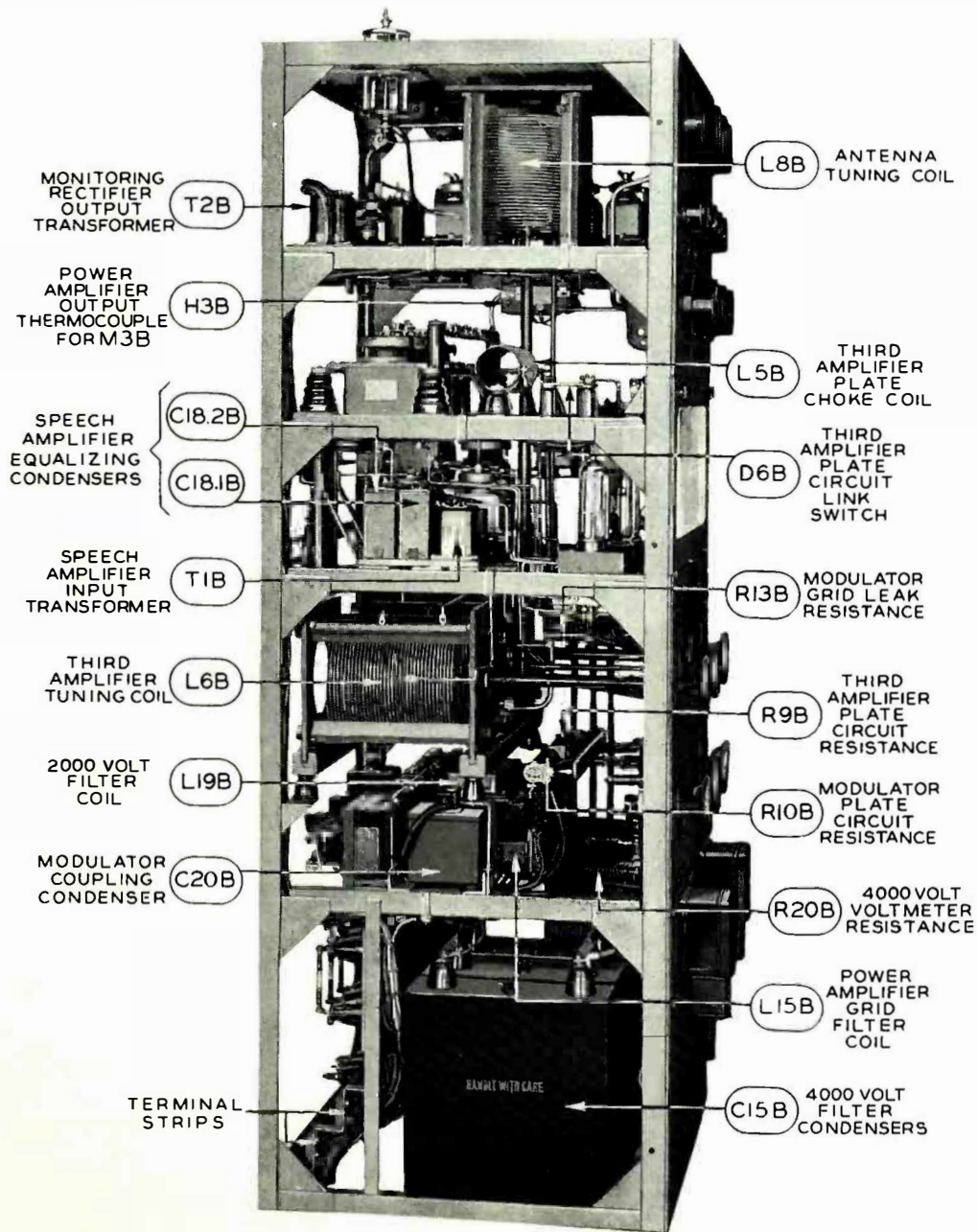


No. D-87739 Amplifier Unit—Rear View

removing the plate voltage from the transmitter. This same protection is afforded when attempting to start with the water supply shut off.

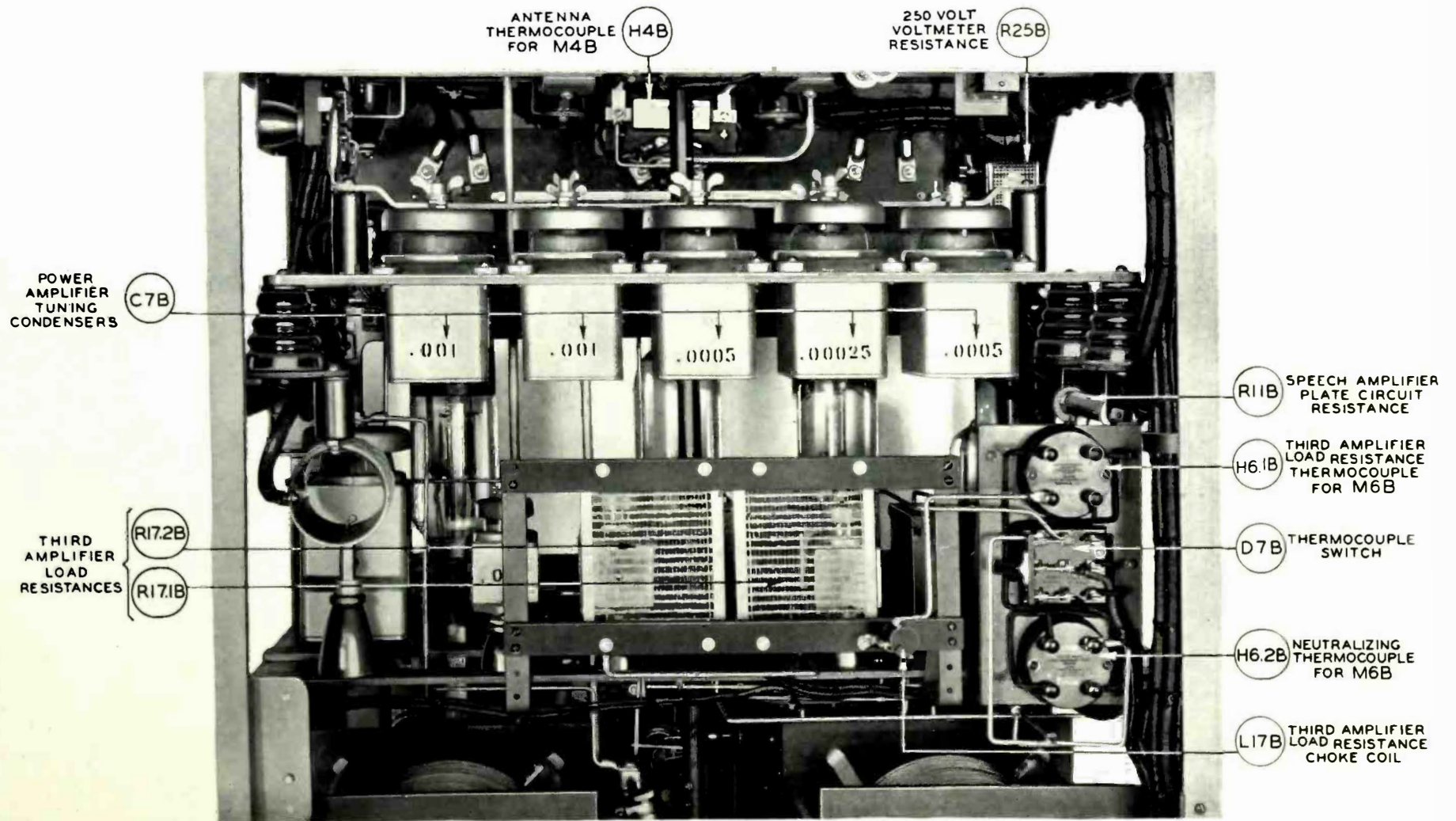
Relay S1B, which is marked "4000-VOLT TIME DELAY RELAY," is mounted near the bottom on the left-hand side of the amplifier panel. This relay is energized whenever the filament voltage is applied. Its contacts are in series with the operating coil of relay S4B, which controls the field circuit of the high voltage generators. An interval of 10 to 20 seconds is required for the time delay relay to operate, thus permitting the vacuum tubes to warm up before the high voltage is applied.

Relay S2B, which is marked "PLATE OVERLOAD RELAY," is mounted near the bottom on the right-hand side of the amplifier panel. The operating



No. D-87739 Amplifier Unit—Left Side View

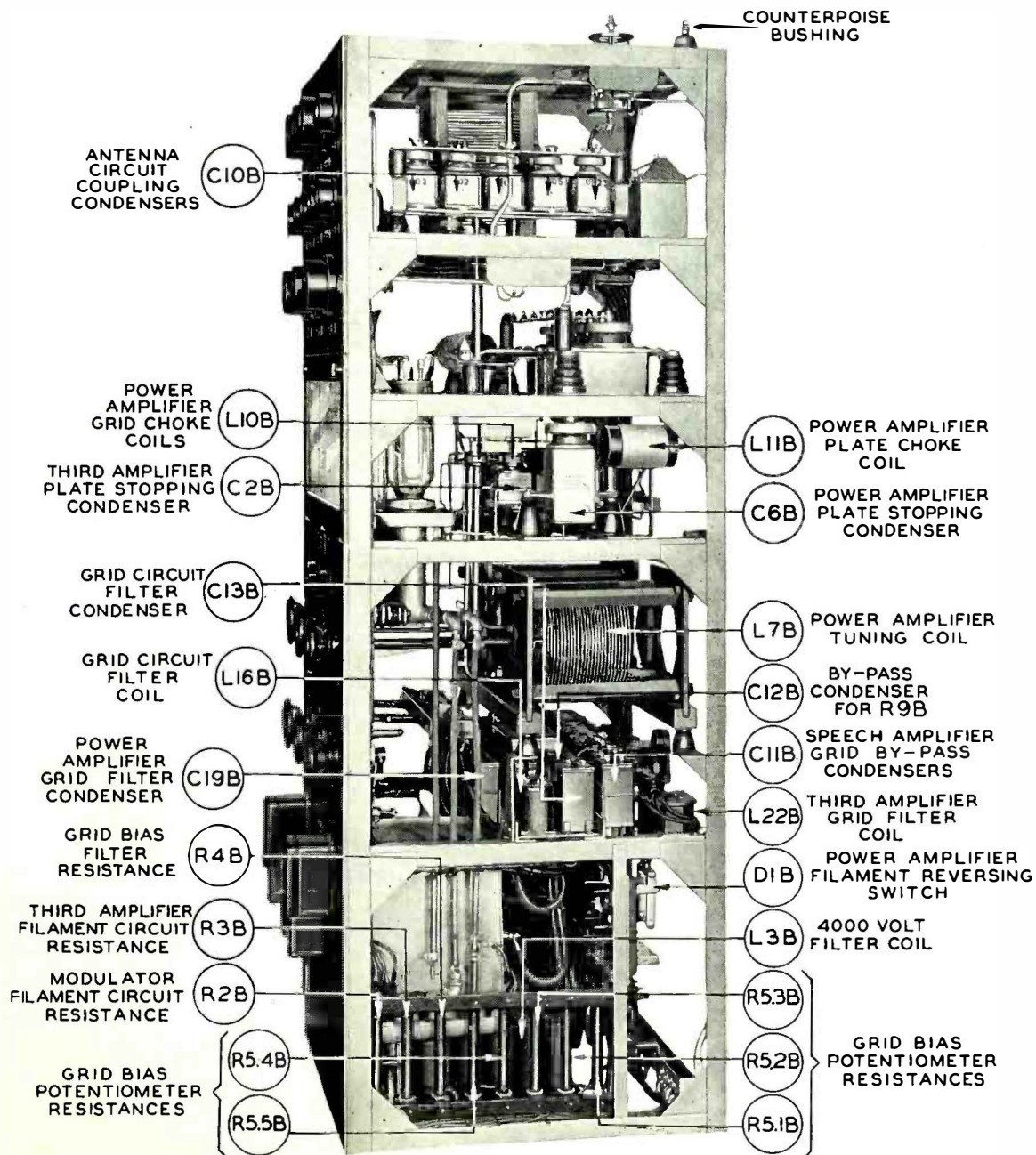
[30]



No. D-87739 Amplifier Unit—Rear View of Upper Section

coil of S2B is connected in the negative lead of the high voltage generators and its contacts control the operation of relay S4B. Whenever excessive current flows in the high voltage circuit, relay S2B trips, thereby de-energizing S1B. The contacts of S4B open the field circuit of the high voltage generators, thus removing the high voltage. It is necessary to reset relay S2B by hand once the contacts have been tripped.

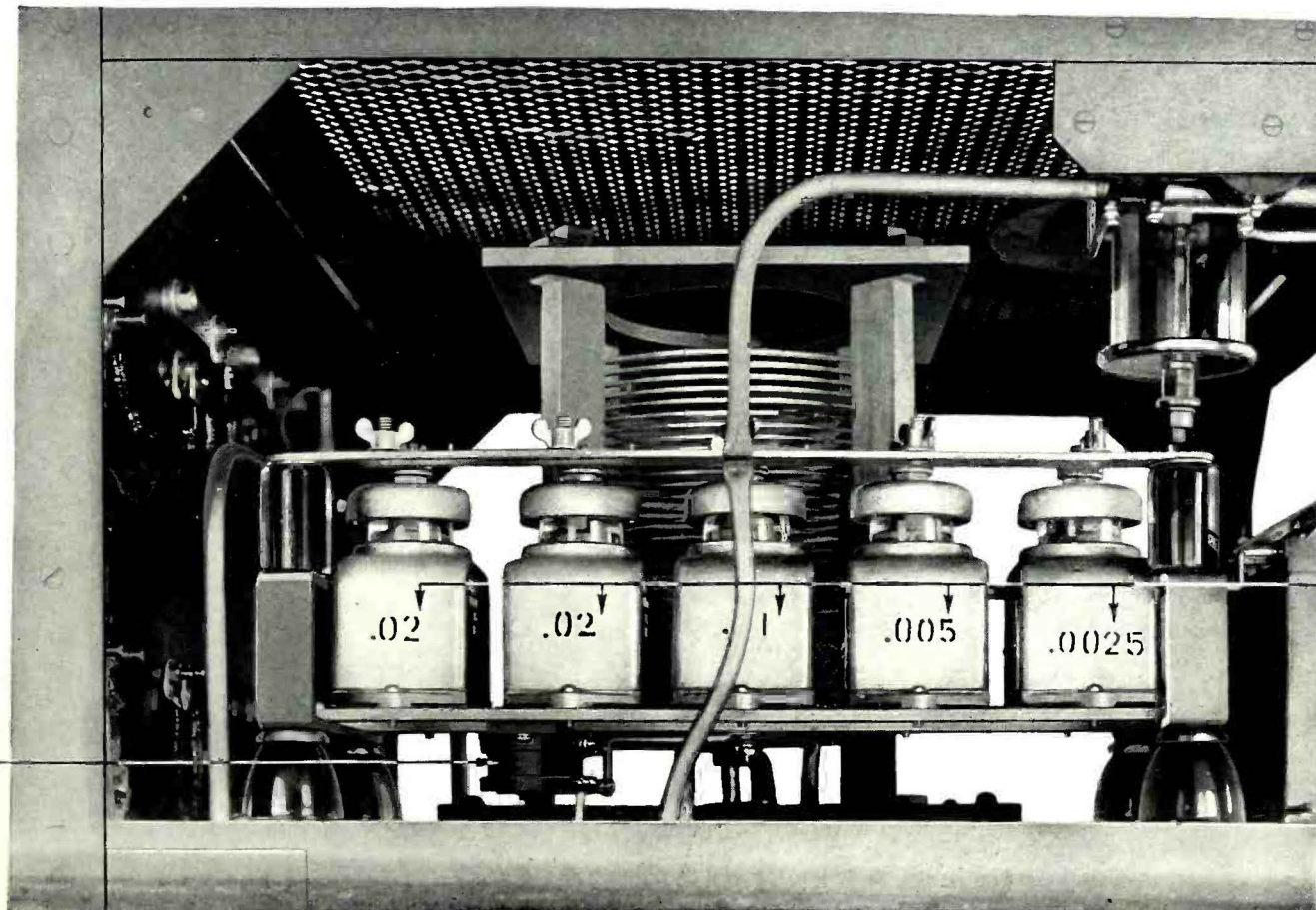
Additional protection is afforded the vacuum tube circuits by fuses mounted in the rear of the Amplifier Unit. The code numbers and ratings of the fuses are listed in the section on Apparatus Information.



No. D-87739 Amplifier Unit—Right Side View

[32]

COUPLING
CONDENSER
PROTECTIVE
COILS (L13B)



(C10B) ANTENNA
CIRCUIT
COUPLING
CONDENSERS

No. D-87739 Amplifier Unit—Right Side View of Upper Section

Speech Amplifier and Modulator

The audio frequency input voltage to the transmitter is applied across terminals 7 and 8. A resistance network R15B is inserted between the input transformer T1B which impresses the audio-frequency voltage upon the grid of the speech amplifier No. 248-A Vacuum Tube, V1B, and terminals 7 and 8. The plate voltage for this tube is obtained from the 2,000-volt generator through plate current meter M5B and the series plate feed resistance R11B. The plate feed resistance R11B in conjunction with condensers C18.1B and C18.2B, forms an equalizing network in the output circuit of V1B. The plate current is indicated by meter M5B marked "SPEECH AMPLIFIER PLATE CURRENT."

The audio frequency input voltage is amplified by V1B and its output voltage is impressed upon the grid of the No. 212-D Modulator Vacuum Tube designated V2B, through the coupling consisting of resistance R11B and condenser C1B. The grid bias voltage for V2B, as well as that for V1B, is obtained from grid bias potentiometer R5B through retardation coil L16B and resistance R4B. Grid current meter M10B and grid leak resistance R13B are connected in the grid circuit of V2B. Noise from the grid bias supply is reduced to a minimum by the filter, consisting of retardation coil L16B and condenser C13B.

The plate current for the modulator is supplied from the 2,000-volt generator through plate feed resistance R10B, audio frequency choke coil L2B, modulator plate current meter M9B and radio frequency choke coil L12B. The voltage is reduced to 1,500 by resistance R10B. The plate current of the modulator tube is indicated by M9B marked "MODULATOR PLATE CURRENT." The audio frequency voltage of V2B, developed across coil L2B, is impressed on the plate of the second amplifier through condenser C20B. One terminal of this condenser is designated 15 and connects to terminal 9 on the Oscillator Unit.

Third Amplifier

The radio frequency input voltage to the third amplifier, which consists of a No. 212-D Vacuum Tube designated V3B, is obtained from the stator of transformer L8A located in the Oscillator Unit. The position of the rotor which is adjusted by the control marked "THIRD AMPLIFIER INPUT," and the taps on the stator of the transformer, control the radio frequency input voltage to the Amplifier Unit and, consequently, the output of the transmitter.

The grid bias voltage for V3B is obtained from potentiometer R5B. A flexible lead permits connection to taps from potentiometer R5B, which are marked "THIRD AMPLIFIER TUBE." A retardation coil L22B, grid current meter M8B, and radio frequency choke coils L9.1B and L9.2B are connected in series in the grid circuit connecting to R5B. The flow of grid current is indicated by meter M8B marked "THIRD AMPLIFIER GRID CURRENT." Generator noise is removed from the grid circuit by the filter consisting of retardation coil L22B and condenser C14B.

The DC plate supply for V3B is obtained from the 2,000-volt generator through link switch D6B, plate feed resistance 9B, plate current meter M7B,

radio frequency choke coil L5B, and anti-sing circuit composed of inductance L14B and resistance R14B. The plate voltage is reduced by the series plate feed resistance R9B. By-pass condensers C12B and C27A connected in parallel through terminals 16 and 36 on the Amplifier Unit and terminals 11 and 4, respectively, on the Oscillator Unit, are provided across plate feed resistance R9B. The plate current is indicated by meter M7B marked "THIRD AMPLIFIER PLATE CURRENT."

The series circuit condensers C4.1B, C4.2B, and C9B, connected in parallel with inductance L6B, constitute the output circuit of vacuum tube V3B. Condenser C2B functions as a plate blocking condenser. A hand wheel, marked "THIRD AMPLIFIER TUNING," controls a sliding contact on coil L6B and provides a three-turn continuous adjustment of inductance. A tap on L6B is also provided for approximate adjustments. Resonance is indicated by a minimum reading of the plate current meter M7B.

The resistances R17.1B and R17.2B are shunted across condenser C9B and serve as a load for the third amplifier. The radio frequency current flowing through these resistances is indicated by meter M6B marked "THIRD AMPLIFIER LOAD CURRENT."

The third amplifier is neutralized by condenser C19A located in the Oscillator Unit and adjusted from the front of the oscillator panel by the control marked "THIRD AMPLIFIER BALANCING CONDENSER." During the neutralizing operation, which will be described later, link switch D6B is opened and change-over switch D7B is placed in the position which connects low current thermocouple H6.2B in the closed circuit of V3B. The neutralized condition is indicated by meter M6B.

Power Amplifier

Radio frequency grid voltage for the No. 228-A Vacuum Tube is obtained from the output circuit of V3B through grid blocking condenser C5B and anti-sing resistance R26B. The grid bias of 250 volts is obtained from the 250-volt generator through the filter circuit consisting of retardation coil L15B and condensers C16B and C19B, and the radio frequency choke coils L10.1B and L10.2B.

The DC plate supply for V4B is obtained from the 4,000-volt supply terminal through retardation coil L3B, plate current meter M2B, and radio frequency choke coil L11B. The plate current is indicated by meter M2B marked "POWER AMPLIFIER PLATE CURRENT."

The filament of V4B is supplied from the 25-volt DC generator through reversing switch D1B. This switch is provided in the filament circuit so that the filament current can be reversed periodically in order to prolong the life of the filament.

