

# *Western Electric*

## **22E SPEECH INPUT EQUIPMENT**



**INSTRUCTION BULLETIN NO. 1175, ISSUE NO. 1**

*Western Electric*

**22E SPEECH INPUT EQUIPMENT**

*Research and design by Bell Telephone Laboratories*

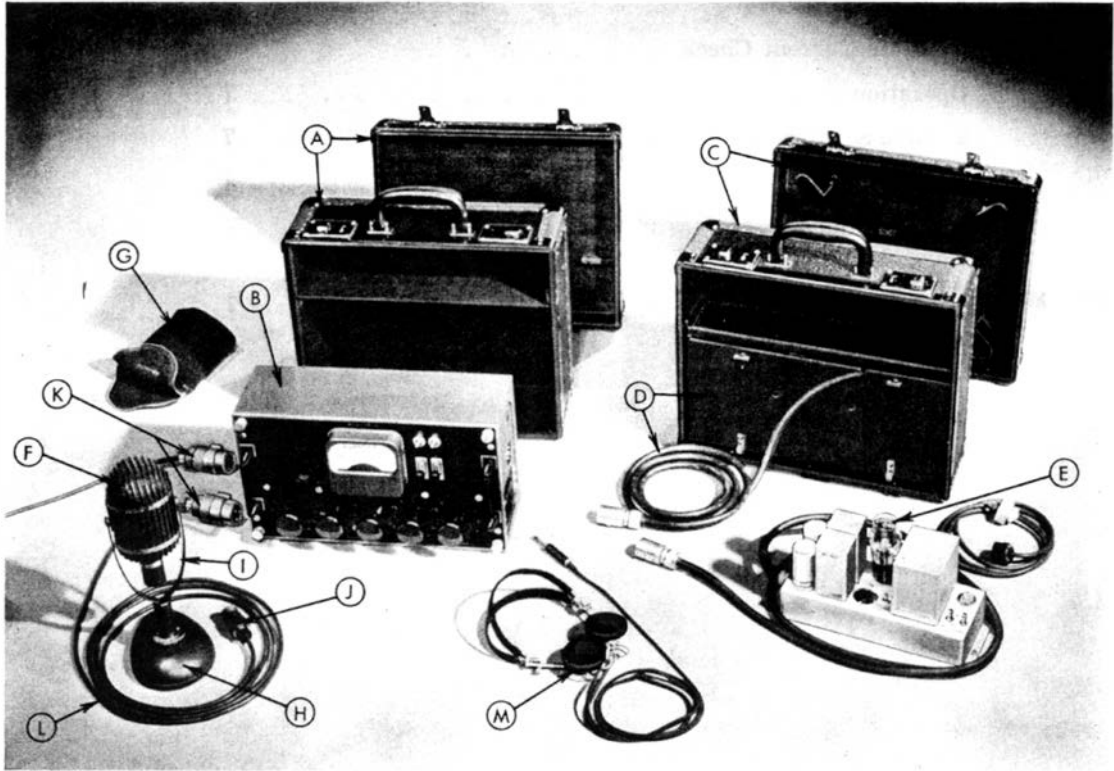
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{A} Amplifier-Control Unit Carrying Case with Cover. {B} Amplifier-Control Unit. {C} Power Supply Carrying Case with Cover. {D} Battery compartment with cord and plug. {E} AC Power Unit with cord and plug. {F} 639 type Microphone. {G} KS-12000 Transmitter

Cover. {H} 24A Transmitter Mounting. {I} 11A Transmitter Attachment. {J} 442A Jack and 712A Adapter. {K} Microphone plugs [Cannon plugs P3.CG-12]. {L} KS-7133 Cordage. {M} 1002F Headset.

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## **22E SPEECH INPUT EQUIPMENT**

### **Typical Characteristics**

<i>Maximum Gain</i>	Approximately 90 db.
<i>Frequency Response</i>	Uniform over the range from 35 to 10,000 cycles. See curve, Figure 1.
<i>Operates From</i>	30 ohm microphones or other 30 ohm circuits of comparable level.
<i>Operates Into</i>	Output Pad of 150 or 600 ohms, selectable by screw-driver operated switch, for feeding telephone lines.
<i>Signal-to-Noise Ratio</i> (Unweighted)	65 db for Battery Operation } Both at 70 db net gain 62 db for AC Operation } and referred to output signal of +18 dbm.
<i>Distortion</i>	Approximately 0.2% at +8 dbm, 1.5% at +18 dbm. See curve, Figure 2.
<i>Mixer Controls</i>	Four parallel mixers of 30 ohms each. Each mixer has 20 steps with a total of 45 db attenuation, and an OFF position. The first 12 steps from minimum attenuation have $1\frac{1}{2}$ db attenuation each, the last 8 steps have gradually increasing attenuation to OFF.
<i>Master Control</i>	Twenty steps and OFF position. The first 17 steps from minimum attenuation are 2 db each, increasing on last 3 steps to OFF.
<i>Power Supply</i>	See Text.
<i>Power Required</i> <i>AC Operation</i>	Approximately 28 watts from nominal 115-volt, 50- or 60-cycle supply.
<i>Batteries</i>	See Section on "Accessories".