The output circuit consisting of tuning condenser C7B in parallel with the series circuit composed of tuning inductance L7B and coupling condenser C10B, receives its power from V4B through condenser C6B. The proper tuning and

coupling condensers are connected in circuit through the aid of links. Approximate tuning adjustment of L7B is obtained by means of a tap which is provided. The final tuning is accomplished from the front of the amplifier panel by means of the handwheel marked "POWER AMPLIFIER TUNING." Resonance is indicated by a minimum reading of the power amplifier plate current meter M2B.

The capacitance C10B couples the power amplifier output circuit to the antenna and is adjusted in steps by selection of suitable coupling capacitors.

The power amplifier is neutralized by condenser C21B. One terminal of this condenser is permanently connected to the plate tap on coil L7B, while the other terminal is connected to an adjustable tap which is placed, for a particular operating frequency, on the proper turn of coil L6B as indicated in Table IV on page 41.

Antenna Circuit

The antenna circuit is tuned approximately by adjusting the tap on the series antenna inductance L8B and the final tuning is done from the front of the amplifier panel by adjusting the handwheel marked "ANTENNA TUNING." Resonance is indicated by a maximum deflection of meter M1B marked "ANTENNA CURRENT."

Radio frequency choke coils L13.1B and L13.2B are connected across the coupling condenser for the purpose of allowing static charges on the antenna to flow to ground.

The radio transmitter was primarily designed to operate with a ground connection or a grounded counterpoise, but an insulated counterpoise may be used if necessary. A terminal for this connection is provided at the top of the transmitter and the required changes are indicated in the schematic diagram of the No. 87739 Amplifier Unit (see page 23). The capacity of the counterpoise to ground should not be less than 5,000 micro-microfarads in order to keep its voltage to ground below 1,000.

Monitoring Rectifier

A monitoring rectifier is provided to rectify a portion of the antenna current for monitoring purposes. This rectifier consists of a No. 205-D Vacuum Tube designated V5B, with the grid and plate strapped together. The radio frequency input voltage for the operation of this rectifier is obtained from the tapped condenser C17B which is connected across the coupling condenser C10B. The variable taps on condenser C17B provide a convenient means for adjusting the input voltage to the rectifier. The audio frequency component of the output passes through transformer T2B to terminals 21 and 22 for connection to monitoring circuits. The direct current component of the output is fed through relay S3B which closes contacts which may be used to operate local signal light circuits through terminals 25 and 26, thus affording a visual indication that the transmitter is in operation.

ADJUSTMENT OF APPARATUS TEMPERATURE CONTROL EQUIPMENT

Temperature Adjustment

The apparatus for the two temperature control circuits is mounted on one Temperature Control Panel located on the back of the No. 87738 Oscillator Unit. The nameplate markings on this panel include either the designation "NO. 1" or "NO. 2," indicating the apparatus associated with a particular control circuit. The following adjustment procedure applies to either control circuit and therefore reference to the numerical designations "NO. 1" and "NO. 2" are omitted. Either of these two circuits may be adjusted without affecting the adjustment of the other.

If it should be necessary to change the temperature of either of the quartz oscillators, it may be done by adjusting the thermostat associated with the quartz oscillator whose temperature it is desired to change. The control knob for the thermostat is located on the oscillator panel to the right of the thermometer. Push this knob in until it engages the thermostat adjusting gear and turn it in either the "HIGH" direction to increase the temperature, or in the "LOW" direction to decrease the temperature. One complete turn of this knob will change the temperature approximately 8 degrees C. The temperature of the quartz oscillator should reach a constant value before any readjustment of the thermostat is made.

Should either of the temperature control circuits fail to function, the contacts of the "HEAT CONT. RELAY" should be inspected.

CAUTION: THERE IS A POTENTIAL OF 110 VOLTS BETWEEN THE RELAY FRAME AND GROUND. WHENEVER ANY RELAY ADJUSTMENT IS TO BE MADE, THE POWER SHOULD BE CUT OFF, TURNING "HEATER SUPPLY" SWITCH "OFF."

If the contacts of the relay are properly maintained (see instructions under Maintenance) and mechanical adjustments are correct, the relay will retain its adjustments for an indefinite period. The correct mechanical adjustments of the relays are made when the Oscillator Unit is tested and therefore, before attempting to readjust the contacts of the relay, the following simple tests should be made:

NOTE: In making the following tests and adjustments it should be noted that the "HEATER SUPPLY" switch controls the power supply to both of the heat insulated chambers. Hence, if it is desired to keep the quartz oscillator whose temperature control circuit is not being adjusted ready for use, the power should not be shut off longer than necessary.

Turn "HEATER SUPPLY" switch "OFF." Remove the relay cover. Open "TEST SWITCH."

Turn "HEATER SUPPLY" switch "ON." Turn the potentiometer dial marked "RELAY CURRENT ADJ." in a clockwise direction as far as possible. This will cause maximum relay current to flow. Throw "TEST SWITCH" to the "TEST" position and observe the relay current meter and the operation of

the relay. The relay current should decrease and the relay should release at a value of current between 0.25 and 0.35 milliamperes. Open the "TEST SWITCH." The relay current should gradually increase and the relay should operate at a value of current between 0.4 and 0.7 milliamperes.

Should the operation of the relay fail to fulfill the conditions specified in the preceding paragraph, then it will be necessary to readjust the relay in accordance with the following procedure:

Mechanical Adjustment of Relay

Turn the "HEATER SUPPLY" switch "OFF." Open "TEST SWITCH."

Turn the knurled screw on the relay holding the biasing spring so that the spring does not bear against the armature.

Adjust the right-hand contact screw until contact is made with the armature. Adjust the left-hand contact screw until the gap setting between the contact and the armature is between 0.003 inch and 0.005 inch. The No. 74-D Gauge is used to measure this gap setting.

Adjust each pole-piece until the gap setting between it and the armature is a maximum of 0.010 inch. This gap setting is measured with the No. 92-A Non-Magnetic Gauge when the armature is resting against the opposite contact screw and lock nuts are tightened.

Turn "HEATER SUPPLY" switch "ON." Turn potentiometer dial marked "RELAY CURRENT ADJ." in the clockwise direction until a maximum indication of relay current is obtained. The relay current should be between 0.8 and 1.2 milliamperes and should cause the relay to operate.

Slowly decrease the relay current by means of the potentiometer dial until a value of 0.25 milliamperes is obtained. If the foregoing mechanical adjustments have been made correctly, the armature will remain in the "OPERATE" position.

NOTE: The armature is in the "OPERATE" position when it is against the left-hand contact screw.

Turn the knurled screw of the relay so that the biasing spring bears against the left-hand side of the armature. Slowly turn this screw still further until the pressure of the spring against the armature causes the relay to release.

Increase the relay current by means of the potentiometer dial until the relay operates. Decrease the relay current until the relay releases observing the relay current which should be between 0.25 and 0.35 milliamperes.

If release does not occur between the specified limits, change the pressure of the biasing spring against the armature, decreasing the pressure when the release current is greater than 0.35 milliamperes and increasing the pressure when the release current is less than 0.25 milliamperes.

Starting with a current less than 0.25 milliamperes increase the relay current until the relay operates and observe the operate current which should be between 0.4 and 0.7 milliamperes.

If the operate current is not within the specified limits, change the gap setting between the left-hand contact screw and the armature a slight amount (not more than $\frac{1}{8}$ of a turn of the right-hand screw), increasing the gap if the operate current is less than 0.4 milliampere and decreasing the gap when the operate current is more than 0.7 milliampere.

Determine whether the relay still releases at a current value between 0.25 and 0.35 milliampere. If the relay no longer meets these requirements change the pressure of the biasing spring until the release current is within the limits given.

Turn the potentiometer dial marked "RELAY CURRENT ADJ." in a clockwise direction to its maximum position. Throw the "TEST SWITCH" to the "TEST" position and observe the relay current. This current should decrease to its previous minimum value and the relay should release. Open the "TEST SWITCH." The relay current should increase to its previous maximum value and the relay should operate.

Upon the completion of this test turn "HEATER SUPPLY" switch "OFF," and throw "TEST SWITCH" to the "OPERATE" position. Replace the relay cover and turn "HEATER SUPPLY" switch "ON."

PROTECTIVE DEVICES

4,000-Volt Time Delay Relay

The time delay relay S1B serves to keep the field circuits of the 2,000-volt generators open from 10 to 20 seconds after the filament voltage is applied. The air escapement valve at the top of the relay, and the armature weight at the bottom, should be adjusted so that the relay contacts close from 10 to 20 seconds after the generators are started. Turning the adjustment at the bottom of the relay to the right raises the armature weight and accelerates the action. The air escapement valve is adjusted by turning the knurled screw at the top to the right, thus closing the valve and retarding the action.

Plate Overload Relay

The overload relay S2B provides overload protection for the plate circuits of the vacuum tubes. The contacts of S2B are in series with the operating coil of relay S4B which controls the field circuit of the high voltage generators. Relay S2B is instantaneous in operation and should be adjusted by means of the thumb nut at the bottom of the relay to operate on 1.5 amperes.

RADIO FREQUENCY CIRCUITS

Before it is possible to adjust properly the output of the transmitter, it is necessary to determine the value of the antenna current which indicates 1 kilowatt in the antenna. This current depends upon the antenna resistance at the operating frequency, and for any output, the following formula for antenna current should be used:

$$\text{Antenna Current} = \sqrt{\frac{\text{Antenna Power}}{\text{Antenna Resistance (at operating frequency)}}}$$

The antenna resistance may be obtained from any one of a number of methods of measurement, or it may be determined by substituting an artificial antenna in place of the real antenna. The elements of the artificial antenna are adjusted until the operation of the transmitter is the same on either the real or artificial antenna. Under these conditions, the resistance of the artificial antenna is approximately equal to the resistance of the real antenna. This resistance is used in the preceding formula to calculate the value of the antenna current.

When the value of the antenna current to give the desired output has been determined, the adjustments of the radio frequency circuits should be made in accordance with the following procedure.

TABLE I—OSCILLATOR TUNING ADJUSTMENT

<i>Frequency, Kilocycles</i>	<i>D12A</i>	<i>D13A</i>
500-750	Tap No. 3	Tap No. 1
750-1000	Tap No. 2	Tap No. 2
1000-1250	Tap No. 2	Tap No. 3
1250-1500	Tap No. 1	Tap No. 4

No. D-87738 Oscillator Unit

CAUTION: REMOVE THE THERMOMETER FROM THE HEAT INSULATED CHAMBER BEFORE REMOVING THE THERMAL ELEMENT.

Open the window panel of the Oscillator Unit and remove the covers from the two heat insulated chambers. Remove the thermal elements from the chambers and mount on each element a No. D-87781 Quartz Oscillator.

The thermal elements with the No. D-87781 Quartz Oscillators mounted in position should be replaced in the heat insulated chambers. Attach the grid connector in each chamber to the oscillator terminal. Insert the thermometers. Replace the covers of the heat insulated chambers, screwing them down tightly.

Remove the No. 248-A Vacuum Tube from its socket. Open the cover of the oscillator compartment located between the two heating chambers, and adjust link switch D12A and link switch D13A of coil L1A to the tap numbers indicated in Table I. Both links of D13A shall be on the same tap except when the oscillator grid current exceeds the value indicated in Table IX, page 47. In the latter case, the auxiliary link of D13A connects to tap 1.

Close the cover of the oscillator compartment and replace the vacuum tube. Close the window panel.

Operate "CRYSTAL SELECTOR" switch D9A located on the oscillator panel to either position "NO. 1" or "NO. 2." Turn the "HEATER SUPPLY" switch located on the Temperature Control Panel to the "ON" position. Adjust the thermostats from the front of the oscillator panel so that the contacts just

TABLE II—FIRST AMPLIFIER TUNING ADJUSTMENT

<i>Frequency, Kilocycles</i>	<i>L4A Tap Number</i>
500- 555	71
555- 675	52
675- 855	37
855-1035	28
1035-1255	22
1255-1500	17

touch. This is indicated by a minimum reading on the "RELAY CURRENT" meters. Turn thermostat knobs in the "HIGH" direction to increase the temperatures to approximately the temperatures specified for the operation of the No. D-87781 Quartz Oscillators. One complete turn of the knob will change the controlling temperature of the thermostat approximately 8 degree C. Final precise adjustment of the thermostats should be made as the temperatures of the quartz oscillators approach the operating temperatures. During the time which is necessary for the quartz oscillators to attain their specified operating temperatures, the following radio frequency adjustments should be made.

Set the control of the input condenser C4A marked "FIRST AMPLIFIER INPUT" and the control marked "THIRD AMPLIFIER INPUT" at a minimum. The spanner wrench furnished with the Oscillator Unit is used to adjust these controls.

Adjust inductance coils L4A and L10A located in the shielded compartment accessible from the rear of the Oscillator Unit, to the tap numbers that are indicated in Tables II and III. Coil L4A is in the right-hand compartment and coil L10A is in the left-hand compartment. The taps on each coil have numerical designations. The flexible leads on the stator of the coupling transformer L8A located in the left-hand compartment, connect to tap 4. The two leads should be connected to similarly numbered taps.

The triple-pole double-throw switch D4A located in the left-hand compartment should be in the position that connects the high current thermocouple H7.1A in the closed circuit of the second amplifier.

No. D-87739 Amplifier Unit

Adjust inductance coils L6B, L7B, and L8B, and condensers C7B, and C10B to the approximate tuning adjustments indicated in Table IV, page 41.

TABLE III—SECOND AMPLIFIER TUNING ADJUSTMENT

<i>Frequency, Kilocycles</i>	<i>L10A Tap Number</i>
500- 545	53
545- 645	43
645- 755	34
755- 895	27
895-1065	20
1065-1305	10
1305-1500	0

TABLE IV—APPROXIMATE TUNING ADJUSTMENTS FOR THE NO. D-87739 AMPLIFIER UNIT OF NO. 6-B RADIO TRANSMITTER

Frequency, Kilocycles	Wave Length Meters	Antenna Resist- ance Ohms	Tuning Capacitance MF (C7B)	Coupling Capacitance MF (C10B)	Third Amplifier Tuning, Turns (L6B)	Power Amplifier Tuning Tap, Turns (L7B)	Plate Tap, Turns		
1,000 WATTS									
1,500	200	6	0.00075	0.0175	8	8	7		
		10	0.00075	0.0125	8	8	7		
		15	0.00075	0.0125	8	8	7		
		20	0.00075	0.0100	8	8	7		
		750 WATTS							
			6	0.00075	0.0175	8	8	8	
			10	0.00075	0.015	8	8	7	
			15	0.00075	0.0125	8	8	8	
			20	0.00075	0.0100	8	8	8	
		500 WATTS							
			6	0.00075	0.02	8	8	8	
			10	0.00075	0.0175	8	8	8	
	15	0.00075	0.015	8	8	8			
	20	0.00075	0.0125	8	8	8			
1,000 WATTS									
1,000	300	6	0.0015	0.0225	12	9	9		
		10	0.0015	0.0175	12	9	9		
		15	0.00125	0.015	12	9	9		
		20	0.0015	0.0125	12	9	9		
		750 WATTS							
			6	0.00125	0.0225	12	9	9	
			10	0.00125	0.0175	12	9	9	
			15	0.00125	0.015	12	9	9	
			20	0.00125	0.0125	12	9	9	
		500 WATTS							
			6	0.00125	0.0250	12	9	9	
			10	0.00125	0.020	12	9	9	
	15	0.00125	0.0175	12	9	9			
	20	0.00125	0.015	12	9	9			
1,000 WATTS									
750	400	6	0.002	0.03	18	10	10		
		10	0.002	0.025	18	10	10		
		15	0.002	0.02	18	10	10		
		20	0.002	0.0175	18	10	10		
		750 WATTS							
			6	0.00175	0.03	18	10	10	
			10	0.00175	0.025	18	10	10	
			15	0.00175	0.02	18	10	10	
			20	0.00175	0.0175	18	10	10	
		500 WATTS							
			6	0.0015	0.0325	18	10	10	
			10	0.0015	0.030	18	10	10	
	15	0.00175	0.025	18	10	10			
	20	0.00175	0.02	18	10	10			
1,000 WATTS									
500	600	6	0.00275	0.0475	31	14	14		
		10	0.00275	0.040	31	14	14		
		15	0.00325	0.0350	31	14	14		
		20	0.00300	0.0300	31	14	14		
		750 WATTS							
			6	0.0025	0.0475	31	14	14	
			10	0.00275	0.040	31	14	14	
			15	0.003	0.0350	31	14	14	
			20	0.003	0.0275	31	14	14	
		500 WATTS							
			6	0.00225	0.0475	31	14	14	
			10	0.00225	0.040	31	14	14	
	15	0.003	0.0375	31	14	14			
	20	0.0025	0.0300	31	15	15			

Connect the flexible lead from condenser C21B to turns of coil L6B as follows: For frequencies from 500 to 750 kilocycles the condenser tap shall be connected to turn 34; for frequencies from 750 to 1,500 kilocycles the condenser tap shall be connected to twice the number of turns to which the tuning tap of L6B is connected. For example, if the tuning tap is on turn 8, then the condenser tap shall be connected to turn 16.

The triple-pole double-throw switch D7B located to the right of load resistance R17B and below tuning condenser C7B, should be in the position that connects the high current thermocouple H6.1B in the load resistance circuit. The "HEATER" of thermocouple H6.1B should be short-circuited with short-circuiting strap D8B during the preliminary tuning of the transmitter. The short-circuit strap is removed when the transmitter is tuned.

In the lower left-hand corner and to the rear of the Amplifier Unit there are two sets of taps from potentiometer R5B. Each set of taps is marked "1, 2, 3, 4" corresponding to the classification numbers of the No. 212-D Vacuum Tubes. The flexible lead on the terminal board marked "MODULATOR TUBE" should be connected to the tap number which corresponds to the classification number etched on the modulator tube. The flexible lead on the terminal board marked "THIRD AMPLIFIER TUBE" should be connected to the tap number which corresponds with the classification number etched on the third amplifier tube.

The field rheostat controls located on the front of the amplifier panel should be turned in a clockwise direction for minimum generator voltage. The "PLATE VOLTAGE" switch D3B should be "OFF." The water inlet and outlet valves controlled from the inside of the Amplifier Unit and located in front of the two No. 212-D Vacuum Tubes should be in the "ON" position. The motor-generator sets are started by operating the top button of the "MASTER CONTROL" switch D2B. This starts both motor-generator sets and at the same time the pump motor thereby starting the circulation of the cooling water. The water pressure should be adjusted in accordance with the procedure outlined on pages 56 to 59 inclusive.

The control of the field rheostat in the center of the amplifier panel marked "250-VOLT GENERATOR" should be adjusted until meter M12B marked "GRID VOLTAGE" indicates 250 volts. This voltage is necessary to close relays S4B and S5B. Relay S4B is closed through operation of switch D3B, and relays S2B and S1B. Relay S1B operates when the filament voltage attains a value of 22 volts. Relay S5B operates through the contacts of water flow relay S6B. Relay S6B is operated by the differential pressure from the Venturi Tube.

The filament voltage should be adjusted by field rheostat control marked "24-VOLT GENERATOR," until meter M10B marked "FILAMENT VOLTAGE" indicates 22 volts.

After the relays have operated it is possible to close the field circuit of the high voltage generators by pushing the top button of the "PLATE VOLTAGE" switch D3B. The plate voltage should be adjusted by the rheostat control marked "4000-VOLT GENERATORS" until meter M11B marked "PLATE VOLTAGE" indicates 4,000 volts.

CAUTION: THE "PLATE VOLTAGE" SWITCH SHOULD BE IN THE "OFF" POSITION WHENEVER ADJUSTMENTS ARE BEING MADE EITHER IN THE SHIELDED COMPARTMENT OF THE OSCILLATOR UNIT OR FROM THE REAR OF THE AMPLIFIER UNIT.

TUNING OF RADIO FREQUENCY CIRCUITS

No. D-87738 Oscillator Unit

The input voltage to the first amplifier is controlled by condenser C4A, whose control is marked "FIRST AMPLIFIER INPUT." Increase this condenser a sufficient amount to enable tuning of the first and second amplifier output circuits. Tune the output circuit of the first amplifier to resonance by means of condenser C8A marked "FIRST AMPLIFIER TUNING." The second amplifier output circuit is tuned by means of condenser C16A. This control is marked "SECOND AMPLIFIER TUNING."

NOTE: Resonance is indicated in all circuits except the antenna by an adjustment to minimum plate current of the tube whose output circuit is being adjusted. In the antenna circuit resonance is indicated maximum antenna current.

The input control condenser C4A should be adjusted until the first amplifier output current meter indicates the value of current specified for the operating frequency as shown on page 62.

When the plate circuits of the first and second amplifiers are in tune with the frequency of the oscillator, and the values of current fulfill the requirements in Table IX, page 47, shut down the transmitter by pushing the lower button of the "MASTER CONTROL" switch. Open link switch D5A mounted on the rear of plate current meter M4A. Throw triple-pole double-throw switch D4A to the position connecting the low current thermocouple H7.2A in the output circuit of the second amplifier, and short-circuit load resistance R17A by closing link switch D7A. Switches D4A and D7A are located in the left-hand shielded compartment accessible from the rear of the Oscillator Unit.

Push the top button of the "MASTER CONTROL" switch, adjust the plate voltage to 4,000. Adjust input control condenser C4A until meter M7A (Second Amplifier Output Current) indicates a value of current within the full scale of the meter. Adjust "SECOND AMPLIFIER BALANCING CONDENSER" (C12A) until meter M7A indicates a minimum. (Use spanner wrench to adjust condenser C12A.)

The second amplifier is now neutralized. Shut down the transmitter by means of the "MASTER CONTROL" switch. Throw triple-pole double-throw switch D4A back to its initial position connecting the high current thermocouple H7.1A in the circuit, and open link switch D7A.

No. D-87739 Amplifier Unit

The control marked "THIRD AMPLIFIER INPUT" located on the Oscillator Unit controls the input to the third amplifier as well as the output of the transmitter. This control is adjusted, by means of the spanner wrench, to a

value sufficient to enable tuning of the third amplifier and the power amplifier. If insufficient input is obtained when the "THIRD AMPLIFIER INPUT" control is at a maximum, increase the number of turns on the stator of the coupling transformer L8A by connecting the flexible leads to the next higher tap number. The leads should be connected to correspondingly numbered taps.

The third amplifier is tuned by adjusting the control marked "THIRD AMPLIFIER TUNING." If resonance cannot be obtained by adjusting this control, it will be necessary to adjust the tap on inductance coil L6B. Resonance in this circuit is indicated by a minimum value of plate current on meter M7B marked "THIRD AMPLIFIER PLATE CURRENT."

The third amplifier is neutralized after the power amplifier output circuit and the antenna circuit are properly tuned. The neutralizing operation is similar to that described for the second amplifier. The high voltage should be removed by operating the "MASTER CONTROL" switch. Link switch D6B mounted on the left upper section of the frame near radio frequency choke coil L5B is opened. Triple-pole double-throw switch D7B is placed in the position connecting the low current thermocouple H6.2B in the closed circuit. Switch D7B is mounted on the thermocouple panel located in the rear of the Amplifier Unit

TABLE V—POWER AMPLIFIER TUNING FOR NORMAL AND REDUCED POWER OUTPUT

<i>Antenna Power</i>	<i>Power Amplifier Plate Current</i>	<i>Power Amplifier Output Current</i>
1,000 watts	0.85 amperes (± 0.10)	14 amperes (± 1.0)
750 watts	0.70 amperes (± 0.05)	12 amperes (± 1.0)
500 watts	0.58 amperes (± 0.05)	10 amperes (± 1.0)

to the right of load resistance R17B. Apply the high voltage by operating the "PLATE VOLTAGE" switch. Adjust condenser C19A by the control marked "THIRD AMPLIFIER BALANCING CONDENSER" on the oscillator panel, until meter M6B marked "THIRD AMPLIFIER LOAD CURRENT" on the amplifier panel indicates a minimum value. (Use spanner wrench to adjust condenser C19A.) Disconnect the high voltage by operating the push button switch. Throw switch D7B in the position connecting the high current thermocouple H6.1B in the load resistance circuit, and close link switch D6B. The third amplifier is now ready to be operated as a neutralized radio frequency amplifier.

Apply the plate voltage by means of the push button switch and tune the output circuit of the power amplifier by adjusting the inductance coil L7B until the plate current indicated on meter M2B marked "POWER AMPLIFIER PLATE CURRENT" is a minimum. The "POWER AMPLIFIER OUTPUT CURRENT" indicated on meter M3B should not indicate more than 15 amperes. If a greater current than 15 amperes is attained when the circuit is tuned, it may be reduced by adjusting the "THIRD AMPLIFIER INPUT."

Approximate adjustments of L7B are made by moving the plate and tuning taps, and final adjustments are made by means of the hand-wheel marked "POWER AMPLIFIER TUNING."

NOTE: The plate tap and tuning tap of L7B should be placed on the same turn of inductance.

TABLE VI—ADJUSTMENT OF POWER AMPLIFIER TUNING AND ANTENNA COUPLING CONDENSERS FOR PROPER OUTPUT IMPEDANCE (See Table VII)

INDICATION		ADJUSTMENT
Plate current high and Output current high		Decrease tuning condenser C7B
Plate current high and Output current low		Decrease coupling (increase C10B)
Plate current low and Output current low		Increase tuning condenser C7B
Plate current low and Output current high		Increase coupling (decrease C10B)

(Plate and output currents referred to are for power amplifier.)

Tune the antenna circuit by adjusting inductance coil L8B until the antenna current becomes a maximum as indicated by meter M4B marked "ANTENNA CURRENT." The antenna circuit is tuned approximately by means of the adjustable tap on inductance coil L8B, and final adjustments are made with the hand-wheel marked "ANTENNA TUNING." As the antenna circuit is brought into resonance, the output current of the power amplifier will decrease, indicating that energy is being transferred to the antenna. A careful readjustment of the power amplifier output circuit tuning and then of the antenna tuning should be made. Regardless of the value of the antenna current, the power amplifier output current and the power amplifier plate current should be readjusted as nearly as possible to the exact values given in Table V.

The ranges of currents in Table V are those within which satisfactory operation may be expected, if impossible to adjust to the exact values given.

For a given antenna power, the power amplifier plate current is a measure of the impedance offered to the radio frequency output voltage of the power amplifier by the circuit composed of L7B, C7B, C10B and the coupled antenna circuit. A change in value of either tuning or coupling condenser (followed by a retuning of inductance L7B and L8B) changes both the power amplifier output current and the power amplifier plate current. The effect of a change in the coupling capacity is to produce a large variation in the power amplifier output current. A change in the tuning capacity, however, results in a large variation in the power amplifier plate current. Tables VI and VII indicate in

TABLE VII—ADJUSTMENT OF POWER AMPLIFIER TUNING AND ANTENNA COUPLING CONDENSERS FOR PROPER OUTPUT IMPEDANCE

INDICATION		ADJUSTMENT
Plate current OK and Output current	...high	Decrease C10B then see Table VI
	...low	Increase C10B then see Table VI
Output current OK and Plate current	...high	Decrease C7B then see Table VI
	...low	Increase C7B then see Table VI

(Plate and output currents referred to are for power amplifier.)

convenient tabular form some suggestions for the adjustment of the tuning condenser C7B and coupling condenser C10B, which may be used in adjusting the power amplifier plate current and the power amplifier output current to within the values specified in Table V, page 44.

Some further considerations of the adjustment of tuning condenser C7B and coupling condenser C10B follow and may prove helpful.

There are two methods of increasing the power amplifier plate circuit impedance. One method is to increase the reactance of the condenser branch of the output circuit, i.e., decrease the value of the tuning condenser C7B; the other method is to loosen the coupling, i.e., increase the capacity of the coupling condenser C10B. The two methods have the same effect on the power amplifier plate current (a decrease) but the first method decreases the power amplifier output current, while the latter increases it. For a decrease in power amplifier output circuit impedance the reverse holds true; the tuning condenser C7B may be increased or the coupling condenser C10B may be decreased in capacity. Either of these two adjustments will increase the plate current. However, the power amplifier closed circuit current is increased in the first adjustment and decreased in the second adjustment.

It will be found that large changes in either condenser C7B or C10B may require a change in the taps on tuning inductance L7B. (Both taps are moved together.) This tap change will amount to one or two turns and must be obtained by trial. The data given in Table VIII indicates the directions the tap change will take in order to bring the circuit again in tune.

TABLE VIII—ADJUSTMENT OF POWER AMPLIFIER TUNING INDUCTANCE

CAPACITY CHANGE (large changes only)	TAP CHANGE
Increase in C7B.....	Decrease turns
Decrease in C7B.....	Increase turns
Increase in C10B.....	Decrease turns
Decrease in C10B.....	Increase turns

In cases where one current (Table V) is within the indicated range and the other one is not, the procedure in Table VII should be followed as the first operation. This will either bring both currents to proper values or will enable Table VI to be used for the second adjustment.

When the adjustments are made in this manner it is desirable to keep a record of current indications for the various capacities used. This record may take the following form:

Value of C7B	Value of C10B	Power Amplifier Output Current	Power Amplifier Plate Current	Antenna Power
-----------------	------------------	-----------------------------------	----------------------------------	------------------

The adjustments giving currents nearest to the exact values of Table V may then be chosen. The closed circuit inductance L7B should be adjusted to give a minimum power amplifier plate current, and the antenna inductance L8B should be adjusted to give a maximum antenna current. The output of the transmitter may now be adjusted to give the antenna current corresponding to

TABLE IX—TYPICAL METER READINGS

OSCILLATOR UNIT	500 to 1500 Kilocycles
First Amplifier Grid Current	0 to 2 milliamperes
Oscillator Grid Current	0.1 to 3 milliamperes*
Second Amplifier Grid Current	3 to 15 milliamperes
First Amplifier Plate Current	50 to 80 milliamperes
Oscillator Plate Current	55 to 70 milliamperes
Second Amplifier Plate Current	70 to 90 milliamperes
First Amplifier Output Current	See page 62
Second Amplifier Output Current	1 to 1.5 amperes
AMPLIFIER UNIT	500 to 1500 Kilocycles
Speech Amplifier Plate Current	30 to 40 milliamperes
Antenna Current**	
Power Amplifier Output Current	13 to 15 amperes
Power Amplifier Plate Current	0.75 to 0.95 amperes
Leakage Current	0.5 to 10 milliamperes
Modulator Grid Current	0
Modulator Plate Current	70 to 120 milliamperes
Third Amplifier Grid Current	0 to 3 milliamperes
Third Amplifier Plate Current	100 to 225 milliamperes
Third Amplifier Load Current	50 to 125 milliamperes
Filament Voltage	22 volts
Grid Voltage	250 volts
Plate Voltage	4000 volts

*The end turns of L1A should be short-circuited by the auxiliary link of D13A if the Oscillator Grid Current otherwise exceeds 3 milliamperes. Under no circumstances should the grid current be allowed to exceed 4 milliamperes, as the quartz plate may be damaged.

**The antenna current will equal the square root of the quotient of 1,000 divided by the effective antenna resistance at the operating frequency.

the desired power output by adjusting the control on the oscillator panel marked "THIRD AMPLIFIER INPUT." With this adjustment made, the transmitter should be retuned and the values of current indicated by the meters should be as shown in Table IX.

With an antenna current of the proper value, the power amplifier output current should fall within the limits noted in Table V. If the power amplifier output current is less than the value noted, a readjustment should be made using the larger capacity in C10B. If the output current is greater than indicated in Table V, a readjustment should be made using a smaller capacity in C10B.

In a very few instances the correct value of power amplifier plate current cannot be obtained with the taps of inductance L7B connected to the same turn. In these cases the value of C7B which gives the nearest higher value of power amplifier plate current should be used, and the following tap adjustment on L7B should be made. The tap on the upper slider of L7B (which connects to the plate circuit of V4B through condenser C6B) should be moved toward the front panel the necessary number of turns to bring the plate current to the correct value. The effect of decreasing the number of turns decreases the plate

circuit impedance without greatly affecting the power amplifier output current. This adjustment should not be resorted to unless it is impossible to obtain the correct adjustment by the methods already outlined. As a general rule the power amplifier output current may be adjusted by changing C10B, and the power amplifier plate current by changing L7B and C7B.

When the final readjustments of the transmitter are made, the meter indications should be as shown in Table IX.

RECAPITULATION OF TUNING ADJUSTMENTS

Adjust the oscillator output inductance L1A, and the first and second amplifier inductances L4A and L10A, respectively to the taps indicated in Tables I, II, and III. For the trial settings of the Amplifier Unit use the values of tuning condenser C7B and tuning inductances L6B and L7B given in Table IV on page 40. It is desirable at first to couple the antenna circuit, by means of condenser C10B, as loosely as possible to the power amplifier output circuit. An initial value of condenser C10B, larger by 0.005 microfarad than the value given in Table IV, should be used. Gradually tighten the coupling by decreasing the value of condenser C10B to the approximate value given in Table IV.

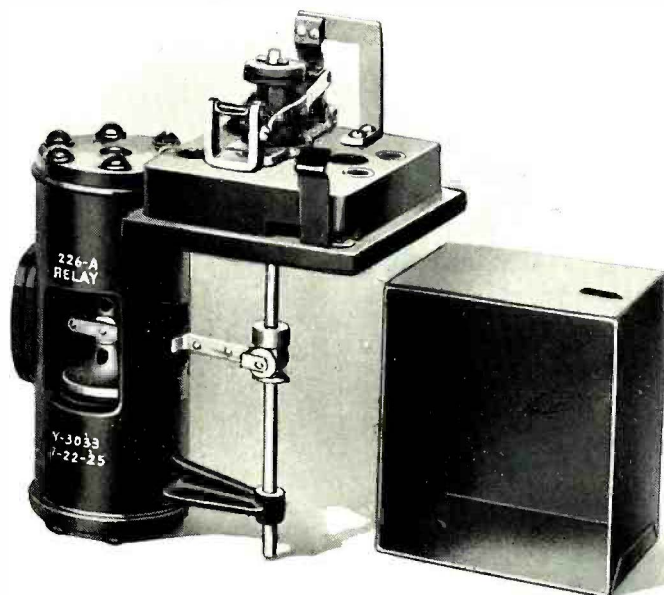
Adjust "THIRD AMPLIFIER INPUT" to a minimum. Adjust "FIRST AMPLIFIER INPUT" to an amount sufficient to enable tuning of the first and second amplifier output circuits. Neutralize the second amplifier.

Increase the "THIRD AMPLIFIER INPUT" sufficiently to enable tuning of the third amplifier, power amplifier, and antenna circuits. Tune for minimum third amplifier plate current and power amplifier plate current, and maximum antenna current. Compare the power amplifier output current with the values given in Table V, and make the necessary circuit adjustments as indicated in Table VI or VII. (Tables V, VI and VII are on pages 44 and 45.) Neutralize the third amplifier.

Adjust the antenna power to the value desired. It is desirable to make initial adjustments with a low plate voltage and a low radio frequency input until the transmitter is approximately tuned. The plate voltage and radio frequency input control may then be increased to normal without danger of excess currents due to maladjustments.

NO. D-88218 WATER CIRCULATING SYSTEM

The No. D-88218 Water Circulating System consists of a water circulating pump, a radiator, an expansion tank, control valves and the necessary piping to connect the system to the transmitter. This system provides for the dissipation of the heat developed on the anode of the No. 228-A Vacuum Tube. This heat, unless dissipated as rapidly as produced, will destroy the tube within a short time. For this reason, the transmitter is provided with a device which automatically removes all power from the No. 228-A Vacuum Tube whenever the water flow is materially reduced due to obstruction in the system or for other reasons. Protection is afforded by the use of a Venturi Tube in conjunction with a No. 226-A Relay. Contacts are provided on this relay which are



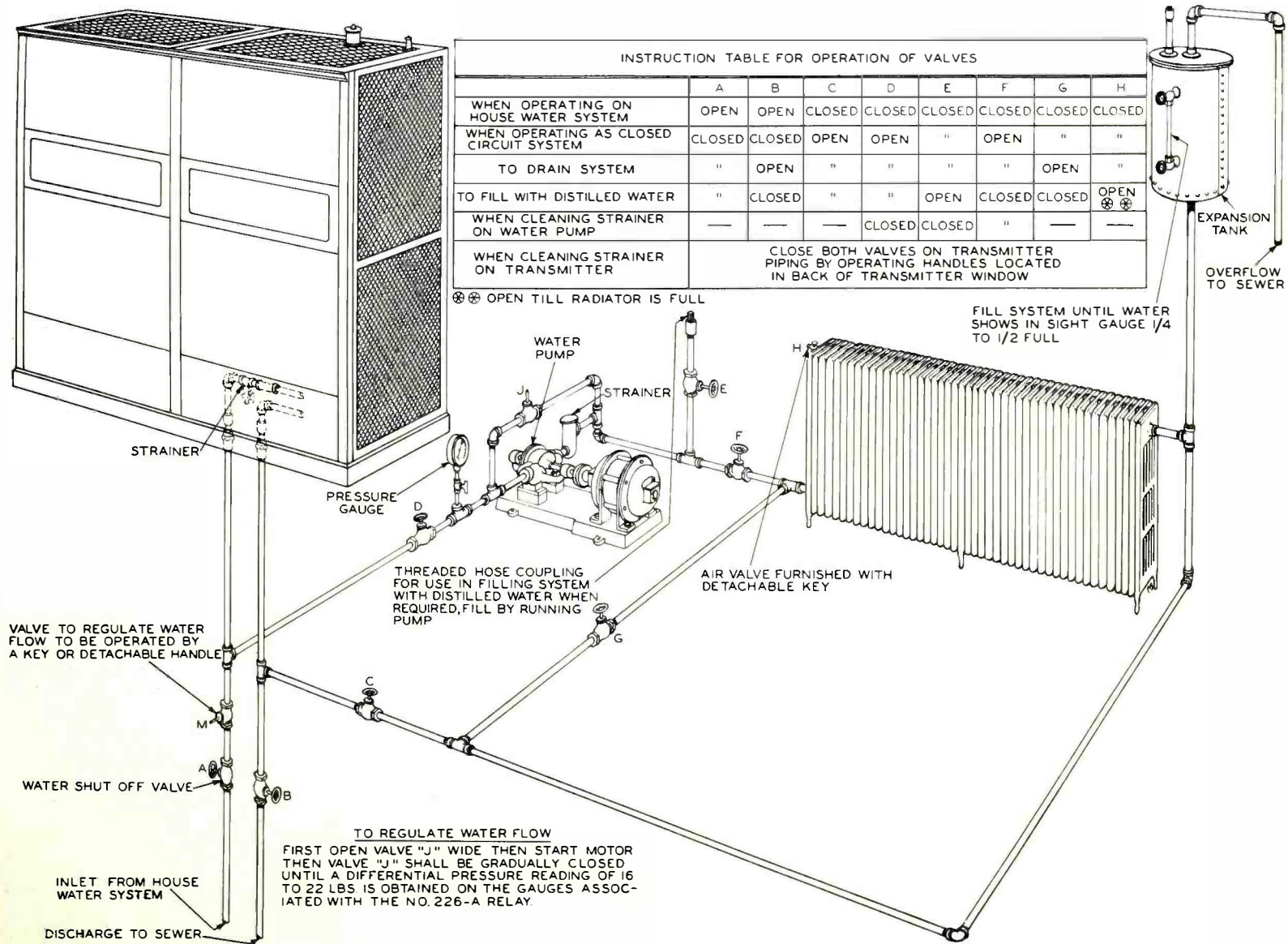
No. 226-A Relay

operated by the motion of two opposed metal bellows. The operation of the relay is as follows: Pressures of different magnitudes which are established at two separate points in the Venturi Tube by the water flow in the system, are transmitted through tubular connections to the metal bellows. The differential pressure established in the bellows causes one to expand and the other to contract, closing or opening a contact through the medium of a multi-lever and push rod.

The correct water flow is obtained by adjusting the inlet valve so that a differential pressure of not less than 15 pounds and not more than 22 pounds is indicated on the two gauges connected with the No. 226-A Relay. The differential pressure is read as follows: When the upper gauge indicates a vacuum (i.e., to the left of the "0") the differential pressure is the sum of the two gauge readings. When the upper gauge indicates a pressure (i.e., to the right of the "0") the differential pressure is the difference between the two gauge readings.

Inside of the Amplifier Unit in front of the two No. 212-D Vacuum Tubes are the controlling handles for two valves at the bottom of the Amplifier Unit.

[50]



Schematic Diagram of the No. D-88218 Water Circulating System

These valves are in the inlet and outlet of the water circulating system and must, of course, be open during operation of the transmitter. These valves are closed when removing the No. 228-A Vacuum Tube from its socket.

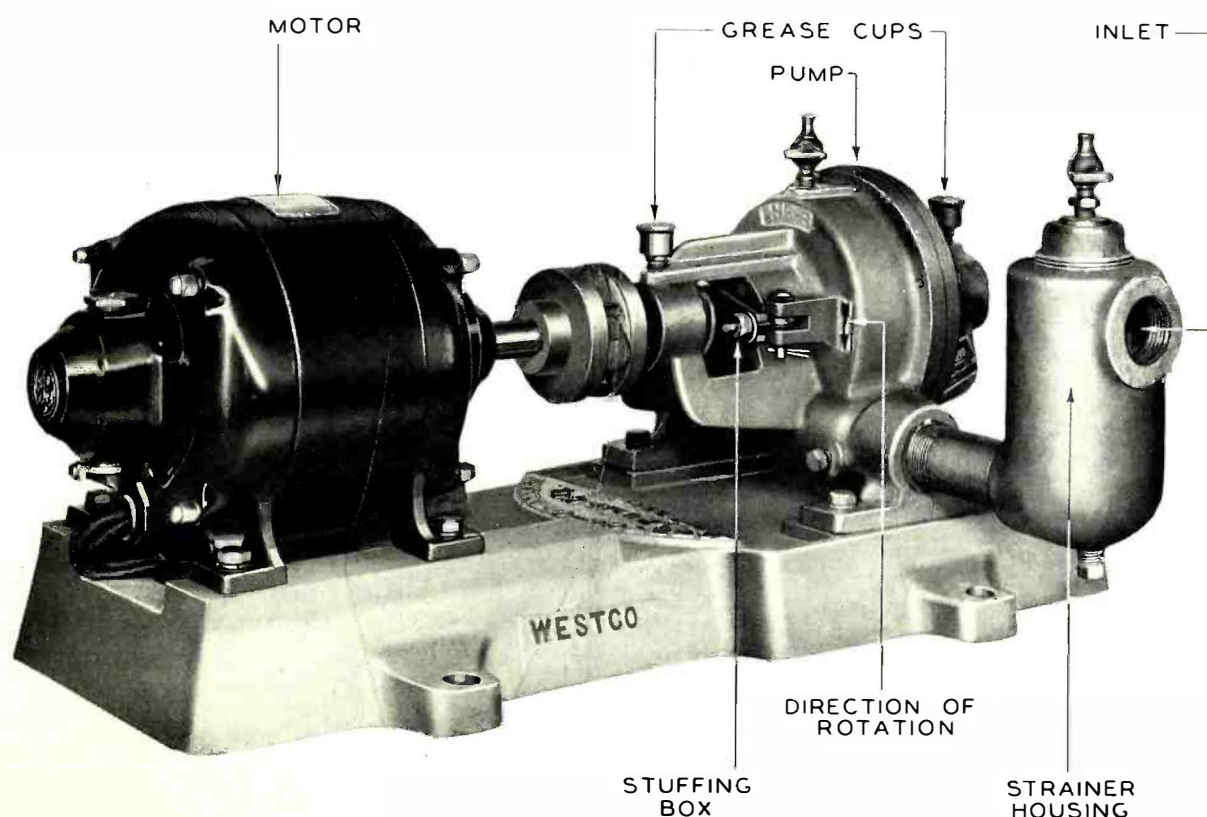
A strainer is provided in the water line ahead of the vacuum tube water jacket. This strainer, which is accessible by removing the front panel at the bottom of the Amplifier Unit, should be cleaned at frequent intervals.