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### *Dimensions*

<i>Carrying Cases</i>	14" x 16 $\frac{3}{4}$ " x 7 $\frac{3}{4}$ "
<i>Amplifier Control Unit</i>	9" x 15" x 5"
<i>AC Power Unit</i>	6 $\frac{1}{8}$ " x 13" x 4"

### *Weight*

<i>Carrying Cases (each)</i>	12 lbs.
<i>Amplifier Control Unit</i>	15 lbs.
<i>Total Battery Weight</i> (Depending on batteries used)	16 to 18 lbs.
<i>AC Power Unit</i>	8 $\frac{1}{2}$ lbs.

### *Finish*

<i>Carrying Cases</i>	Black Fabrikoid
<i>Amplifier Control Unit</i>	Amplifier Cabinet is gray crinkle finish and the panel non-glare "Alumilite".

## **GENERAL**

The Western Electric 22E Speech Input Equipment is compact, light in weight, portable, and designed to provide complete pick-up facilities for remote broadcast programs. The equipment consists of a combination amplifier and control unit with a carrying case, and either a power unit for a-c operation, or battery accessories, or both, as specified, with a carrying case and connecting cords. The space available in the power supply carrying case is adequate to permit carrying both the battery and a-c power supplies simultaneously, if desired. When both the a-c and the battery power supplies are utilized, the battery supply cable plugs into a jack on the a-c power supply chassis, and a plug and cable connect from the a-c supply to the amplifier unit. Two switches on the a-c power supply enable the operator to operate the amplifier from either the a-c supply or the battery supply, or to operate the filaments from a-c and the plates from battery, or vice versa, as may be required.

Receptacles and parallel mixing potentiometers are provided for four microphones. A master gain control is incorporated in the 3-stage amplifier. Pads for either 150 or 600 ohm output are selectable by means of a switch. Provisions are made for connections to two telephone lines, one normally used for

program transmission and the other for an order wire circuit. Two output line keys permit the operator to switch the lines at any time in case of emergency, thus making both lines available for broadcasting. A standard volume indicator with attenuators for output levels from +4 to +14 vu is used for monitoring the level of the outgoing program, and is also used as a voltmeter to indicate the condition of the batteries.

Binding post terminals and a multiplied jack provide connections to a telephone set for communication with master control, and two headset monitoring jacks permit aural monitoring of the program by the operator and a second person.

The amplifier has a net gain of approximately 90 db, and the frequency response is essentially uniform over the range from 35 to 10,000 cycles (see Figure 1). For fundamental frequencies from 100 to 7,500 cycles per second the harmonic distortion is less than 1% at output levels up to +18 dbm. (See Figure 2). The unweighted noise level is 65 db for battery operation or 62 db for a-c operation at +18 dbm with 70 db net gain.

The rear cover of the unit can be quickly removed for access to the vacuum tubes and other amplifier components without disconnecting any of the cords.

## DESCRIPTION

### ES-675710 Amplifier Control Unit

#### Input and Mixing Circuits

Four Cannon P3-13 Panel Receptacles accommodating Cannon Type P3-CG-12 Plugs are mounted on the left end of the amplifier. These receptacles are numbered to correspond with their associated mixing potentiometers. The four channel parallel mixing circuit is designed to work with 30 ohm dynamic microphones or other 30 ohm circuits of comparable level. Should it be desired to work with microphones of 150/250 ohms impedance, the Western Electric 172A Repeating Coil is recommended as an impedance matching transformer. This coil is designed to be connected in series with the microphone cord and thus does not require mounting provisions. It matches a 250 ohm device to a 30 ohm circuit with approximately a 1 db loss.

The 30 ohm circuits are unbalanced with respect to ground. The microphone input circuits are connected through the associated mixing potentiometers to the input of the amplifier. Each mixing potentiometer has 20 steps with a total of 45 db attenuation, and an OFF position. The first 12 steps from minimum attenuation have  $1\frac{1}{2}$  db attenuation each, with gradually increasing attenuation on the last 8 steps to cut-off. The output of the mixing circuits is amplified through a single stage terminating in the master gain control which is followed by two additional stages of amplification. The master gain control has 20 steps of attenuation and an OFF position. The first 17 steps from minimum attenuation have 2 db attenuation each with increasing attenuation on the last three steps to cut-off.

#### Output Circuits

The amplifier is provided with two output pads of 150 ohms and 600 ohms respectively. These two pads are selectable by means of a screwdriver-operated switch. The 600 ohm pad is normally used for most program lines, but the 150 ohm output is frequently used where the mismatch will provide a beneficial

equalizing effect tending to compensate for the frequency transmission characteristics of the line.

There are two lever type line keys on the front panel. A program line may be connected to each of these keys through the line binding posts mounted on a plate at the right hand end of the amplifier. By throwing either of these keys downward, connection is made between the line associated with that key and the output of the line pad, thereby allowing program feed to that line. By throwing the key upward, connection is between the line and the TEL jack which is paralleled to the pair of binding posts located on the right hand end of the unit. Therefore, in cases of emergency the program and order wire lines can be interchanged immediately simply by reversing the key positions. When in the normal position, these keys short circuit the program lines and enable the master control operator to make loop tests.