The water pump is of a single stage, rotary impeller type, having vanes that extend into the water channel. The impeller is fastened to a shaft which revolves in two out-board ball bearings. The vanes attached to the impeller rotate in very close proximity to the pump casing, thereby causing a water seal to be formed which increases and maintains the pressure in the water channel.

A strainer is installed at the inlet to the pump to prevent foreign material, which might enter into the piping system during installation or thereafter, from entering the pump channel and damaging the vanes. The wire mesh strainer basket contained within the strainer casing should be inspected and cleaned frequently. Access to the strainer basket is obtained by removing the cover or plug from the top of the strainer casing.

The pump is direct-connected to a one-half horse power motor through a noiseless flexible coupling, both being mounted on the same base.

The radiator is a standard hot-water radiator of 135 square feet of radiating surface, consisting of 30 sections, 38 inches high, and has an overall length of 5 feet 7½ inches. The radiator is tapped for 1-inch pipe, top and bot-



No. KS-3068 Water Pump

tom, opposite ends. It is provided at one end with a pet-cock which should be open whenever the system is being filled so that any air that may accumulate in the radiator is expelled.

Due to the fact that an increase in the temperature of water will increase the volume, assuming a constant pressure, it is necessary to provide for the expansion of the water in the cooling system. A galvanized iron tank with a capacity of 10 gallons is installed in an elevated position to allow for the expansion. A vent which is open to the atmosphere relieves the pressure within the tank whenever expansion takes place. The tank is also equipped with a glass water gauge, and the water circulating system should be filled until the gauge indicates that the tank is one-quarter to one-half full.

A typical diagram of a water circulating system utilizing the equipment described in the preceding paragraphs is included in these instructions. Distilled water, which has less conductivity than other available water supply, should be used in the circulating system. This is important, since the power amplifier vacuum tube in the Amplifier Unit is operated at a potential of 4,000 volts above ground, and it is desirable to keep the leakage current in the water column through the hose connection as low as possible. The leakage current is indicated by meter M1B marked "LEAKAGE CURRENT." Full instructions on the operation of the water circulating system, the setting of valves, etc., are given in the diagram on page 50.

OPERATING PROCEDURE

GENERAL

The antenna switch should be set in the operating or ungrounded position when it is desired to broadcast. At all other times, the antenna should be grounded through this switch to protect the transmitter against lightning.

The adjustments and settings of the No. 6-B Radio Transmitter should be checked prior to each broadcasting period to assure the correct adjustments for proper operation of the transmitter on the assigned frequency. The temperatures indicated by the thermometers on front of the oscillator panel should be checked before the transmitter is operated to see that they are at the values specified for the respective crystals. It is advisable from the standpoint of careful maintenance of the carrier frequency to record the crystal temperatures at short intervals during operation, making such slight thermostat adjustments which may be necessary from time to time.

The "PLATE VOLTAGE" switch should be in the "OFF" position. The motor-generators are started by operating the top button of the "MASTER CONTROL" switch. The cooling water will start circulating simultaneously with the starting of the motor-generator sets.

The filament and grid voltages should be adjusted to 22 and 250 volts respectively, by means of the rheostats on the front of the amplifier panel.

The plate voltage is applied by operating the top button of the "PLATE VOLTAGE" switch. This voltage should be adjusted to 4,000 volts by varying the "4000-VOLT GENERATOR" field rheostat.

The readings of all meters should be compared with those indicated in Table IX on page 47 to assure proper transmitter operation before starting the program. It will be observed that the meter indications when the transmitter is first started will be above normal, gradually decreasing to their normal value as the transmitter warms up.

The level of the program into the transmitter as shown on the volume indicator of the speech input equipment should be approximately —8 db.

During the program a continuous observation of the meter indications should be made to verify the proper operating currents or voltages as prescribed in Table IX. Also, a continuous observation of the crystal temperatures should be made so that the specified operating temperatures are maintained.

The bearings of the motor-generators should be well supplied with oil and checked for heating every half hour.

OPERATION AT REDUCED POWER

The No. 6-B Radio Transmitter may be operated at reduced power by decreasing the "THIRD AMPLIFIER INPUT" control. The power input to the antenna may range from approximately 100 watts to 1,000 watts inclusive. The transmitter should never be operated at a carrier power greater than 1,000 watts, as this will seriously impair the quality and modulation.

MAINTENANCE

For the best operation, the No. 6-B Radio Transmitter must be kept free from dust and dirt. High pressure air is recommended for cleaning the apparatus inside the enclosures, but a soft, clean cloth can be used with good results. Waste and oily cloths should never be used. Lemon oil is recommended for cleaning the front of the panel units. It should be used sparingly and wiped off with a clean cloth.

DAILY ROUTINE

As far as possible, anticipate tube failures and make the required tube replacements. Tube failure may be guarded against to some extent by keeping a record of the length of time the tubes are in use, and by observing the condition of the elements inside of the tubes. The plate or grid may have become warped, or the filament may have sagged, due to excessive heat, in such a manner as to increase the probability of these parts short-circuiting.

Clean the commutators of the high and low voltage generators with a rag to remove oil and dust. This will help keep the generator noise at a minimum.

CAUTION: BE SURE THERE IS NO VOLTAGE ON THESE MACHINES AT THIS TIME.

Clean the oil and dust from the motor-generator sets.

WEEKLY ROUTINE

Once a week the following routine should be followed in addition to the daily routine.

Inspect and clean the contacts of the temperature control relays mounted on the temperature control panel. The thermostat contacts should also be inspected and cleaned if necessary. These contacts are cleaned in accordance with the procedure outlined on page 68.

Clean the commutators of the high voltage and low voltage generators with cloth or canvas. Do not use emery or crocus cloth for this purpose. Wipe dust and grease off the brush holders.

CAUTION: BE SURE THERE IS NO VOLTAGE ON THESE MACHINES AT THIS TIME.

Wipe dust and dirt off of exposed apparatus. This includes the motor-generator sets and the radio transmitter together with the apparatus and meters mounted on it. Compressed air or bellows should be used to clean out the inaccessible places. Many cases of trouble will be prevented by keeping the equipment clean.

Inspect the condition of the brushes on the motor-generator sets and replace them when necessary. The brushes should be replaced when they have been worn so short that there is danger of the brush spring resting on the brush holder.

Check the lubrication of the motor-generator sets, and make sure that the oil rings are rotating properly. Any good grade of machine oil may be used.

Check the store of tubes and other spare parts. Have all spares readily accessible and clearly classified. It is important to permit no confusion of serviceable and unserviceable material. Such confusions may cause unnecessary delays in broadcasting at the time trouble arises. A list of spare parts furnished with the equipment will be found in the section on Spare Parts.

Inspect and clean strainers in the water circulating system.

ADDITIONAL ROUTINE

Once a month test all nuts, bolts and screws and tighten loose ones if any are found. Also, check connections and if any loose contacts are found, tighten or resolder them. Cases of trouble can often be prevented by such tests.

Two or three times a year lower the antenna and clean the dirt and soot off the insulators. Inspect contacts and tighten the nuts and bolts, if any are used on the antenna fittings. It is important that the antenna insulators should be cleaned periodically, especially in locations where there is much smoke in the air. Where smoke exists, soot collects on the insulators and produces high resistance ground leaks which will reduce the radiation efficiency of the station.

NO. D-87781 QUARTZ OSCILLATOR

An occasion may arise when it will be necessary to inspect, clean and replace the crystal of the No. D-87781 Quartz Oscillator. This is done in accordance with the following procedure :

Remove the three outer screws clamping the housing to the lower electrode. In doing this care shall be taken not to separate the housing from the lower electrode, as this will likely tear the foil connecting the upper electrode and the oscillator terminal. Carefully invert the quartz oscillator, taking care to keep the housing and lower electrode intact. Then remove the lower electrode. Carefully lift out the crystal by the edges. This affords inspection of the crystal, housing and electrodes.

The crystal, housing and electrode should be cleaned through the use of carbon tetrachloride and lens paper or other lintless material. After the crystal has been cleaned, DO NOT TOUCH THE SURFACES OF THE CRYSTAL.

The procedure of reassembling the No. D-87781 Quartz Oscillator is the reverse of that described in the above paragraph. Replace the crystal, holding it by its edges, in the inverted housing. Then replace the lower electrode and invert the quartz oscillator, taking care to keep the housing and lower electrode intact. Tighten the three screws clamping the housing to the lower electrode. The quartz oscillator is now ready to be placed into operation. Care should be taken not to shake the No. D-87781 Quartz Oscillator unduly, as there is considerable space for the movement of the upper electrode. Careless handling of the quartz oscillator may seriously injure the crystal.

If there is occasion to ship the No. D-87781 Quartz Oscillator, care should be taken to suitably pad the crystal before making shipment. The Quartz Oscillator should then be placed in a carton containing adequate padding.

NO. 100-A CONDENSER

If the installation instructions which are packed with each condenser have been carefully followed, and the condensers operated at normal temperatures and rated voltage, little or no routine maintenance is required for the No. 100-A Condensers.

These condensers should be installed in a place where there is free circulation of air, and where the room temperature may be maintained between 40 degrees F. and 105 degrees F. They should be used only on direct current circuits and operated at potentials not exceeding 33 volts. If it is necessary to disconnect a condenser from the circuit for more than one week, the film on the positive plate may deteriorate. To prevent this, the condenser should be connected across a source of normal operating voltage for one or two hours each week that it is out of service.

When a condenser has not been maintained in this manner, it may pass a high current and give off gas when a potential is applied. If the cell is in this condition, it will be necessary to refilm the positive plate before putting a condenser back into service. This process is an emergency measure only, and should not be substituted for weekly maintenance while the condenser is out of service. Allowing the film on the positive plates to deteriorate, shortens the life of these cells. The refilming may be done by connecting the condenser in series with a 110-volt lamp rated between 50 and 100 watts, across a supply of direct current having a potential equal to or slightly greater than that of the circuit in which the condenser is used. Care should be taken in doing this that the positive terminal of the condenser is connected to the positive side of the source of potential. The condenser should be allowed to remain connected in this circuit until the current flowing through it drops to a value of 50 milliamperes or less. This may, in some cases, take one or two days.

Care should be taken to keep the hole in the porcelain cover plugged with a cork and to have the groove of the cover set properly over the rim of the glass jar. The paraffin in the grooves maintaining the seal. Unless the air space above the oil is sealed to prevent air circulation, crystals from the evaporation of creeping condenser fluid will form on the supports above the oil.

Occasionally a gray precipitate will appear at the bottom of the jar. This is a result of a corrosive action which takes place on the positive or corrugated plates and their terminals. Such a corrosive attack is particularly likely to take place if sufficient care has not been exercised in the installation of the condensers. This action is not harmful unless the terminals of one of the positive plates are weakened sufficiently to allow the plate to drop against the negative structure. In the event of a short-circuit of this nature, the condenser plates can be removed from the fluid, the remaining supports of the affected plate cut off and the damaged plate removed. The remaining electrodes may then be used until a new condenser is obtained.

RELAYS

Experience has shown that dirty contacts constitute one of the chief sources of relay trouble due to dust collecting on the contacts in spite of the individual covers. Abrasives, such as fine files or emery cloth, should never be used on contacts. In cases of badly pitted contacts, crocus cloth may be used, but the contacts should be cleaned as outlined after such use.

For cleaning contacts, a small quantity of carbon tetrachloride of highest purity and some hard wood toothpicks, flat on one end, are required. A drop or two of the liquid should be deposited on the relay contacts, they being held slightly separated. The point of a toothpick may be used for this purpose. The flat end of the toothpick should then be dipped in the liquid to a depth of about one-quarter of an inch and rubbed back and forth two or three times between the contacts, which should be closed with a slight pressure on the flat sides of the toothpick. The liquid will soften any deposit that may have collected on the contacts, and the rubbing will remove it. Then with the contacts again held slightly open, they should be flushed with a little of the liquid taken up on the clean point of the toothpick (not the end used for rubbing). This will wash off any loose particles that remain. The toothpick should not be reused for cleaning another set of contacts, otherwise the deposit removed from one contact might be left in the liquid and later deposited on the other contacts. Care should be taken to keep the liquid from coming in contact with the rubber studs or insulators as far as is practicable, as carbon tetrachloride has an injurious effect on rubber if applied frequently.

In order to assure unretarded action of the valves of the 4,000-Volt Time Delay Relay, it is recommended that Neatsfoot Oil be applied to the bellows once every three months or oftener if necessary.

LOCATION OF TROUBLE

GENERAL

If routine maintenance tests are made regularly and carefully, very few cases of trouble will occur. To the new operator, simple troubles are often found difficult to locate, while to the experienced operator, the cause is usually obvious.

It is not possible to anticipate every case of trouble that may arise, however, the time required to find the cause of any trouble will be reduced to a minimum if a systematic procedure of testing is used.

The transmitter may fail to function either at the time of attempting to start it, or it may fail while it is in operation. In either case, the procedure for making a test is to check the circuits in the sequence they are made operative in the process of starting the transmitter. In most cases, it is generally possible to immediately isolate the trouble, that is, to locate it in some one unit of the equipment such as the Motor-Generator, the Oscillator Unit, Amplifier Unit, the Water Circulating System, or the Antenna System. Frequently it is possible to still further isolate the trouble, as for example, in the Amplifier Unit, it is possible to determine whether it is in the modulator, speech amplifier, the third amplifier, the power amplifier or the monitoring rectifier circuit. Trouble may also arise in a motor-generator set, for example, in the motor, the filament voltage generator or the grid bias voltage generator. Before starting on any elaborate set of tests, check the position of all switches and controls and make sure that they are in the correct position.

TRANSMITTER

Overloading

The margin of safety in designing the No. 6-B Radio Transmitter has been made ample to allow for the proper and continued operation of this transmitter at the rated power output of one kilowatt. It should be realized that the instantaneous power output of the transmitter during modulation is considerably greater than one kilowatt. For peaks of modulation the output power may approach four kilowatts. To assure continuity of operation and high quality of transmission, the transmitter carrier output power should under no circumstances exceed one kilowatt.

Failure of Antenna Current

If current is indicated by the output meter of the power amplifier, but not indicated by the antenna current meter, the cause may be due to an open, grounded or untuned antenna circuit, or to a short-circuit of the antenna coupling condensers.

Reduced Radiation

Reduced radiation, indicated by reports from radio listeners, accompanied by reduced antenna current, usually indicates that connections in the antenna

lead or ground have corroded, introducing a high resistance in the antenna-ground system. Inspection of all contacts in this system should be made, and imperfect contacts eliminated. Reduced radiation may also be caused by dirty insulators which provide a high resistance leak to ground. The antenna should be lowered and the insulators cleaned or replaced. If reduced radiation is unaccompanied by a change in antenna current it is probably due to a seasonal or atmospheric condition which will eventually right itself.

Deviation From Assigned Frequency

The deviation of the carrier frequency from its assigned frequency is usually due to the failure of the temperature control equipment. The temperature should be observed to see that it is at the operating value specified for the particular crystal. A log of the temperature of the crystal during operation should be carefully maintained and any deviation in temperature promptly corrected.

Frequency deviation may also be caused by poor contact of the lower electrode of the No. D-87781 Quartz Oscillator with the metal mounting block of the thermal element, thus effectively lowering the temperature of the crystal. Care should be taken that the lower electrode is clamped tightly to the metal mounting block. If the retaining clips on the metal mounting block lose their tension, squeeze them towards the center of the block. *Do not bend the clips.*

Failure of the No. D-87781 Quartz Oscillator

Should either quartz oscillator cease to operate as indicated by zero oscillator grid current, it should be inspected for a defective crystal or for dirt between the crystal and electrodes. The procedure for inspecting, cleaning and replacing crystal is outlined on page 55. If the crystal is defective, it should be replaced. If dirt is present, the crystal, housing and electrodes should be cleaned as described on page 55.

Intermittent operation of the quartz oscillator is usually due to a bad connection. All connections between the quartz oscillator terminal and the grid terminal of the oscillator tube should be carefully inspected, and loose connections should be corrected.

NOTE: To assure that both quartz oscillators are in operating condition the position of the "CRYSTAL SELECTOR" switch should be changed periodically.

Temperature Control Equipment

Should the temperature rise to an abnormal value, the operator should check the operation of the relay in accordance with the simple test that is outlined on page 37. If the relay is functioning properly, the trouble is probably due to dirty thermostat contacts. Turn "HEATER SUPPLY SWITCH OFF." *First remove the thermometer,* then remove the thermal element with the attached No. D-87781 Quartz Oscillator from the heat insulated chamber. Clean the contacts of the thermostat in accordance with the procedure outlined for the cleaning of relay contacts on page 57.

If the temperature rises to an abnormal value it may cause the mercury to enter the expansion chamber of the thermometer. A slight amount of mercury in the expansion chamber will cause inaccuracy in the temperature readings. If this condition exists, the thermometer should be replaced, as it is practically impossible to restore the mercury.

Should the temperature decrease to a subnormal value, the operator should look for a failure of either the No. 102-D Vacuum Tube (AC Power Supply) or the No. 102-F Vacuum Tube (DC Power Supply), an open heater circuit, or improper operation of the relay. If the relay is at fault, its operation should be checked as outlined on page 37.

Failure of Filament Voltage Supply

The condition is ordinarily an indication that the 25-volt generator field circuit is open. This is usually caused by the failure of either the water circulating system, field circuit relay S5B, or open fuses in the control circuits. Failure of a filament to light may be due to a defective tube, an open in the filament leads, or to an open fuse.

Failure of Grid Bias Voltage Supply

This trouble is usually caused by a defective field circuit due to an open in the field, the field leads or the field rheostat R21B. The failure of grid bias voltage will cause all control circuits to be inoperative. However, if voltage is indicated by voltmeter M12B and the control circuits fail to function, then the cause of the trouble may be located by checking through the circuits in the sequence of operation as described on page 10.

Failure of Plate Voltage Supply

The failure of the high voltage supply is usually caused by an open in the field circuit. This open may be due to a failure in the operation of either time delay relay S1B, overload relay S2B, field relay S4B, or push-button switch D3B. An open field circuit may also be caused by a defective field rheostat R23B. If voltage is indicated by voltmeter M11B but no current indicated by the plate current meters, the high voltage fuses in the back of the Amplifier Unit are probably open.

Fuse Failure

If a fuse blows, a thorough search should be made to find the cause of the trouble before replacing the fuse. If nothing is found, replace the fuse and apply power to the transmitter, observing the meters and other apparatus in the circuits controlling the particular fuse. If the fuse blows out a second time, the trouble should be found and rectified before again replacing the fuse.

DISTORTION

Listening Test

A listening test for quality distortion is made by comparing the program signal at the input of the transmitter with the reproduced program signal from

the monitoring rectifier using the same bridging amplifier and loud speaker. The volume of the signal from the loud speaker should be adjusted, by means of the potentiometer provided for the purpose in the speech input equipment, to be the same when the amplifier is connected to either circuit.

The comparison of the quality of the two signals is made by operating the key which connects the bridging amplifier first to the input circuit and then to the output monitoring circuit, and at the same time listening critically to the low frequency and high frequency sounds from the loud speaker. Both speech and musical sounds should be used for comparison purposes. The observations should be made continuously for a short period of time, switching back and forth between the two circuits at frequent intervals.

If distortion is observed in the signal from the monitoring circuit, with the correct level of program input so that the load impedance is not of a proper value, it is possible that the output circuit of the power amplifier is incorrectly adjusted.

NOTE: In the operation of the transmitter no attempt should be made to draw current in the grid circuit of the modulator tube, as complete modulation is obtained at a much lower level. Over-modulation will cause serious distortion. The correct level for the transmitter is -8 db.

Load Impedance of Power Amplifier

It is necessary that the power amplifier work into the correct load or output circuit impedance. An indication of the correct impedance is given by the power amplifier plate current, as stated on page 44. If the adjustments are doubtful, the third amplifier, the power amplifier, and the antenna circuits should be readjusted very carefully, as these three circuits are somewhat interdependent, and the detuning of one circuit may affect the tuning of the others.

Second Amplifier

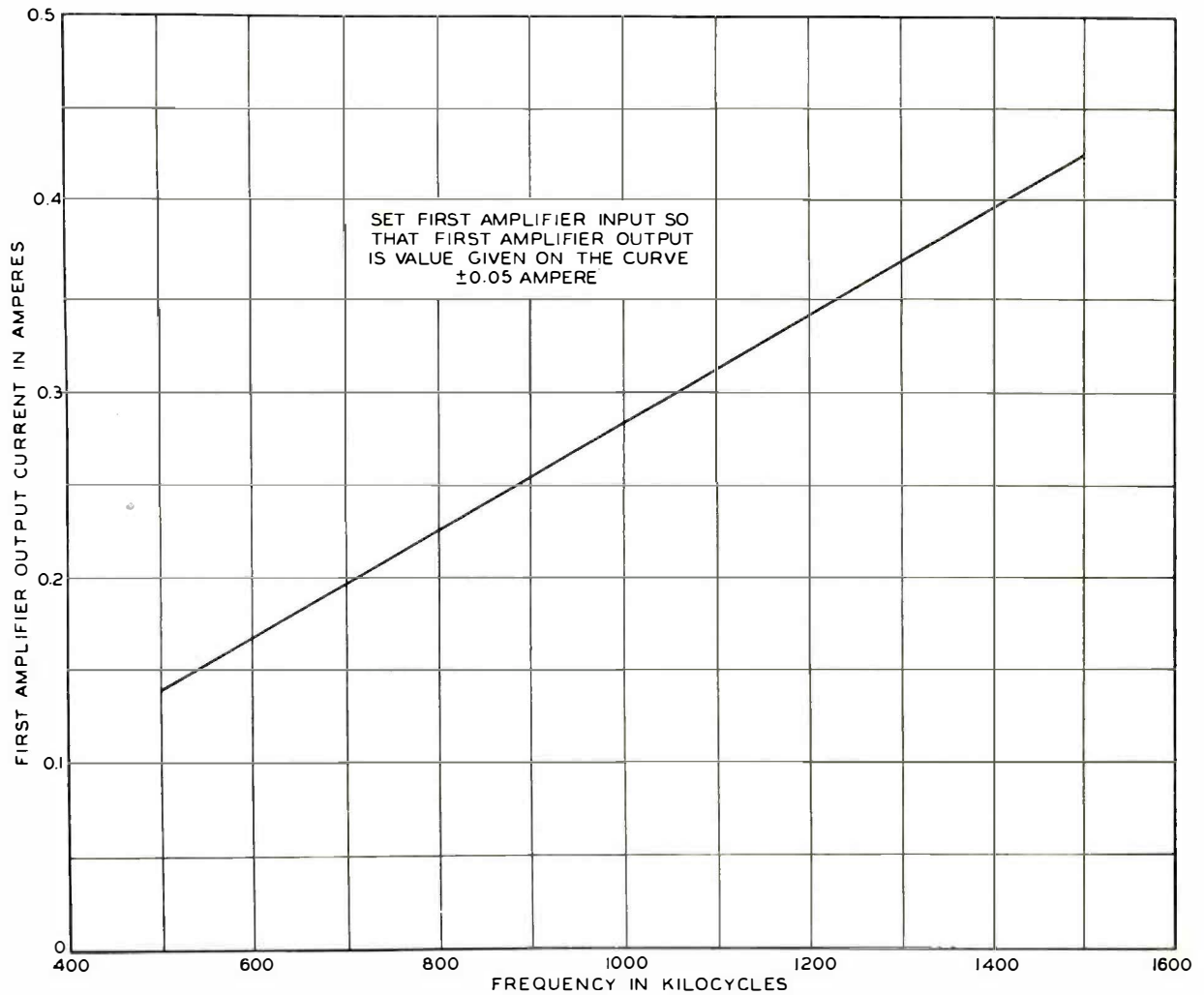
It is necessary that the second amplifier is operated with the proper AC grid voltage. The measure of this voltage is given by the first amplifier output current meter M8A. For the assigned frequency, the value of current that meter M8A should indicate is obtained from the curve on page 62. This current is controlled by adjustment of condenser C4A (FIRST AMPLIFIER INPUT).

If the second amplifier grid current is lower than that given in Table IX, page 47, and poor quality is experienced, replace second amplifier tube V3A.

Tuning of Output Circuits

In order that the load impedance for each amplifier be correct, it is absolutely necessary to have each output circuit adjusted for minimum plate current.

The impedance is also dependent upon the load resistance and, where poor quality appears to be due to incorrect load impedance, it is suggested that load resistors R17.1B and R17.2B be measured in order to see if they are of the proper values.



First Amplifier Output Current

Audio Amplifier System

There are very few faults that can occur in the audio frequency system that will enter into the quality of the radiated signal, without being evident from meter readings. In the event that any of the meter readings are abnormal, the cause should be found and remedied.

In case poor quality is noted and it is thought to be in the audio amplifier system and all meters read normal, test the secondary of transformer T1B, and the secondary shunt resistances R24.1B, R24.2B and R24.3B for an open circuit. Open the transformer primary connection and test for an open circuit.

Measure the resistances R15.1B, R15.2B, R15.3B, R15.4B, R15.5B and R15.6B to see that they have the proper values.

SPARE PARTS

The following vacuum tubes for use in the No. 6-B Radio Transmitter are furnished with the No. 106-B Radio Telephone Broadcasting Equipment of which the No. 6-B Radio Transmitter is a part:

VACUUM TUBES

For Service

- 2—No. 102-D for AC Power Supply
- 2—No. 102-F for DC Power Supply
- 1—No. 205-D
- 4—No. 248-A
- 2—No. 212-D
- 1—No. 228-A

For Spares

- 2—No. 102-D for AC Power Supply
- 2—No. 102-F for DC Power Supply
- 2—No. 205-D
- 4—No. 248-A
- 2—No. 212-D
- 2—No. 228-A

The following additional spare parts are furnished with the No. 6-B Radio Transmitter:

- 2—Nipples per Assembly Detail 1-A, ESA-309831, Issue 4.
- 1—Ring Nut per Detail 1, ESO-307968, Issue 4.
- 1—Flange Ring per Detail 2, ESO-307968, Issue 4.
- 1—Split Ring per Detail 1, ESO-307971, Issue 4.
- 6—Gaskets, Detail 2, ESO-307971, Issue 4.
- 6—Gaskets, Detail 3, ESO-307971, Issue 4.
- 10—D. & W. Telegraph Fuses, 2 amperes, 2,500 volts, Catalogue No. 2760.

The above, with the exception of the last item, refers to various parts of the No. 126-A water-cooled vacuum tube socket assembly.

ORDERS FOR REPLACEMENT APPARATUS SHOULD SPECIFY, IN ADDITION TO THE INFORMATION GIVEN ABOVE, THE TYPE AND SERIAL NUMBER OF THE RADIO TRANSMITTER AND ANY OTHER PERTINENT INFORMATION AVAILABLE.

The following apparatus is suggested as an additional complement of spare parts which may be purchased separately if the extra insurance against interruptions in service warrants:

- 1—No. KS-6346 Thermometer.
- 2—Armatures, one for each of the 2,000-volt generators of the No. KS-5320 Motor Generator Set.
- 1—Complete set of brushes for the No. KS-5320 Motor Generator Set.
- 1—Complete set of brushes for the No. KS-5322 Motor Generator Set.
- 1—Shaft packing for water pump KS-3068-4 (Eureka Packing Company's "AM-BEST" packing, $\frac{1}{4}$ inch diameter, 20 inches long.)

CONDENSERS

	<i>Circuit Designation</i>		<i>Circuit Designation</i>
1—0.002 Mfd.	C2A	4—1 Mfd.	C26A
1—1 Mfd.	C5A	1—0.005 Mfd.	C2B
1—0.002 Mfd.	C7A	1—0.002 Mfd.	C4.1B
1—0.0003 Mfd.	C9A	1—0.01 Mfd.	C6B
1—0.00075 Mfd.	C10A	1—0.0035 Mfd.	C9B
1—2 Mfd.	C20A		

RESISTANCES

	<i>Circuit Designation</i>		<i>Circuit Designation</i>
1— 50,000 Ohms	R5A	1— 260 Ohms	R33A *
1— 0.67 Ohms	R8A	1— 1.34 Ohms	R2B
1— 5,000 Ohms	R9.1A	1— 9 Ohms	R5.2B
1— 10,000 Ohms	R9.2A	1— 75 Ohms	R5.3B
1— 5,625 Ohms	R16.1A	1— 4,000 Ohms	R9B
1— 44 Ohms	R17.1A	1— 3,500 Ohms	R10B
1— 88 Ohms	R20.1A	1— 400 Ohms	R14B
1— 44 Ohms	R20.3A	1— 440 Ohms	R17.1B
1—100,000 Ohms	R23A	1— 100 Ohms	R26B
1— 10,000 Ohms	R25A	1— 107 Ohms	R36.1A *
1— 27,240 Ohms	R29A *	1— 110 Ohms	R37.1A *

* When the temperature control panel is DC operated, resistances R29A and R33A should be omitted and R36.1A and R37.1A substituted.

APPARATUS INFORMATION

The following list specifies the fuses and vacuum tubes required and indicates resistance values to facilitate the location of faulty resistors.

FUSES FOR NO. D-87738 OSCILLATOR UNIT

Designation	D&W Enclosed Cartridge Fuse
F1.1A	3 Ampere No. 91125
F1.2A	3 Ampere No. 91125
F2A	10 Ampere No. 91133

FUSES FOR NO. D-87739 AMPLIFIER UNIT

Designation	D&W Enclosed Cartridge Fuse
F1B	3 Ampere No. 91125
F2B	3 Ampere No. 91125
F3B	3 Ampere No. 91125
F4B	3 Ampere No. 91125
F5B	65 Ampere No. 91149
F6B	50 Ampere No. 91143
F7B	20 Ampere No. 91136
F8B	3 Ampere No. 91125
F9B	3 Ampere No. 91125
F10B	2 Ampere No. 2760
F11B	2 Ampere No. 2760
F12B	2 Ampere No. 2760

All fuses are 250-volt fuses except the No. 2760 fuses, which are 2,500 volts.

VACUUM TUBES

No. D-87738 Oscillator Unit		No. D-87739 Amplifier Unit	
<i>Designation</i>	<i>Code Number</i>	<i>Designation</i>	<i>Code Number</i>
V1A	No. 248-A	V1	No. 248-A
V2A	No. 248-A	V2	No. 212-D
V3A	No. 248-A	V3	No. 212-D
V4A*	No. 102-D	V4	No. 228-A
V5A*	No. 102-D	V5	No. 205-D
V6A**	No. 102-F		
V7A**	No. 102-F		

* For AC Power Supply.

** For DC Power Supply.

RESISTANCES FOR NO. D-87738 OSCILLATOR UNIT

<i>Designation</i>	<i>Resistance, Ohms</i>	<i>Designation</i>	<i>Resistance, Ohms</i>
R1A	950	R19A	44
R2A	950	R20.1A	88
R3A	50,000	R20.2A	88
R6A	5,000	R20.3A	44
R7.1A	100	R21A	100,000
R7.2A	100	R22A	100,000
R8A	0.67	R23A	100,000
R9.1A	5,000	R24A	100,000
R9.2A	10,000	R25A	10,000 Variable
R9.3A	10,000	R26A	10,000 Variable
R10.1A	100	R29A	27,240
R10.2A	100	R30A	27,240
R11.1A	10,000	R31A	20,000
R11.2A	10,000	R32A	20,000
R12.1A	44	R33A	260
R12.2A	44	R34A	500
R14A	5,000	R35A	8
R15.1A	100	R36.1A	107
R15.2A	100	R36.2A	107
R16.1A	8,500	R37.1A	110
R16.2A	8,500	R37.2A	110
R17.1A	44	R38A	935
R17.2A	44	R39A	935
R18A	0.67		

RESISTANCES FOR NO. D-87730 AMPLIFIER UNIT

<i>Designation</i>	<i>Resistance, Ohms</i>	<i>Designation</i>	<i>Resistance, Ohms</i>
R2B	1.34	R15.4B	150
R3B	1.34	R15.5B	150
R4B	1,500	R15.6B	500
R5.1B	79	R17.1B	440
R5.2B	9 tapped at 3 and 6	R17.2B	440
R5.3B	75	R18B	1,000
R5.4B	75	R19B	11
R5.5B	75	R20B	Multiplier for M11B
R9B	4,000	R21B*	Approximately 1,250
R10B	3,500	R22B**	Approximately 7
R11B	25,000 tapped at 9,000	R23B***	Approximately 220
R13B	48,000	R24.1B	100,000
R14B	400	R24.2B	100,000
R15.1B	150	R24.3B	100,000
R15.2B	150	R25B	Multiplier for M12B
R15.3B	270	R26B	100

* Field rheostat for 250-volt generator of No. KS-5322 Motor-Generator Set.

** Field rheostat for 25-volt generator of No. KS-5322 Motor-Generator Set.

*** Field rheostat for high-voltage generator of No. KS-5320 Motor-Generator Set.

ENGINEERING SERVICE AND INFORMATION FOR ORDERING REPLACEMENTS

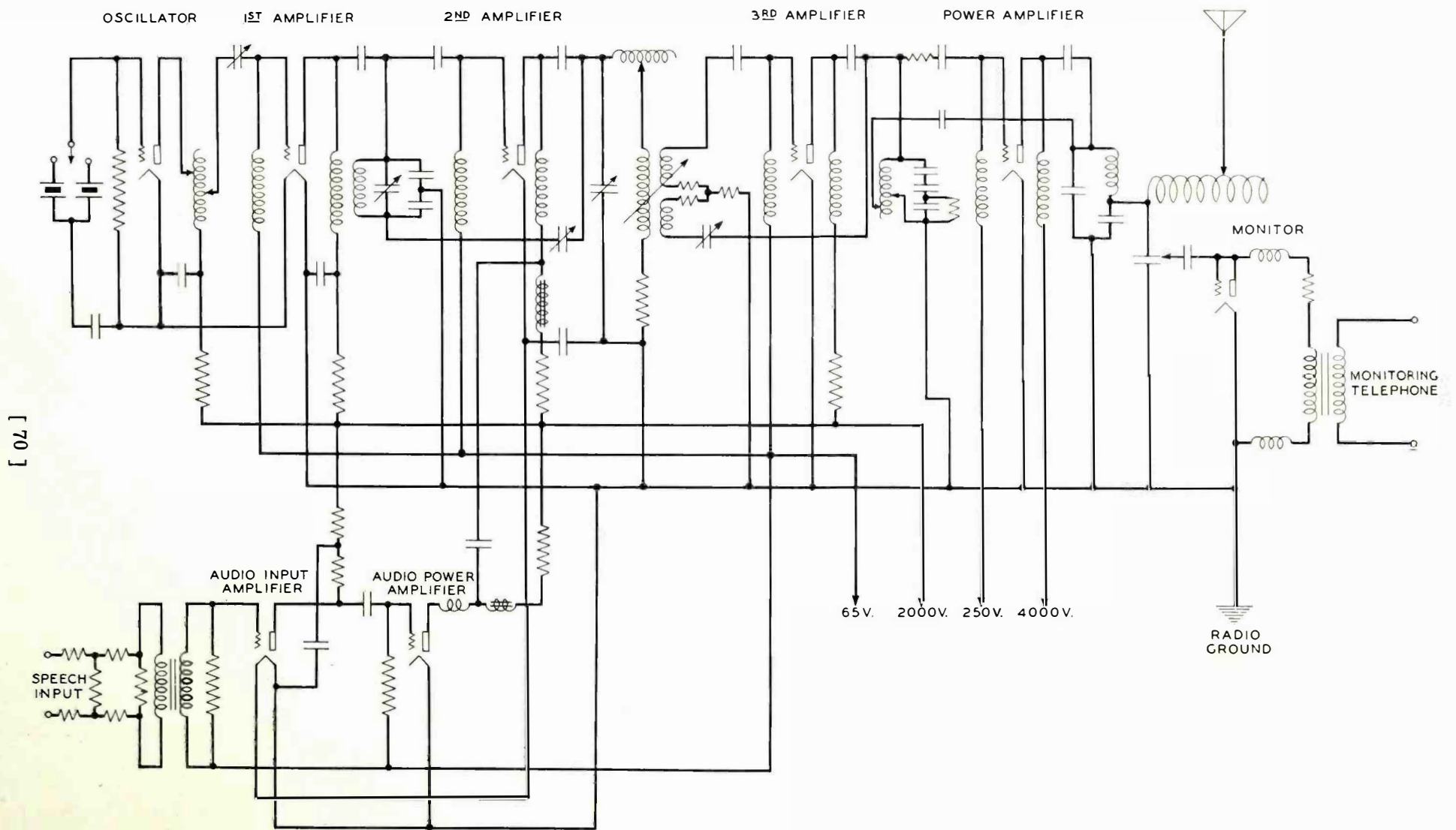
Should the purchaser desire to avail himself of engineering services, the matter should be referred to the nearest Branch House of the Graybar Electric Company and authorization for such service placed with them.

In Canada, this service may be obtained from the Northern Electric Company, Limited, and through the International Standard Electric Corporation in other foreign countries.

Orders for replacement apparatus should specify the apparatus designation (such as R2A) shown on the drawings and usually stamped on the apparatus, as well as the name, catalog number and nameplate data. The type and serial number of the radio transmitter and other pertinent information should be included.

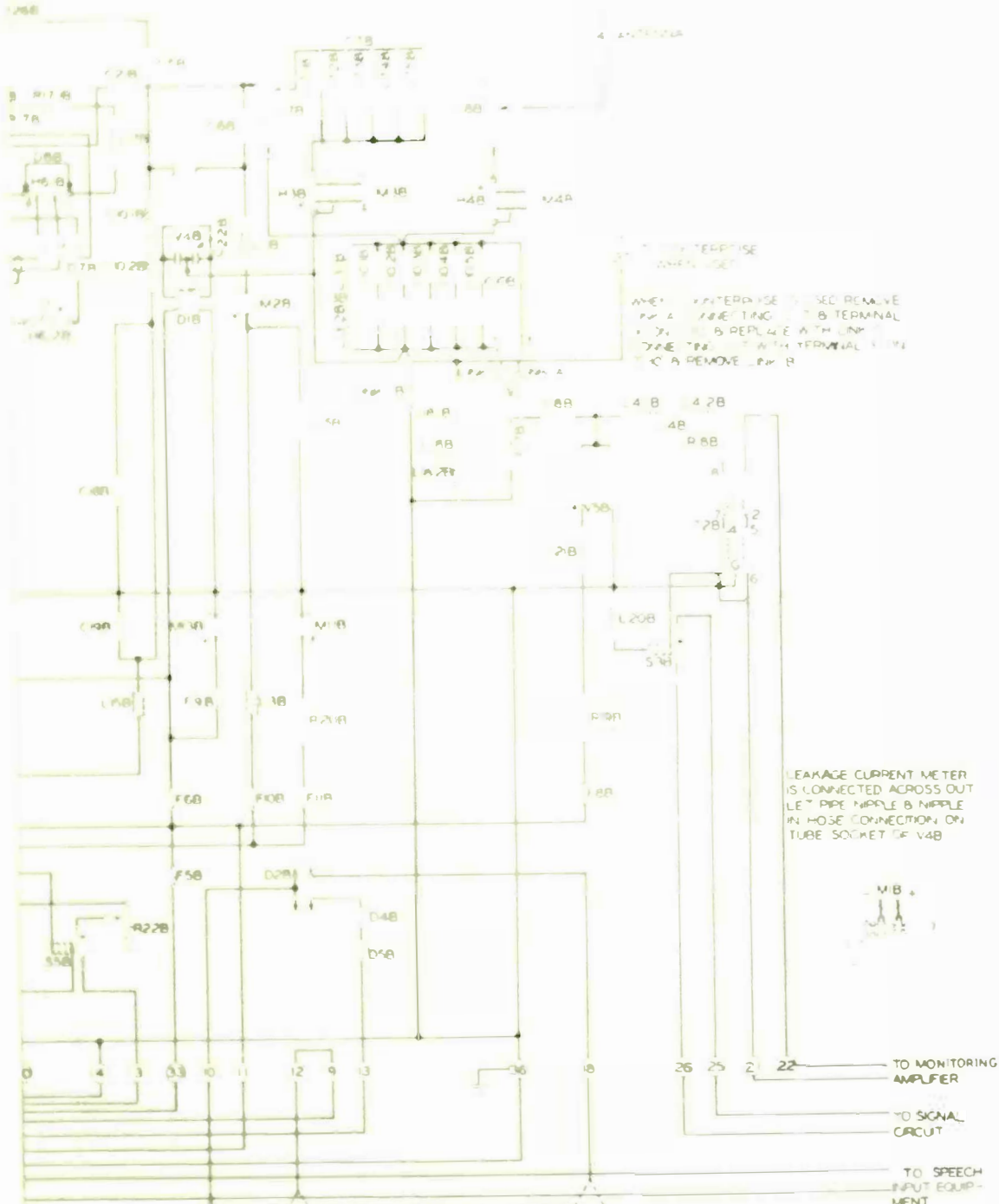
INSTRUCTION BULLETIN NO. 409

SCHEMATIC AND WIRING DIAGRAMS



[70]

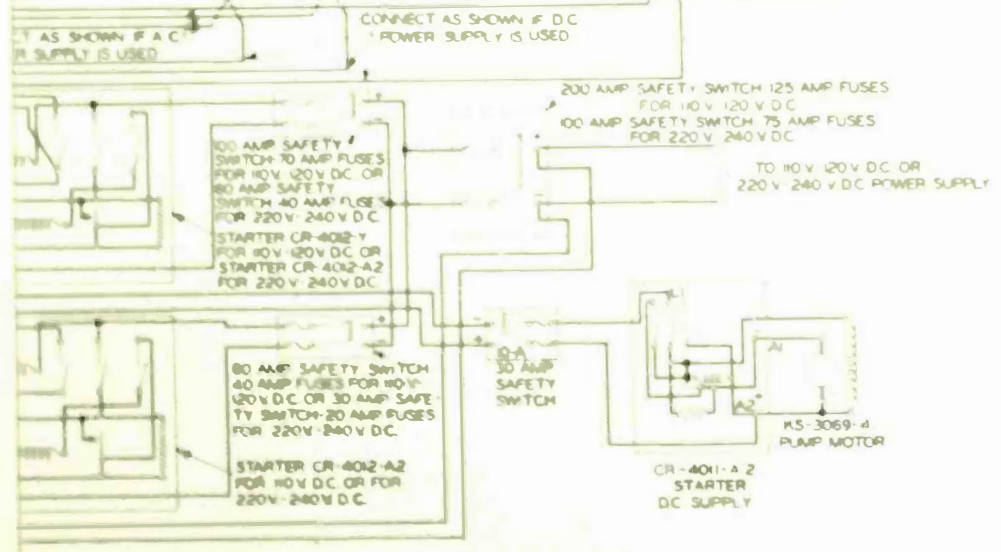
Simplified Schematic Diagram for the No. 6-B Radio Transmitter