#### Volume Indicator

The 22E Speech Input Equipment provides for use of either a Western Electric KS-8208 or a KS-8218 Volume Indicator Meter. These meters are standardized for the measurement of volume levels in program circuits and transmission systems and are identical electrically except for different scales. The KS-8208 Meter employs the "A" scale on which the program level is marked from -20 to +3 vu above the scale arc, with an arbitrary 0-100 voltage scale in small figures below the arc. The KS-8218 Meter has the "B" scale in which the 0-100 scale markings are in large figures above the arc of the meter scale, with the -20 to +3 vu markings indicated below the arc. The 100 (0 vu) reference point of the meter is located on both scales so as to permit utilization of approximately two-thirds of the available scale length.

The face of the meter can be illuminated by operating the LAMP switch on the panel of the Amplifier-Control Unit. This switch



is connected to two 0.150 ampere lamps mounted inside the meter case.

The output level (deflection to the 0 vu or 100 mark) to be indicated by the meter is set by means of the volume indicator range switch to correspond to levels at the outgoing line of +4, +6, +8, +10, +12 and +14 vu. In most cases +8 vu is a satisfactory level to feed a line. This range switch has an OFF position, and a PLATE and FILAMENT position for checking plate and filament batteries. For the purpose of checking battery voltages, the 0 vu or 100 mark on the scale indicates the minimum operating voltage. Checking may be done during program without interfering with the operation of the amplifier.

### **Monitoring**

Two monitoring jacks are provided on the right hand end of the front panel of the amplifier. These jacks are connected in parallel and are intended to provide monitoring facilities for the operator and a second person. They are bridged across the output of the line pad in use. As shown in the schematic diagram, Figure 3, an isolation resistor is included in the monitoring jack circuit to isolate the program channel from an accidental short circuit. The jacks accommodate Western Electric Type 47 or similar type plugs.

When loudspeaker monitoring is desired, or when sound reinforcement is required, a Western Electric 124E or 142A Amplifier, or equivalent, may be used. These amplifiers have a high impedance input which can be bridged directly across the line or plugged

into one of the headset monitoring jacks of the 22E Amplifier.

A 47 Type Plug and a cord such as the 630 Type are recommended for making connections between the 22E Amplifier and the monitoring amplifier.

### **ES-610199 Power Unit**

For a-c operation, the ES-610199 Power Unit provides all necessary power for filaments and plates. One type 80 rectifier tube serves as the plate supply rectifier. The unit contains a receptacle for the battery unit cord and plug, and two switches so that the filament and plate supplies may be obtained from either batteries or the a-c supply. All power connections to the Amplifier-Control Unit are made with a single 6-foot, heavy duty, five-conductor cable. A plug cap is furnished in the power unit socket for the purpose of connecting a length of rubber-covered cordage from an a-c outlet. The cordage and the male cap are not furnished as a part of the unit.

### **B-147071 Set of Accessories for Battery Operation**

The B-147071 set of accessories is a kit containing all the parts necessary to adapt the lower compartment of the battery carrying case to accommodate a complete set of batteries for battery operation. A length of cable, connecting wires, hardware and complete instructions for installing the batteries are included in the kit. Batteries are not furnished, and must be ordered separately if required. A list of batteries required for operation is given in the section "Accessories Required".

## **INSTALLATION**

In ordering, it is necessary to specify whether the 22E Speech Input Equipment is intended for a-c or for battery operation, or for both, and which type volume indicator meter is desired.

### **Equipment Furnished For AC Operation**

When a-c operation is specified, the equipment furnished consists of the following basic components:

1. Amplifier-control Unit (ES-675710) in Carrying Case (ES-610263), with VI Meter KS-8208-L2 (or KS-8218-L1).
2. Power Supply Carrying Case (ES-610264-2).
3. AC Power Unit (ES-610199) with cord and plug for connecting to amplifier.
4. AC Power Plug Body (a-c wall plug and cord not furnished).

Required vacuum tubes to be ordered separately are: 2-6J7 and 1-6F6 for the amplifier, and 1-80 for the a-c unit.

#### **For Battery Operation**

When battery operation is specified, the equipment furnished consists of the following basic components:

1. Amplifier-control Unit in carrying case.
2. Power supply carrying case.
3. Battery cord, plug, and set of battery accessories per B-147071.

Vacuum tubes and batteries should be ordered separately.

#### **For Both AC and Battery Operation**

When both a-c and battery operation are specified, the equipment furnished consists of the following basic components:

1. Same as (1) under a-c operation.
2. Same as (2) under a-c operation.
3. Same as (3) under a-c operation.
4. Same as (4) under a-c operation.
5. Same as (3) under battery operation.

Tubes and batteries should be ordered separately.

#### **Accessories Required**

##### **Power Cord and Plug**

The AC Power Unit is furnished with a plug cap for making a-c power connection to the unit. However, no cordage or wall plug is furnished.

##### **Batteries**

Batteries as listed above are not furnished and must be ordered separately.

For storage battery operation, the required batteries are:

- 4—Eveready No. 762S or Burgess No. 5308 (for plate).
- 1—Exide No. 3-AC-7-1 storage battery per DA-26588. (For filaments).

For dry cell battery operation, the required batteries are:

- 4—Eveready No. 762S or 4—Burgess No. 5308 (for plate),
- 2—Burgess 4F2H (for filaments).