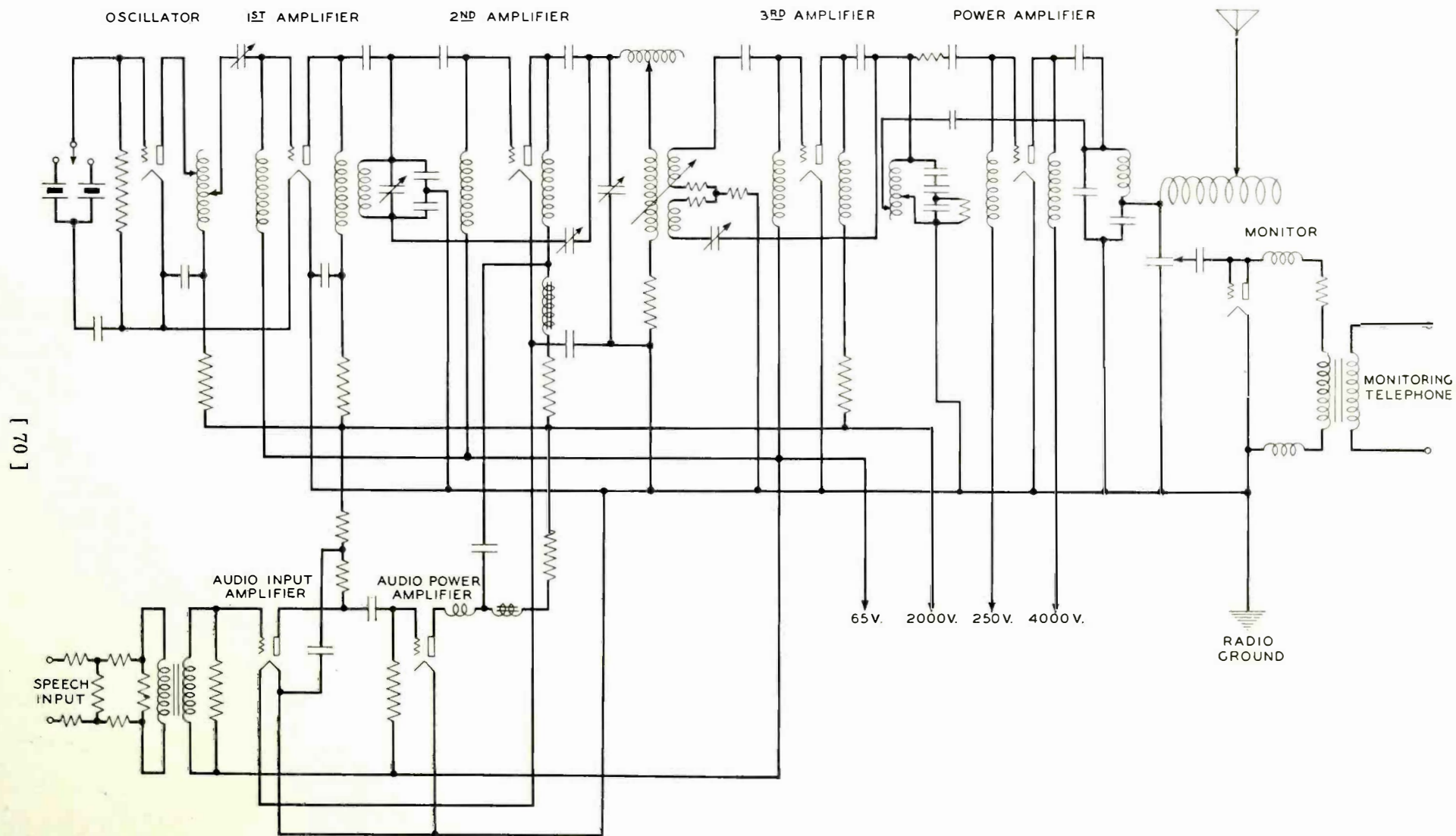


INTERPULSE WHEN USED

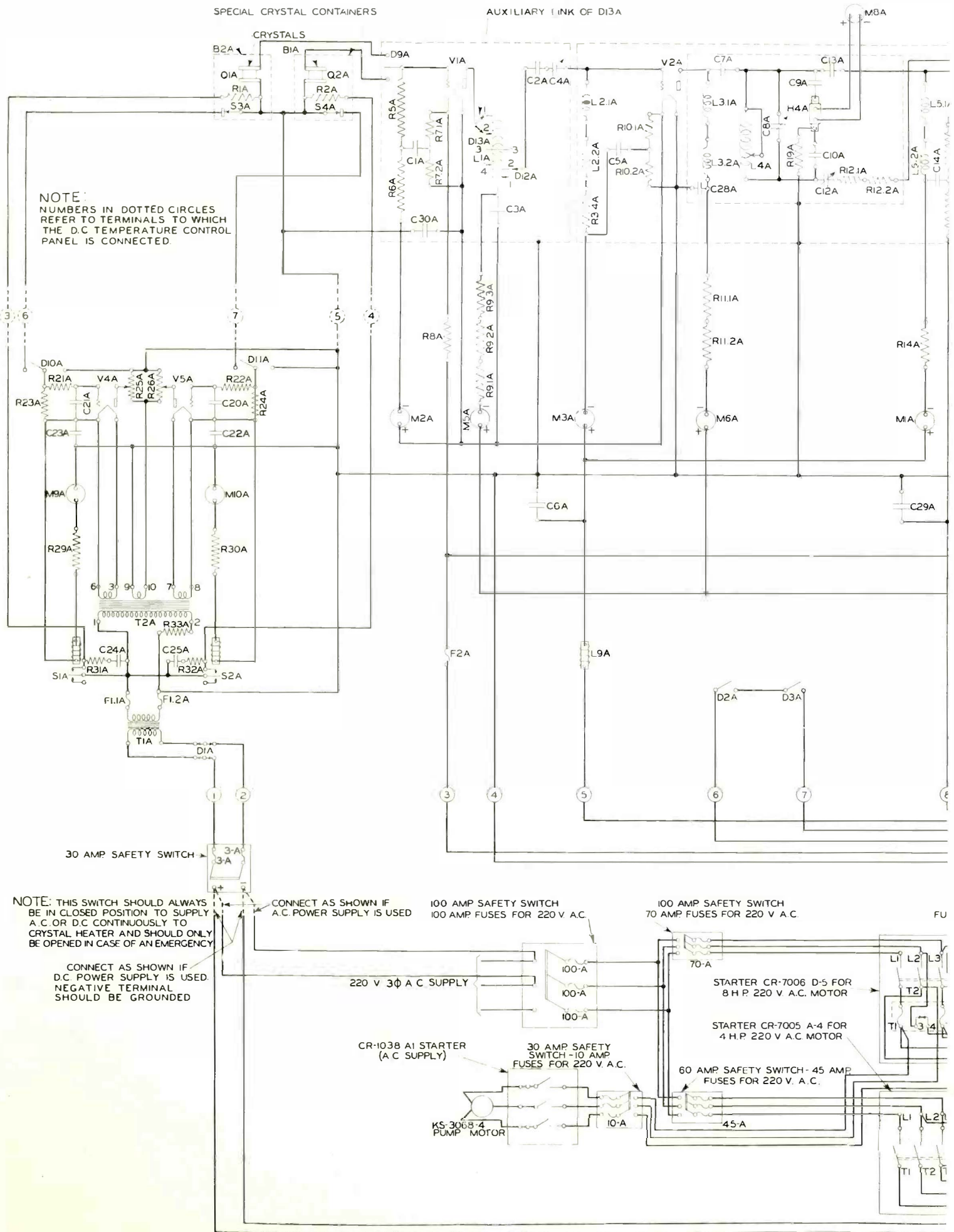
- W-1 INTERPULSE SEC REMOVE
- W-2 INTERPULSE B TERMINAL
- W-3 INTERPULSE A TH UNP
- W-4 INTERPULSE WITH TERMINAL
- W-5 REMOVE W-1 W-2

LEAKAGE CURRENT METER IS CONNECTED ACROSS OUTLET PIPE NIPPLE B NIPPLE IN HOSE CONNECTION ON TUBE SOCKET OF V4B

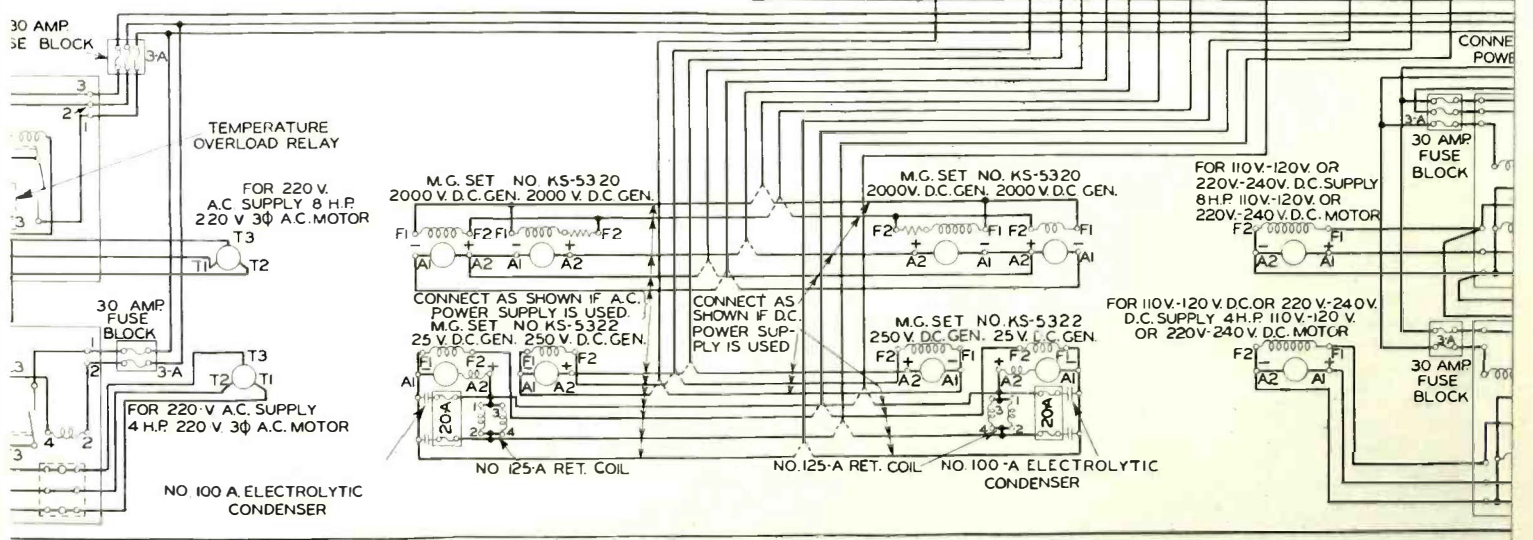
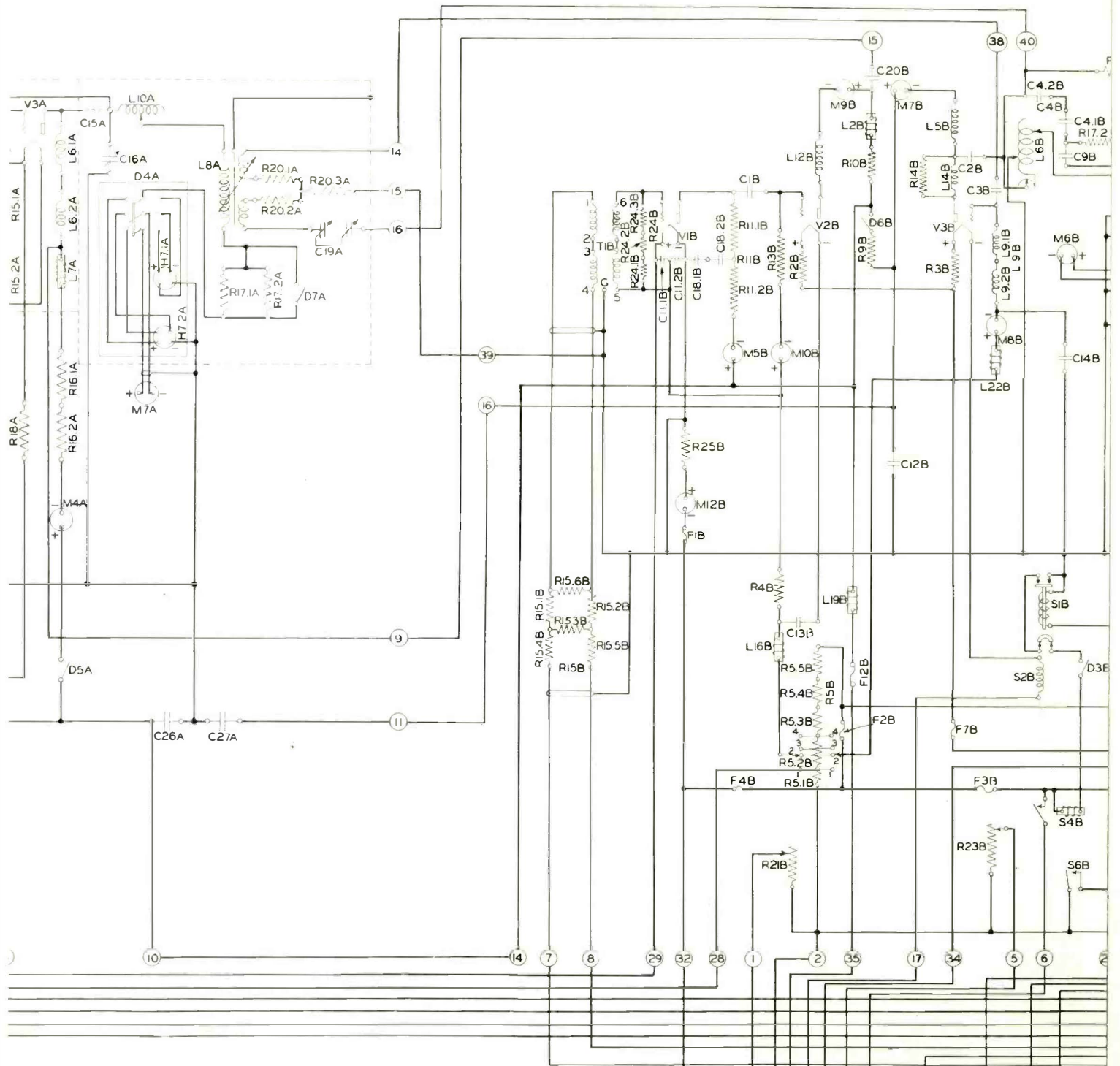