#### **Monitoring**

One or two Western Electric 1002F Headsets are recommended for monitoring purposes. If highest quality headset monitoring is desired, the Western Electric Dynamic Headset (D-97690 equipped with a D-90944 Cord and 47 Type Plug) is recommended. For loudspeaker monitoring, a 124E Amplifier having a high impedance bridging input and no ground on its input, or a 142A Amplifier with a suitable bridging input coil, should be selected so that it can be bridged directly across the outgoing line or plugged into one of the headset monitoring jacks.

#### **Microphones and Microphone Accessories**

Western Electric 633 or 639 type microphones are recommended for use with this equipment. Information pertaining to these microphones and to their accessories may be obtained from any Western Electric Distributor.

Cannon P3-CG-12 straight cord plugs for use with microphone cords should be ordered separately as required.

KS-7133 Shielded Microphone Cordage, recommended for use with Western Electric microphones or other low level or high quality program circuits, should be ordered separately as required.

#### **Assembly**

##### **Amplifier Control Unit**

1. Remove the cover of the Amplifier-control Unit of the 22E Speech Input Equipment by loosening the four thumb

screws located at the corners of the front panel, and pulling the panel forward.

2. The VU Meter (KS-8208 or 8218, whichever was specified in the order) is equipped with two 6.3-volt lamps. These are connected in series in the KS-8208 Meter. Remove the front cover of the meter by removing the four screws on the front of the case. Reconnect the straps of the lamp sockets so that the two lamps are connected in parallel, and replace the front cover. Remove the nuts and washers from the four screws imbedded in the corners in the back of the meter case. Attach the meter to the panel from the front using the four screws and nuts that were removed. Connect the OR and OR-RD wires to the large meter terminals, and the RD and GR-RD wires to the two small terminals. It is not necessary to observe polarity in either case.
3. Insert 2 Type 6J7 Vacuum Tubes in the cushioned and center sockets, and a type 6F6 Vacuum Tube in the remaining socket.
4. Replace the rear cover of the unit and fasten by turning the thumb screws in the clockwise direction.

#### **Power Unit**

The AC Power Unit should be assembled to the shelf in the upper part of the power unit carrying case by means of the four screws and stop nuts supplied. One type 80 rectifier is required and must be ordered separately. The power cord and wall plug are not supplied and should be made up to suit operating conditions.

#### **Battery Equipment**

The 22E Speech Input Equipment power supply carrying case is designed for operation either with batteries or with the ESR-610199 AC Power Unit or both.

The B-147071 Set of Accessories for battery operation contains all the accessories, excepting batteries (listed above) that are

necessary to modify the carrying case. Full instructions for battery operation are furnished with the 22E Speech Input Equipment when ordered for battery operation.

#### **Setting Up for Operation**

##### **Microphones**

The microphones should be connected through the associated cables to the desired Cannon receptacle at the left end of the unit. Each microphone receptacle is numbered to correspond with the associated mixing potentiometer. The shield of the microphone cord should be connected to Pin No. 3 of the plug.

##### **Program Line and Order Wire**

The program line and the order wire, or spare program line, are connected to the terminals marked "LINE 1" and "LINE 2" at the right hand end of the unit.

With a screwdriver, set the output impedance switch D4 to "150" or "600" to correspond with the desired output impedance of the amplifier.

##### **Order Wire Telephone Set**

The order wire telephone set can either be connected to the terminals marked "TEL" or plugged into the jack marked "TEL".

##### **Monitoring Headsets**

One or two pairs of Western Electric 1002F Headsets or the equivalent equipped with Western Electric 47A Plugs, or equivalent, should be plugged into the jacks marked "Monitor". Where loudspeaker monitoring is desired, or where sound reinforcement is wanted, a Western Electric 124E or 142A Amplifier equipped with a suitable bridging input coil may be connected to one of the monitor jacks or bridged across the line.

##### **Ground**

The terminal marked "GND" should be connected to a good electrical ground.

##### **Battery Connections**

Internal connections of the batteries in the carrying case are described in the in-

structions which are a part of the B-147071 Set of Accessories for Battery operation. If batteries only are to be used, the battery cable plug should be plugged into the power supply receptacle at the right hand end of the amplifier.

### **AC and Battery Operation**

If both a-c and battery supplies are to be used, the five-wire a-c supply cable should be plugged into the receptacle at the right hand end of the amplifier unit, and the battery supply cable plugged into Jack J2 of the a-c unit. Selection of either a-c or battery operation of the filaments and plates is then made by operating switch D3 (plate) and switch D2 (filament), both of which are mounted

on the a-c power unit.

To turn on the equipment, connect the power cord to the a-c line and operate the power switches on both the amplifier and the power unit. The equipment is now ready for operation.

When using batteries, the drain on the batteries due to the volume indicator lights is 0.3 ampere. To prolong battery life, it is recommended that the volume indicator lamp switch be left OFF as much as possible. This is particularly important when dry batteries are used, since the continuous use of the lamps will greatly reduce battery life. Filament and plate batteries should be changed when the meter indicates voltages below "0 vu" or "100" on the scale.

## **OPERATION**

### **Gain Settings**

As a general rule, the master gain control should be operated as low as practicable since this will result in the minimum amount of noise. Enough latitude should be permitted, however, to allow for variations in sound levels of the program.

### **Output Level**

Normally an output level of +8 vu is adequate. In some cases, it may be necessary to transmit programs at a higher level. The 22E Speech Input Equipment will deliver levels at +18 vu without serious distortion. (See Figure 2.)

### **Precautions**

The plate and filament voltages can be checked while the equipment is in operation. It is recommended that a close check be kept on the condition of the batteries.

The output line keys are so connected that when in the mid-position the program line is short circuited. The purpose of this is to enable master control to make loop tests when the remote location is unattended. In the event that more than one pickup is made from a location where multiple extensions of the program line are used, the line keys should not be left in the mid-position since this will disable all of the line extensions.

## **MAINTENANCE**

Some tubes have higher noise levels than others. It may be desirable to select tubes for the first amplifier stage, although the cushioned socket greatly reduces trouble from microphonic noise.

While this equipment is rugged in construction, it should be afforded the degree of maintenance and inspection that any high quality equipment would ordinarily require.

Cleanliness is essential for best operation and therefore the equipment should be kept free of dust and dirt. Compressed air or a soft bristle brush is recommended for cleaning the apparatus. Potentiometer contacts should occasionally be cleaned with carbon tetrachloride and then thinly covered with a good grade of light mineral oil. Excess oil should be wiped off with a lint-free cloth.

The gray crinkle finish of the amplifier cabinet may be cleaned by wiping with a clean cloth moistened with carbon tetrachloride. Scratches and chips in the finish may be repaired by the application of gray enamel per D-97106 to the injured areas. This enamel may be obtained from the nearest distributor of Western Electric audio facilities. It is supplied with an aluminum powder

that is not required for this application.

Should the 22E Speech Input Equipment fail to operate properly, all batteries, tubes and accessories should be checked. Trouble in the 22E Speech Input Equipment can be traced by means of the schematic diagrams, Figures 3 and 5 and the wiring diagrams, Figures 4 and 6.

## TYPICAL CUSTOMER'S APPARATUS LIST

<i>Desig. No.</i>	<i>Apparatus</i>
C1, C2	230A Condensers, 0.4 microfarad
C3	314B Condenser, 0.1 microfarad, per ESA-675815
C4, C5	230A Condensers, 0.4 microfarad
C6	439A Condenser, 2.0 microfarads
C7	Cornell-Dubilier Corp. Type 4 Condenser .03 microfarad $\pm 10\%$
C8	Sprague type DEW or Aerovox type GEP Condensers, 50 microfarads, DC working voltage 25 maximum
C9	141A Condenser, .10 microfarad
C10, C11	Sprague type DEW or Aerovox type GEP Condensers, 50 microfarads, DC working voltage 25 maximum
C12	Cornell-Dubilier Corp. Type 4 Condenser .01 microfarad $\pm 5\%$
D1, D2	Hart and Hegeman Type 20994-DQ Toggle Switches with $\frac{3}{8}$ " mounting sleeves, one round and one hexagonal mounting nuts
D3.1, D3.2	P. R. Mallory Co. #1321 Two-Gang Switch, Two Circuits, 11 Points each Circuit with Shaft $\frac{1}{2}$ lg., 2 Plain Hex. Nuts and 1 Lockwasher
D4	Yaxley Manufacturing Co. Switch S.P.O. No. 21262 with screwdriver slot per ESO-610251-5
J1, J2, J3, J4	Cannon Electric Development Co. Type P3-13 Panel Receptacles
J5, J6, J7	218J Jacks
J8	Jack per ESO-610126-3
K1, K2	2AAB Key Units
M1	KS-8208 or KS-8218 Meter as ordered
P1, P2, P3, P4	Daven Type WE-71 Potentiometers per ESO-612728-2 or Tech. Laboratories Potentiometer per BA-73987-12
P5	Daven Type WE-54 Potentiometer per ESO-610251-4 or Tech. Laboratories Potentiometer per BA-73987-11
	International Resistance Corp. Type BT-A Resistances, resistance values as specified:
R1	0.1 megohm $\pm 10\%$
R2, R34	620 ohms $\pm 5\%$
R3	2400 ohms $\pm 5\%$
R4	3000 ohms $\pm 5\%$
R5, R9	1.0 megohm $\pm 10\%$
R6, R10, R13	0.24 megohm $\pm 5\%$
R7, R28	51,000 ohms $\pm 5\%$
R11	0.51 megohm $\pm 5\%$
R27	5,100 ohms $\pm 5\%$
R32	1.0 megohm $\pm 5\%$
R33	30,000 ohms $\pm 5\%$
	International Resistance Corp. Type BW Resistances, resistance values as specified $\pm 5\%$
R12	620 ohms, Type BW-1
R14	3300 ohms "

## TYPICAL CUSTOMER'S APPARATUS LIST

(Continued)

<i>Desig. No.</i>	<i>Apparatus</i>
R15	2400 ohms "
R16	2000 ohms "
R17	1600 ohms "
R18	1300 ohms "
R19	5100 ohms "
R20, R21	200 ohms "
R22	1800 ohms "
R23, R24	51 ohms "
R25, R26	47 ohms "
R29	430 ohms "
R30, R31	13 ohms "
R35	3900 ohms "
R36	1300 ohms "
R37	240 ohms, Type BW-1/2
R38	150 ohms "
R39	510 ohms "
T1	285N Input Transformer
T2	178B Output Transformer
V1	RCA 6J7 Vacuum Tube or equivalent
V2	RCA 6J7 Vacuum Tube or equivalent
V3	RCA 6F6 Vacuum Tube or equivalent
—	Amplifier Carrying Case per ESR-610263
—	Power Supply Carrying Case per ESR-610264-2