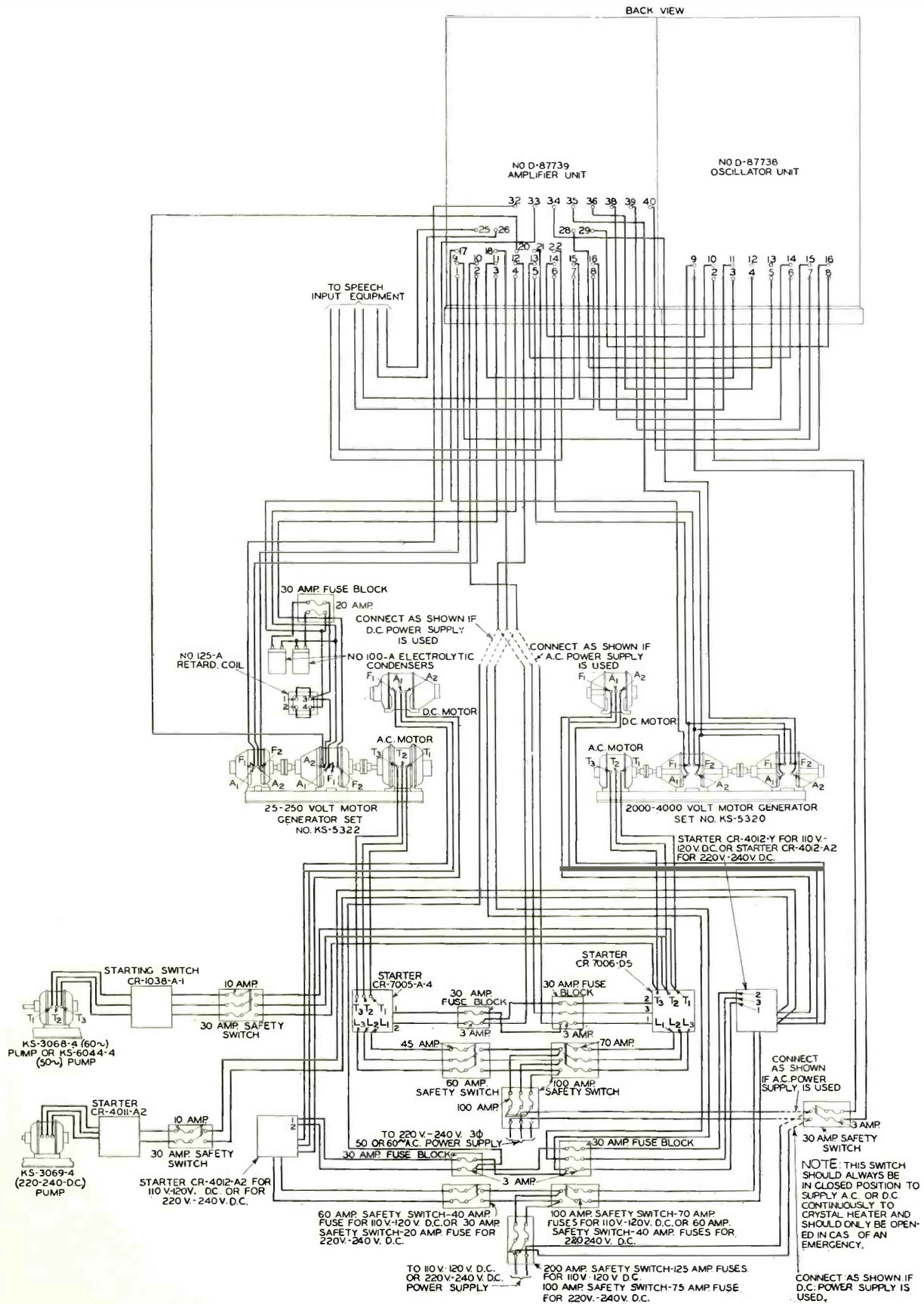


Simplified Schematic Diagram for the No. 6-B Radio Transmitter

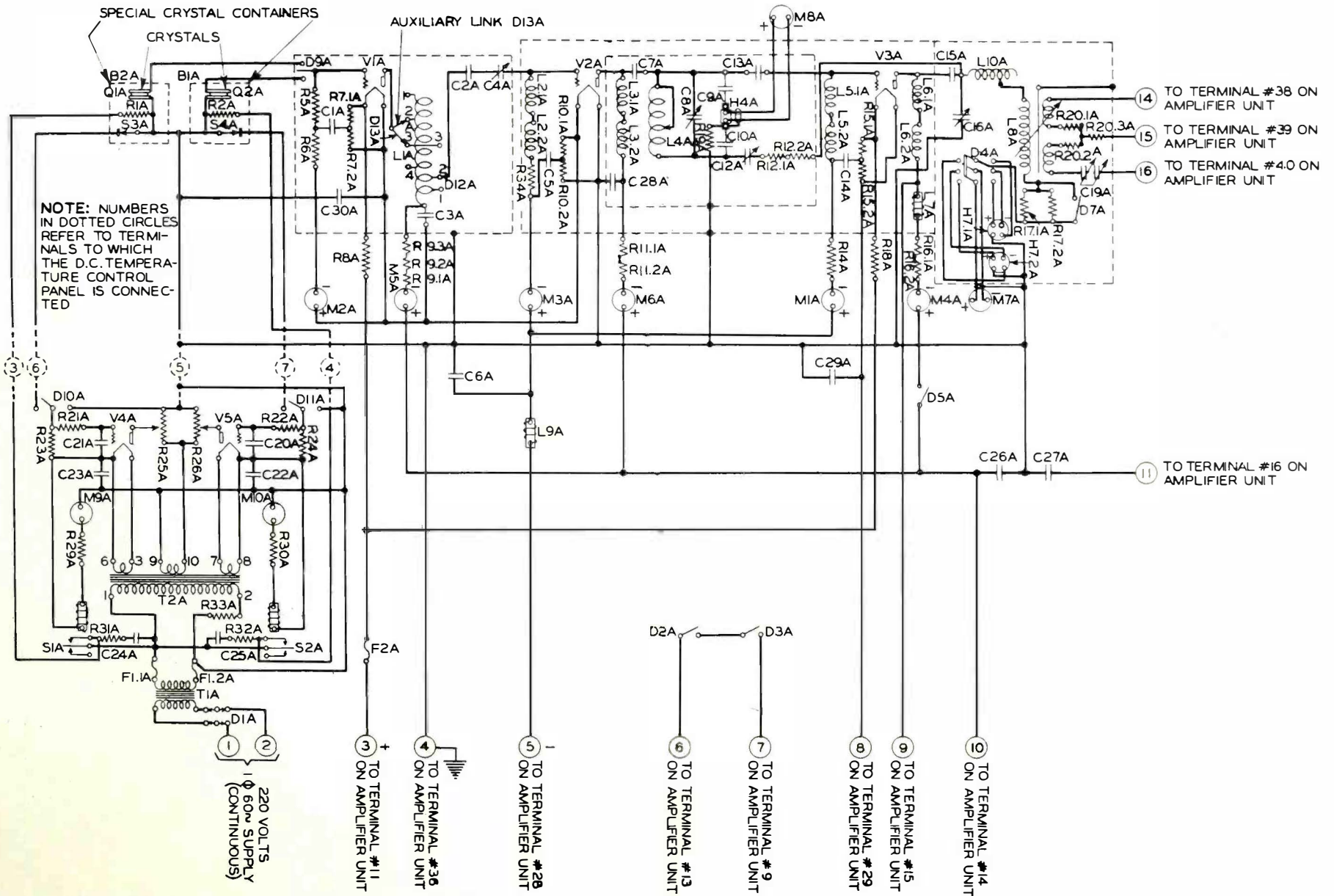


Schematic Diagram of the No. 6-B Radio Transmitter and Power Equipment

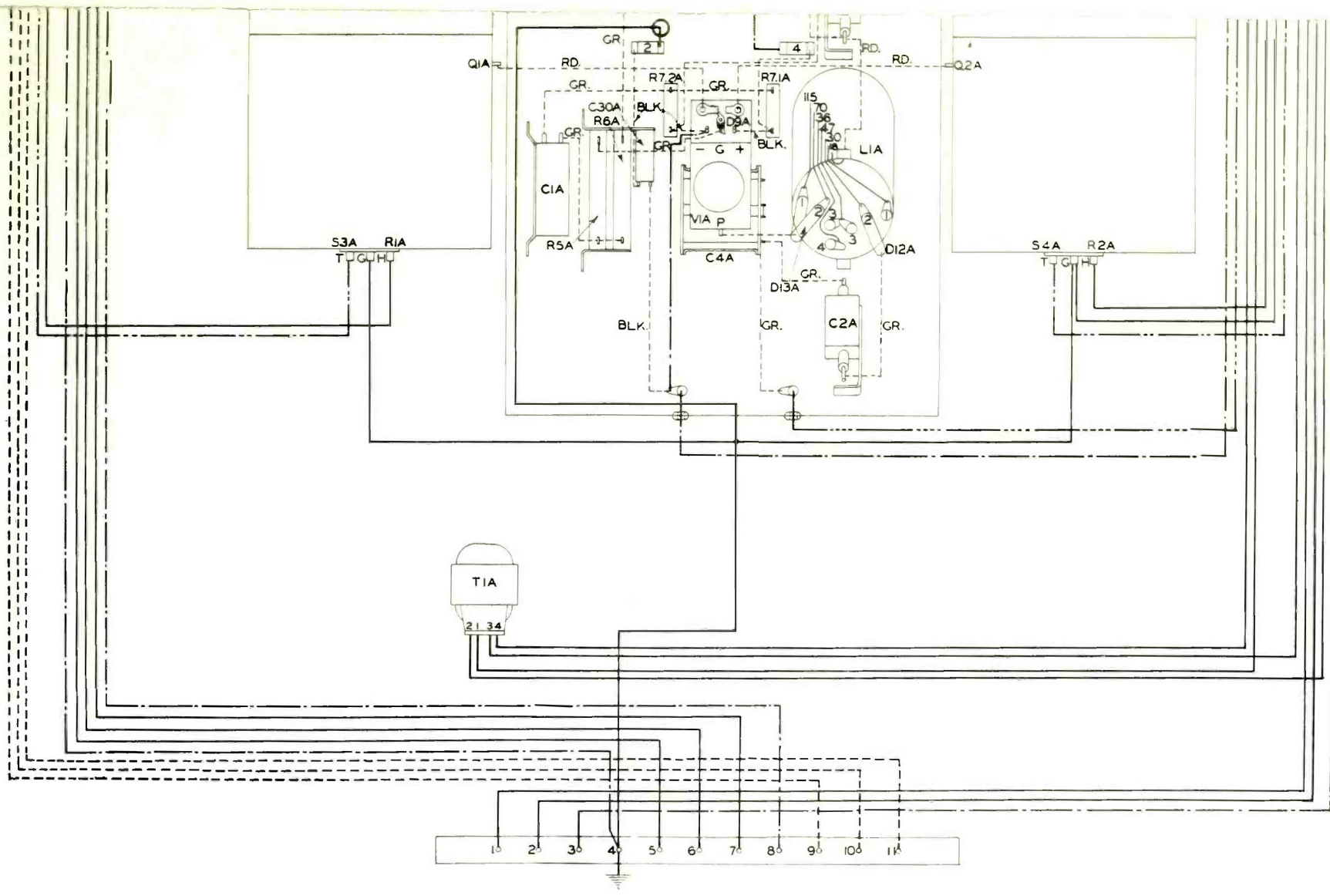


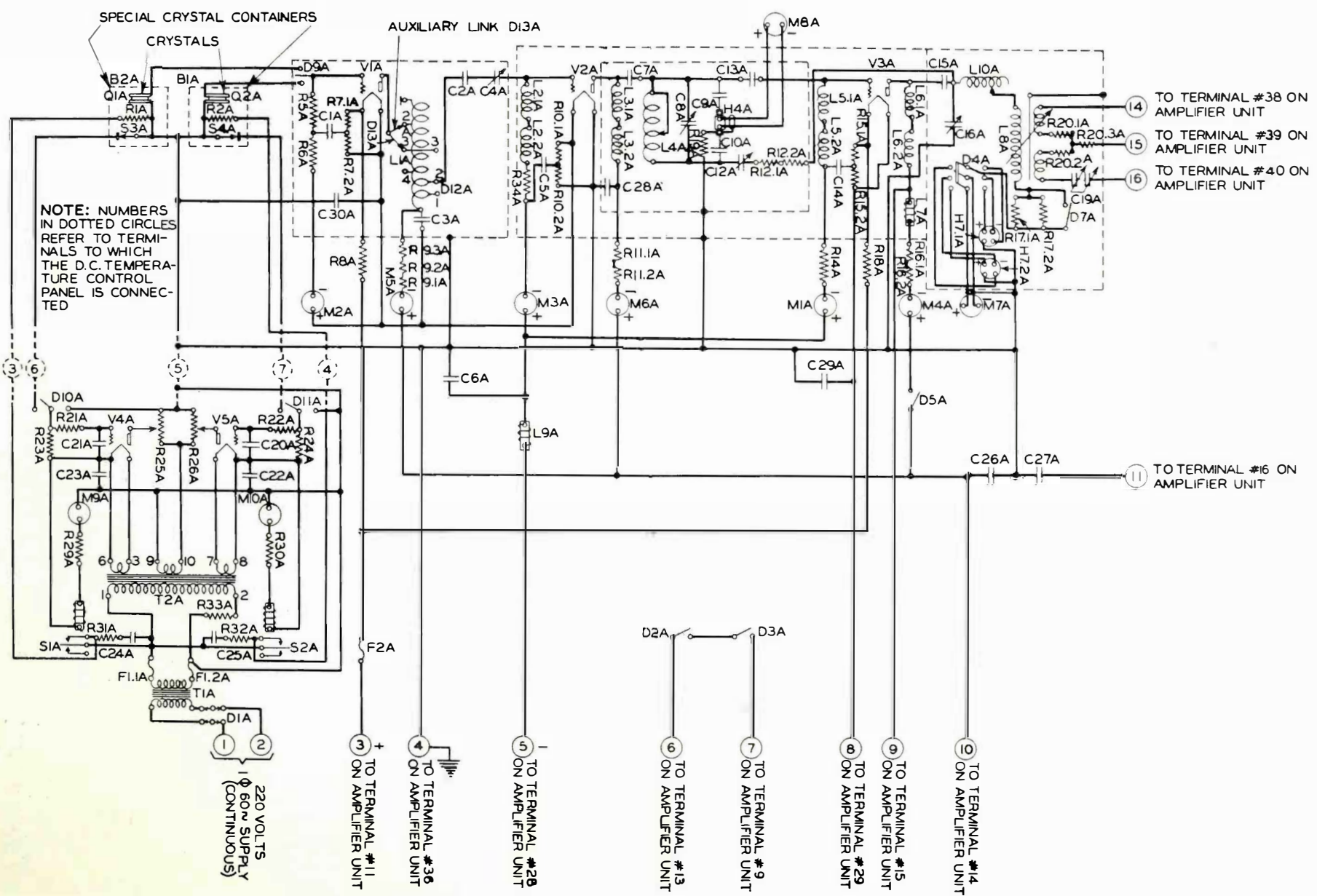


Wiring Diagram of the No. 6-B Radio Transmitter and Power Equipment



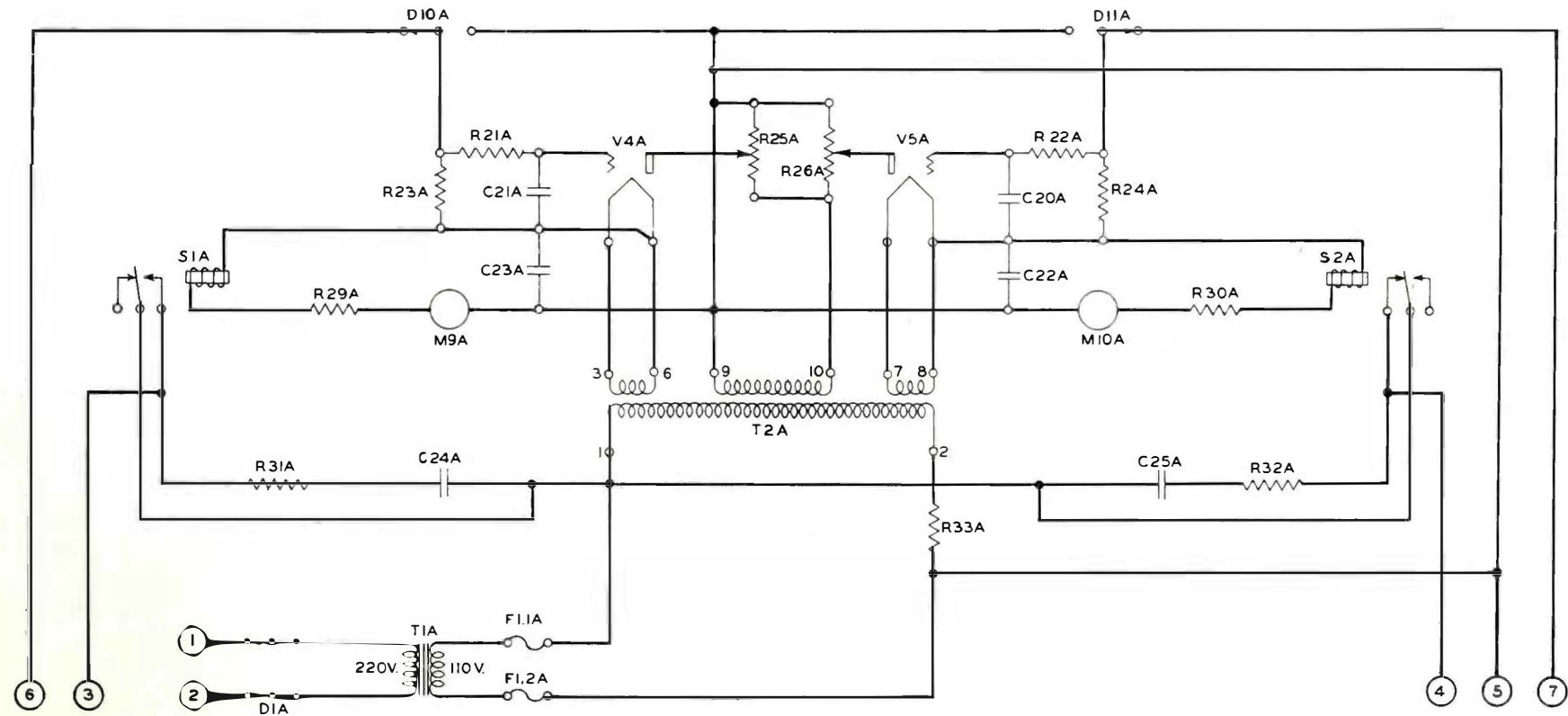
Schematic Diagram of the No. D-87738 Oscillator Unit with AC Temperature Control Panel





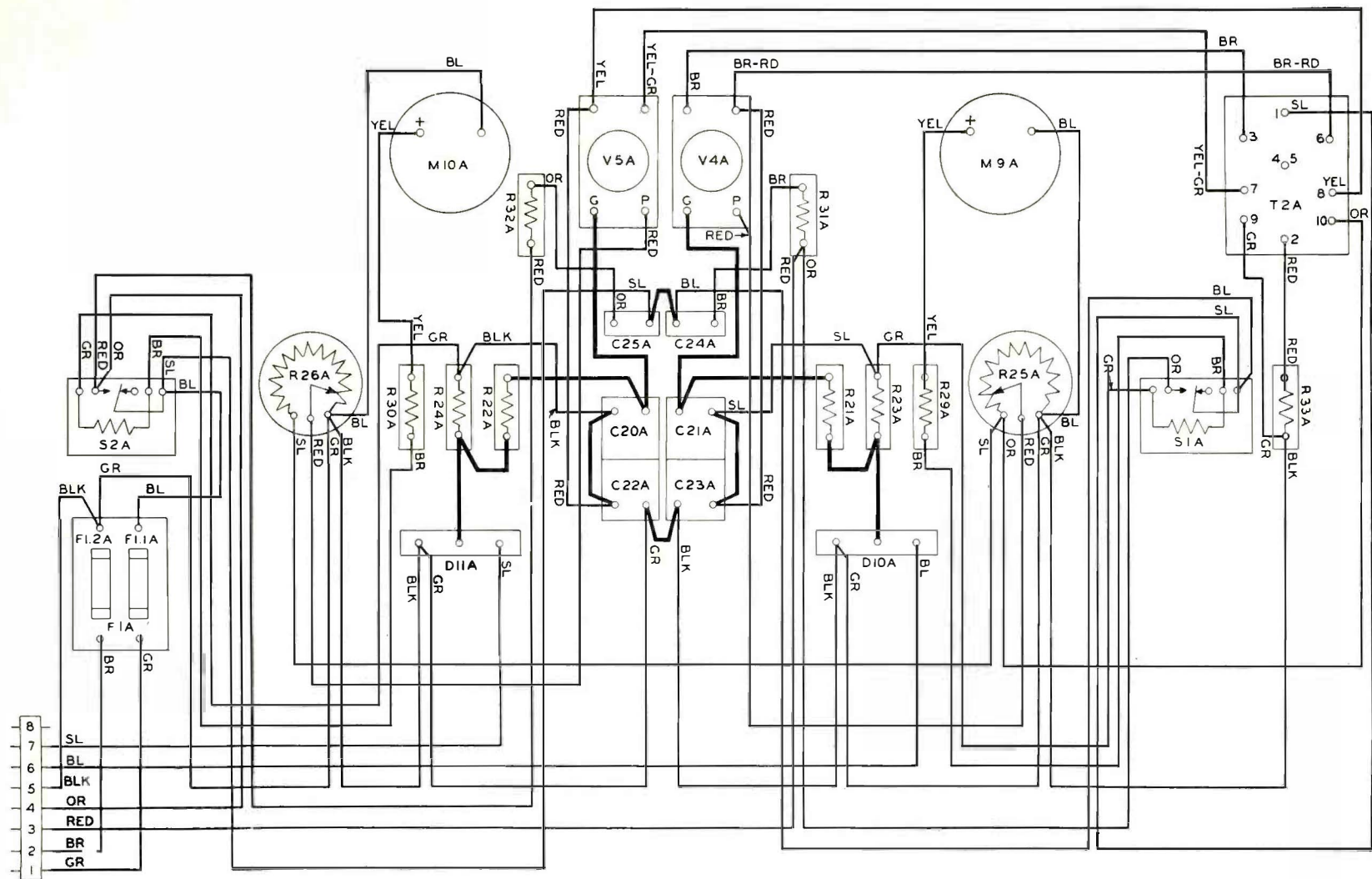
Schematic Diagram of the No. D-87738 Oscillator Unit with AC Temperature Control Panel

[78]



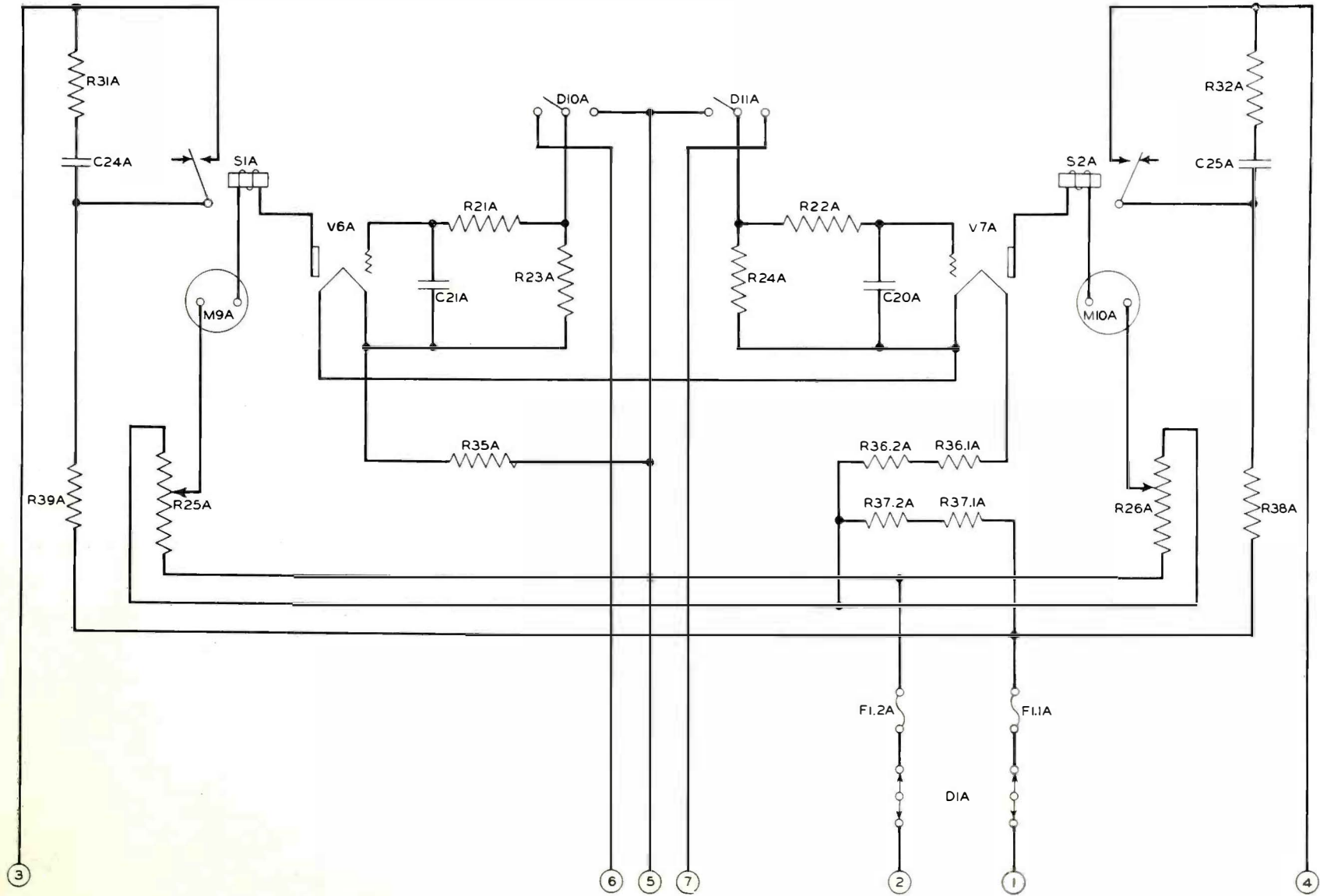
Schematic Diagram of the AC Temperature Control Panel

[79]

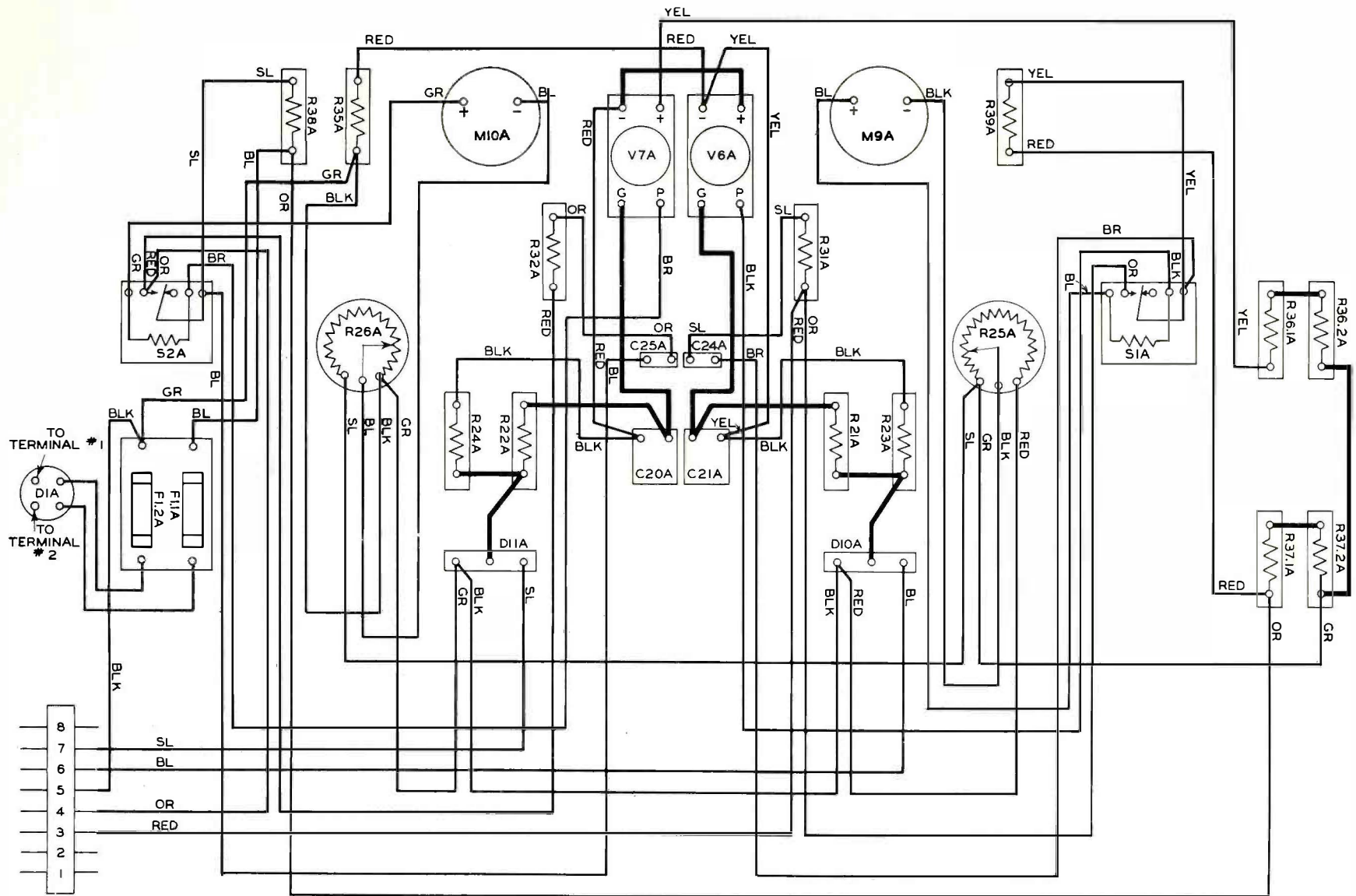


Wiring Diagram of the AC Temperature Control Panel

[08]