### Following Items are Specific to the type of Power Supply

#### *For AC Supply*

C1.1, C1.2	Mallory Capacitor, 10-10 mf — 450 V Type FPD 231, 1 dia. x 2 lg. can. Furnish with metal washer A-93403
C2	Mallory Capacitor, 15 mf — 450 V Type FPS 143, 1 dia. x 2 lg. can. Furnish with metal washer A-93403
L1	221E Retard Coil
L2	221A Retard Coil
T1	344B Transformer
VS1	33-1-A V.T. Socket per KS-7741
D2, D3	Toggle Switch per ESO-676800-3 with index slot
D1	Toggle Switch per ESO-676800-4 with index slot on same side as handle when in "OFF" position. Omit indicating plate.
—	Hubbell 6630 Body
—	ESO-610217-2 Cord Assembly

#### *For Battery Supply*

— Set of accessories for battery operation per BL-147071

*All apparatus is Western Electric unless otherwise specified.*

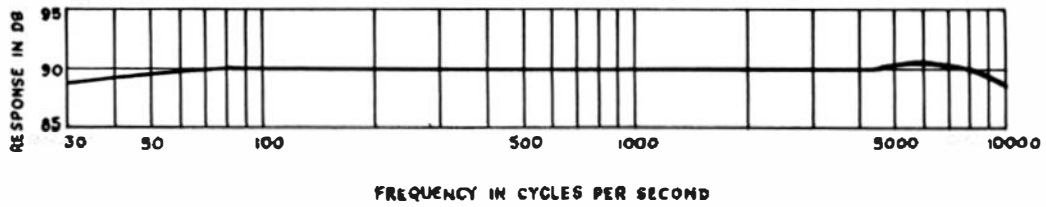