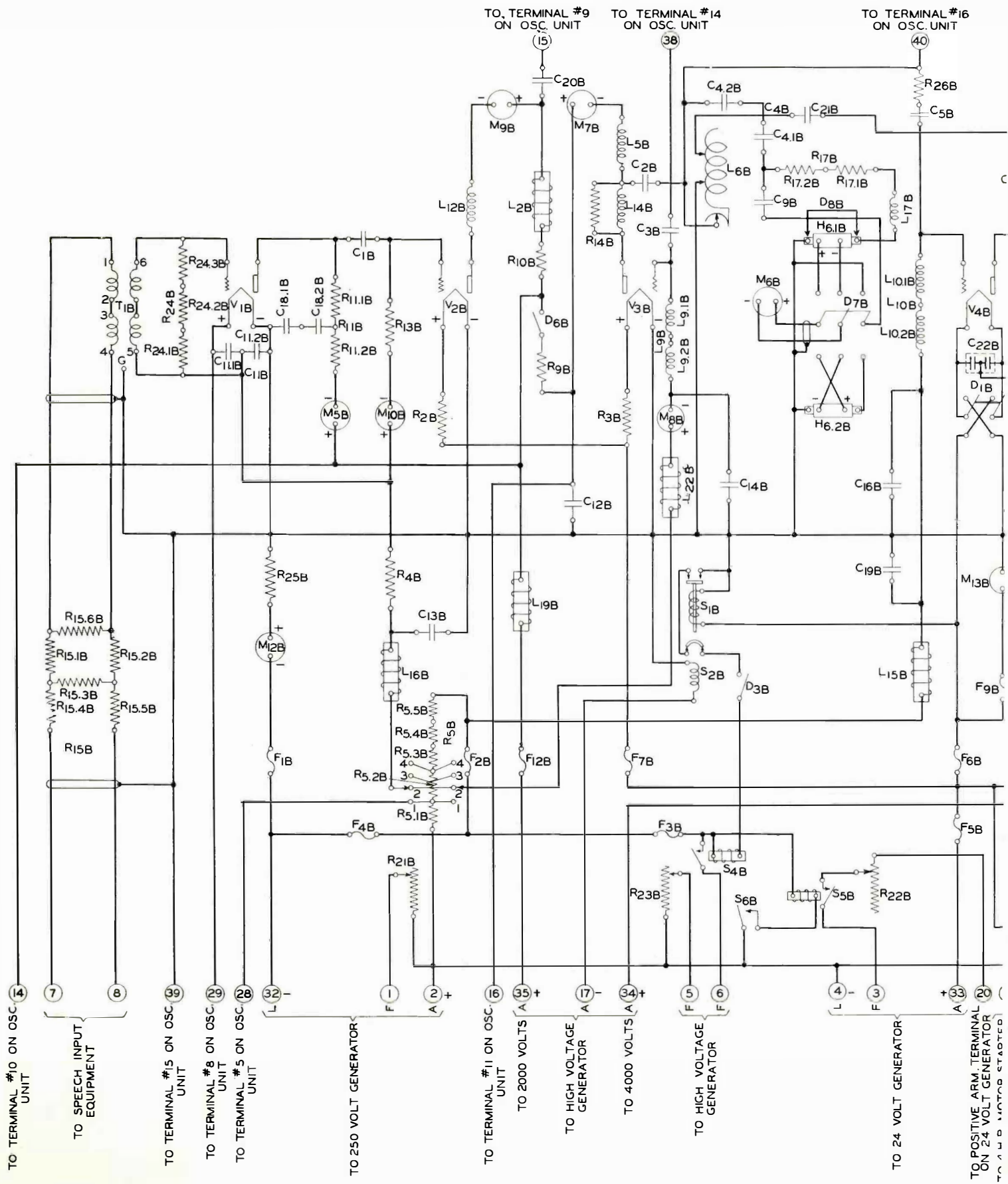


Schematic Diagram of the DC Temperature Control Panel

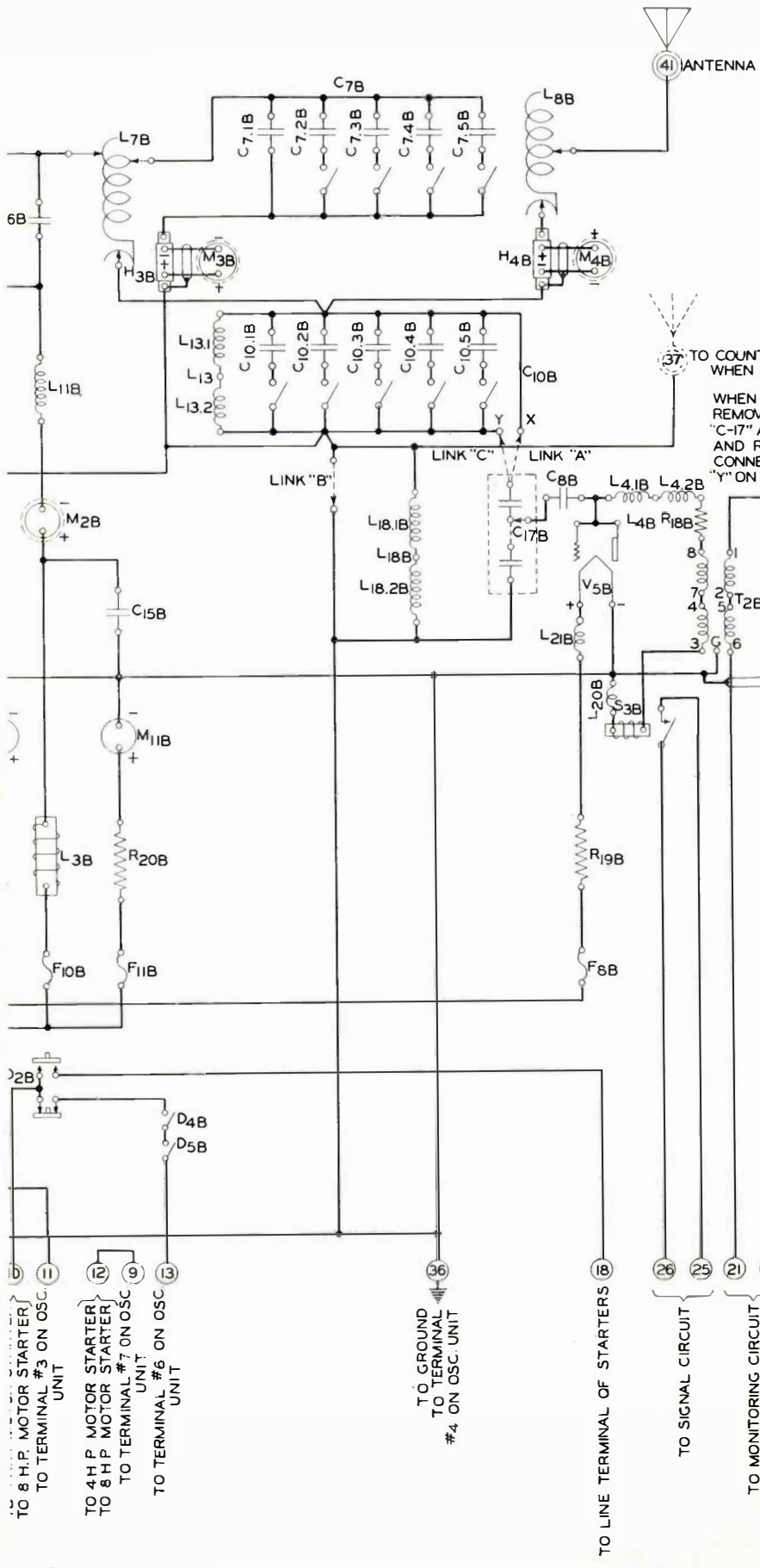


[81]

Wiring Diagram of the DC Temperature Control Panel



Schematic Diagram of the No. D-87739 Amplifier Unit



WHEN COUNTERPOISE IS USED REMOVE LINK "A" CONNECTING "C-17" AND TERMINAL "X" ON "C-10" AND REPLACE WITH LINK "C" CONNECTING "C-17" WITH TERMINAL "Y" ON "C-10" AND REMOVE LINK "B"

LEAKAGE CURRENT METER IS CONNECTED ACROSS OUTLET PIPE NIPPLE AND NIPPLE IN HOSE CONNECTION ON TUBE SOCKET OF V4B

TO 8 H.P. MOTOR STARTER }
TO TERMINAL #3 ON OSC. UNIT

TO 4 H.P. MOTOR STARTER }
TO 8 H.P. MOTOR STARTER }
TO TERMINAL #7 ON OSC. UNIT

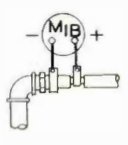
TO TERMINAL #6 ON OSC. UNIT

TO GROUND
TO TERMINAL #4 ON OSC. UNIT

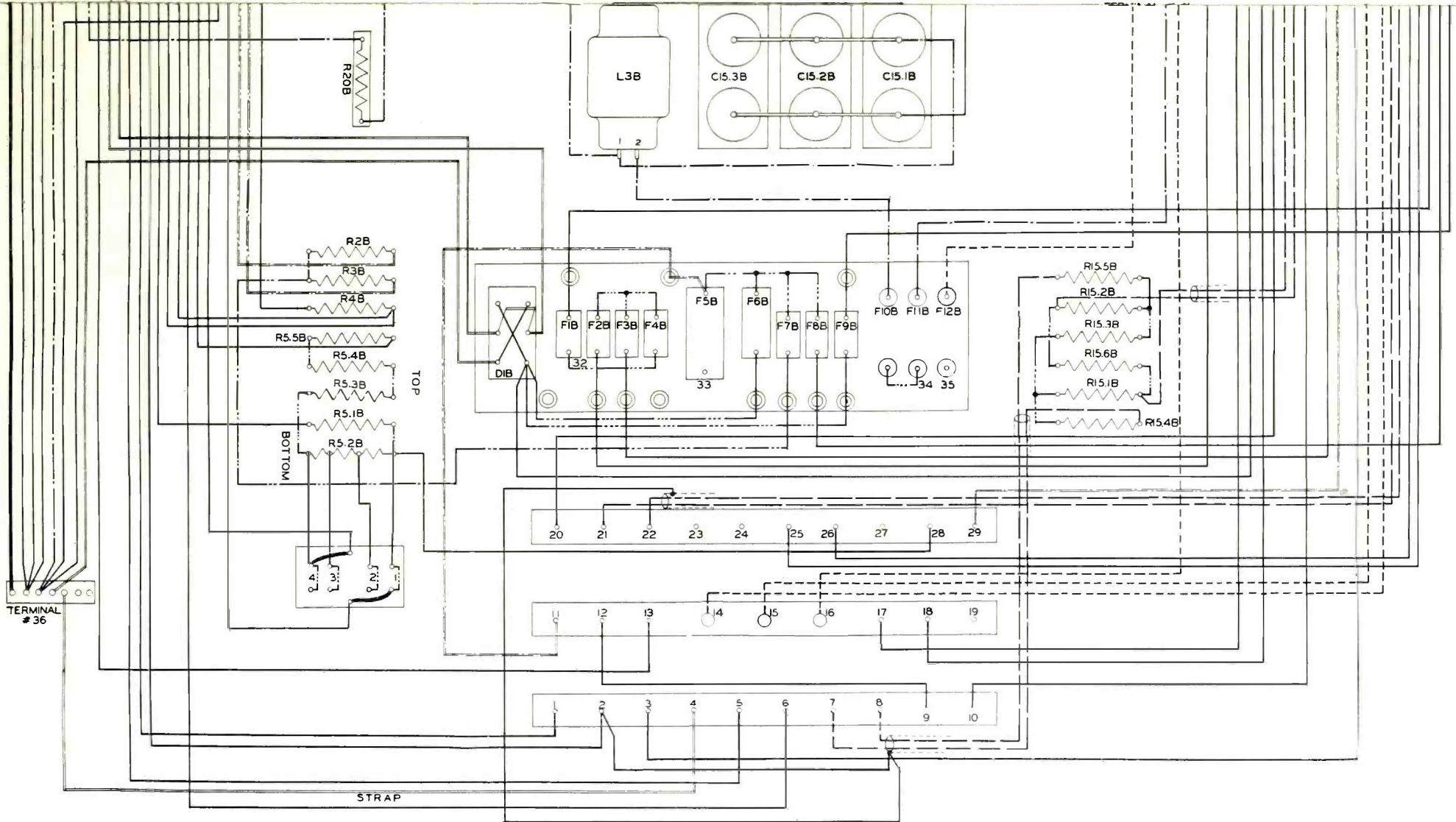
TO LINE TERMINAL OF STARTERS

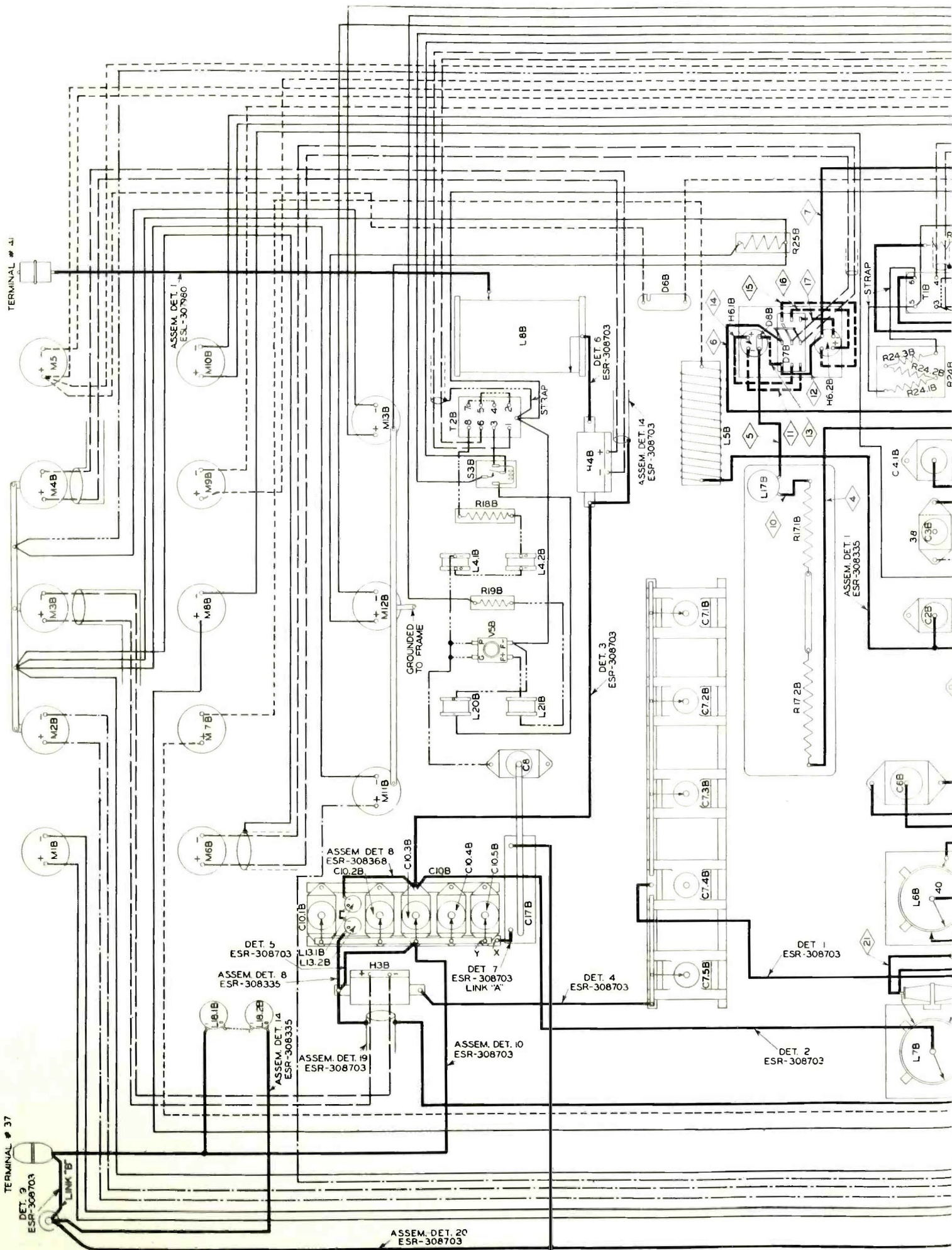
TO SIGNAL CIRCUIT

TO MONITORING CIRCUIT

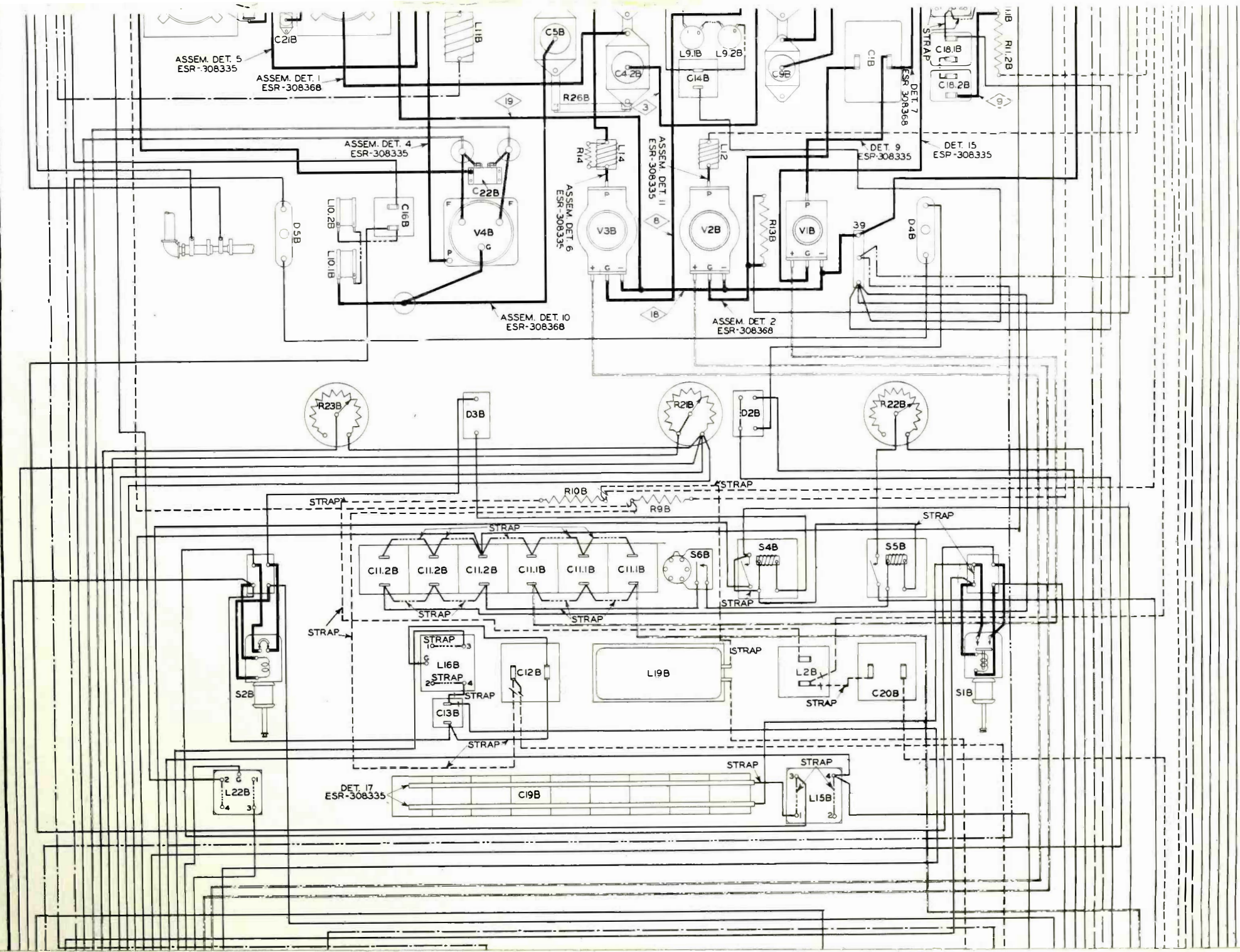


TERMINAL # 37





Wiring Diagram of the No. D-87739 Amplifier Unit



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