Fig. 1—Frequency Response Curve

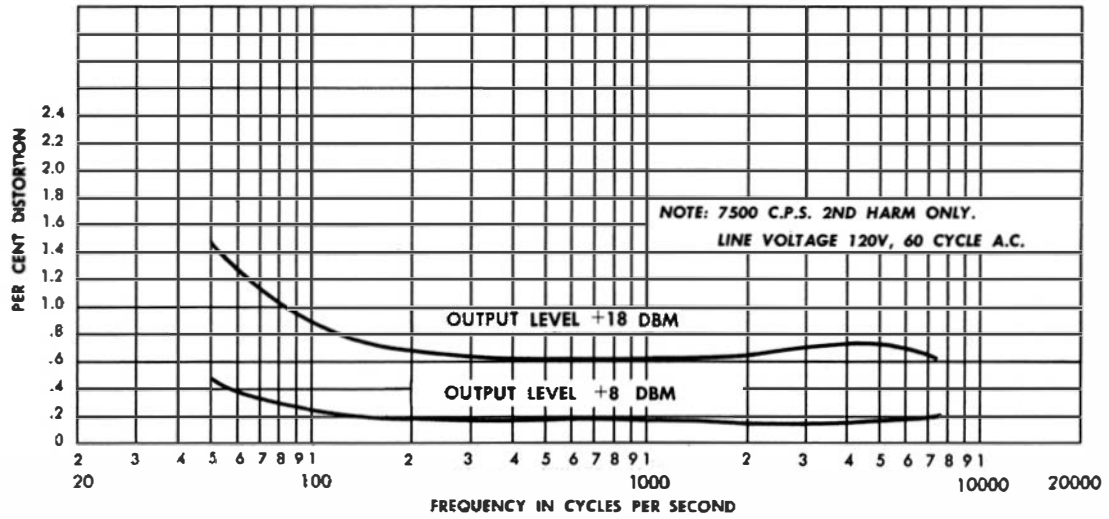


Fig. 2—Distortion-Frequency Curve



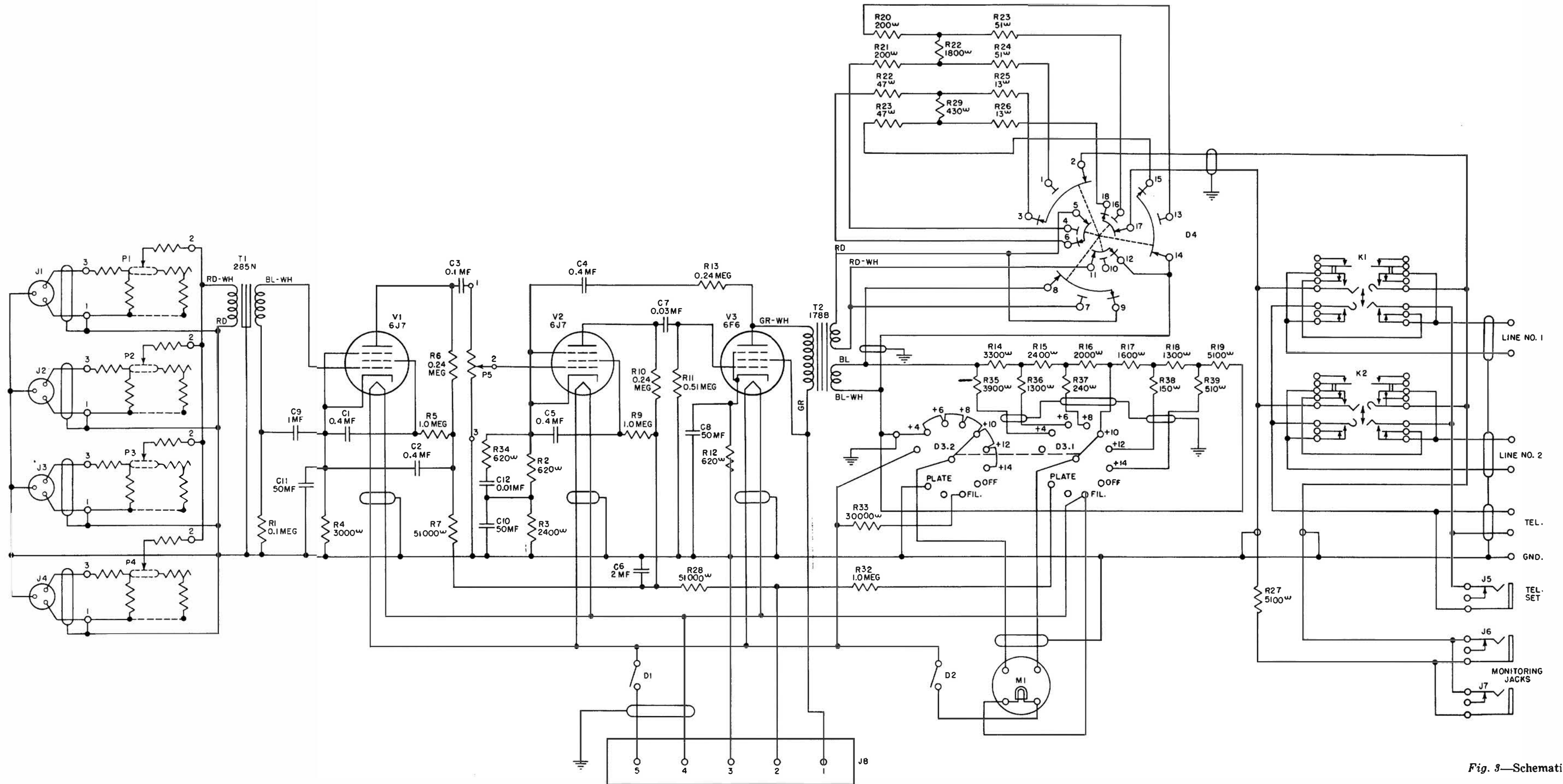


Fig. 3—Schematic

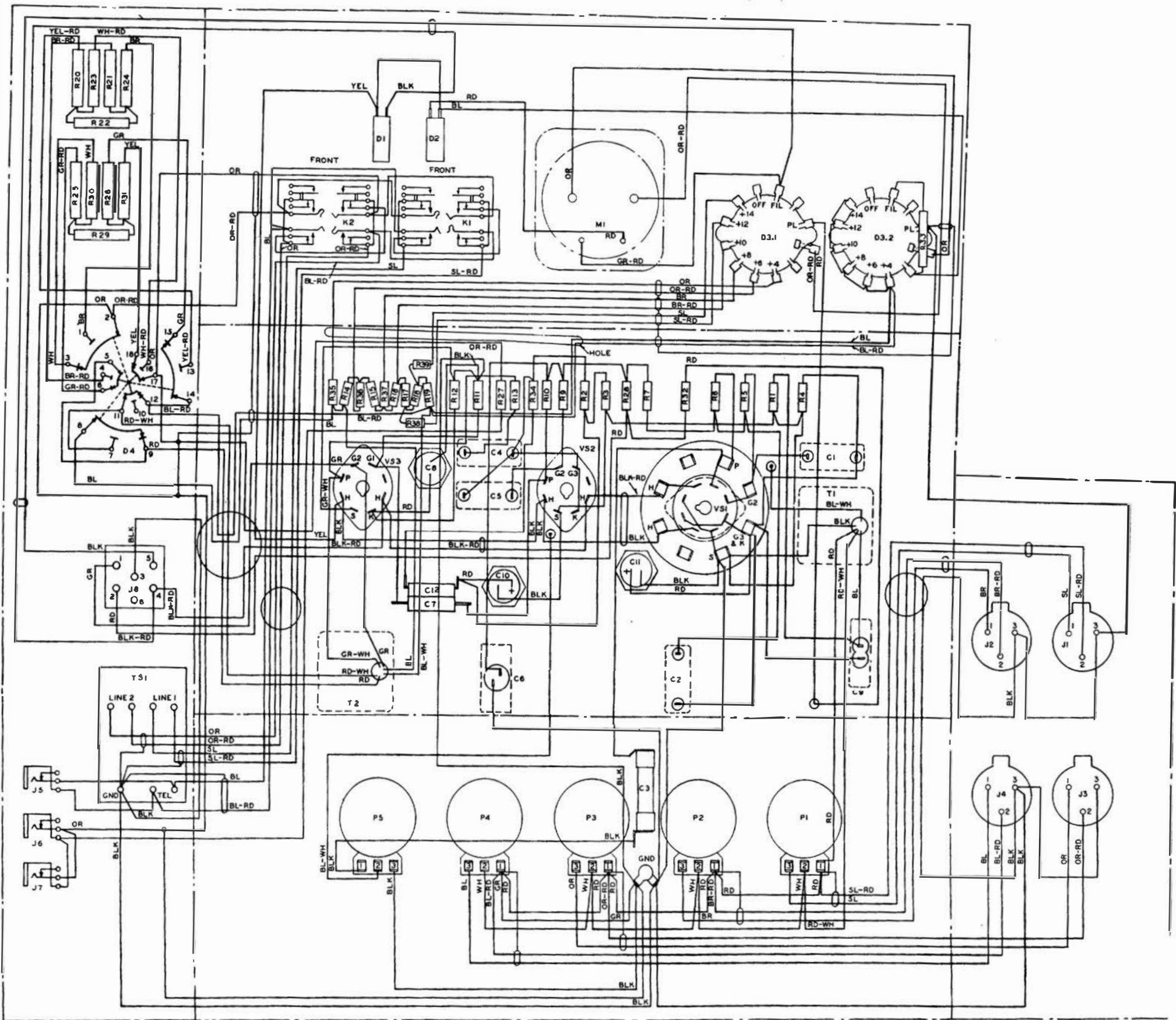


Fig. 4—Wiring Diagram



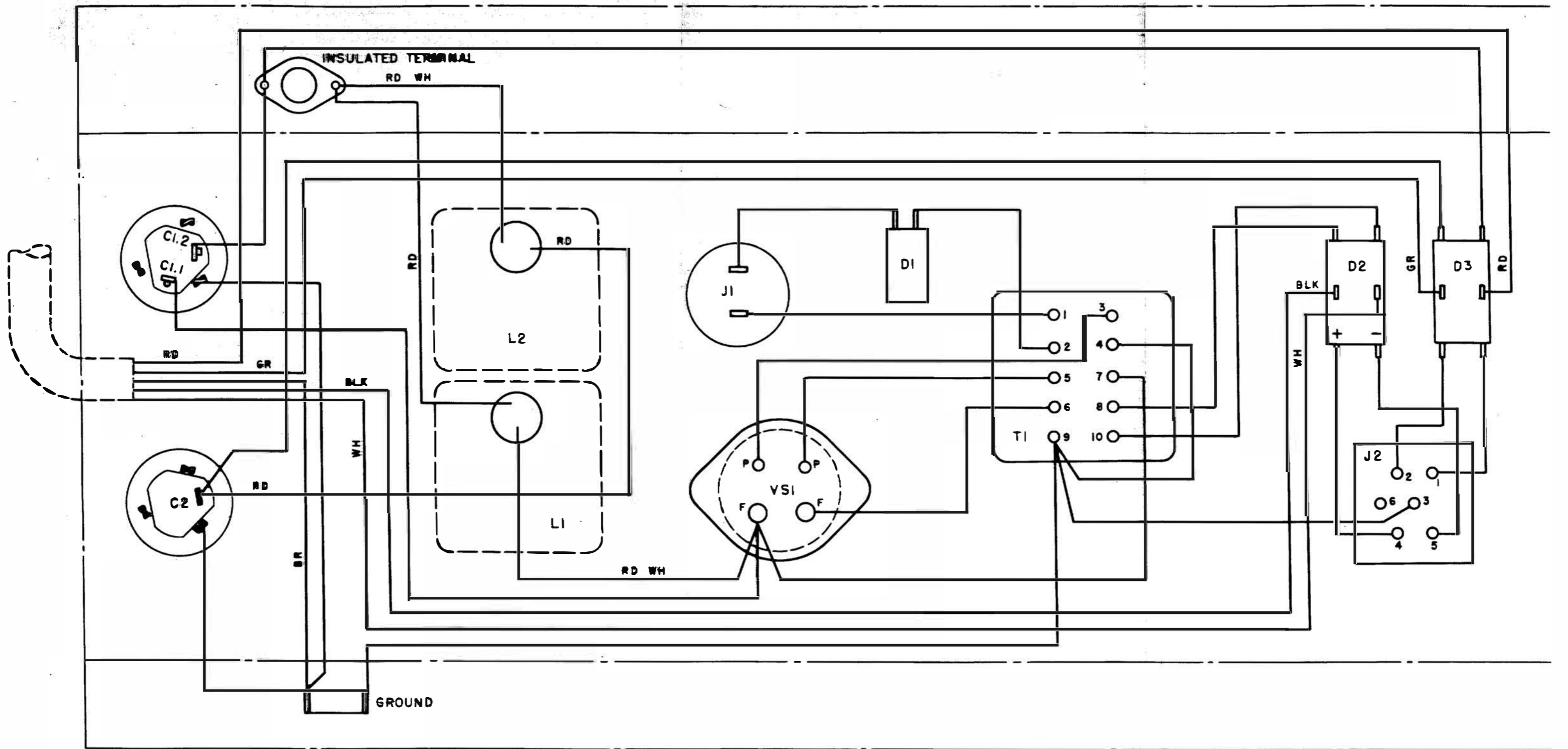


Fig. 6—Power Unit Wiring Diagram



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**— QUALITY COUNTS —**