KS-16575-L1 AMPLIFIER (McINTOSH)
TESTS, ADJUSTMENTS AND REQUIREMENTS

CONTENTS

1. GENERAL

1.01 This section describes the tests, adjustments and requirements associated with the KS-16575-L1 amplifier. It includes routine maintenance and trouble investigation tests.

1.02 Section 024-120-300 lists the initial and routine tests, as well as information on the frequency of routine maintenance tests, on the KS-16575-L1 amplifier.

1.03 A description of the component parts of the amplifier is included in Section 024-120-100.

1.04 ***Test Equipment:*** The tests throughout this section require the use of the following test equipment:

1 — KS-14510 Volt-Ohm-Milliammeter or Weston 779A Analyzer
1 — KS-15560 or KS-15750 Tube Tester
1 — 21A or equivalent Transmission Measuring Set
1 — Pad as described in Paragraph 2.16
1 — Oscilloscope, Dumont 304 or equivalent
2 — W3AE Shielded Cord or equivalent equipped with a 241A plug
1 — 600-ohm Resistor, 106A or equivalent

1.05 Tests should be made in the order listed.

2. TESTS AND ADJUSTMENTS

Primary Power Voltage Measurement

2.01 The purpose of this test is to determine which terminals on the terminal strip in the amplifier are to be connected to the ac supply. It is important that the line voltage adjustment be made correctly on this amplifier. If the line voltage is consistently high (disregarding momentary peaks or surges) the electron tube life will be shortened. If the line voltage is consistently lower than the nominal voltage for which the amplifier is adjusted the power handling capacity of the amplifier will be reduced. This may cause distortion of program signals.

2.02 Apparatus:

KS-14510 Volt-Ohm-Milliammeter or Weston 779A Analyzer

2.03 Procedure:

(1) Adjust the voltmeter for an ac voltage reading of over 100 volts.

(2) Measure the supply voltage at the fuse box or other convenient point between the fuse box and the amplifier.

Required Strapping: The correct terminals for the connection of primary power are as follows:

SUPPLY VOLTAGE	TERMINALS
110-120	19-20
120-130	18-20

The ungrounded supply conductor should be connected to terminal 20.

Caution: In making these measurements care should be taken to avoid contact with live terminals. Disconnect supply voltage before changing terminal connections.

Electron Tube Tests

2.04 These tests will verify that the condition of the electron tubes is satisfactory for operation in the amplifier.

2.05 Apparatus:

1 — KS-15560 or KS-15750 Tube Tester

2.06 Procedure:

(1) Test each tube in accordance with the information given in Section 100-635-101 or 100-636-101 as appropriate.

(2) Discard any tubes that fail to meet the requirements.

Caution: If the amplifier has been operating, the tubes may be too hot to handle safely. Use asbestos gloves or tube pulling tool for removing a tube.

Gain and Gain-Frequency Tests

2.07 Gain tests on the KS-16575-L1 amplifier require care due to the amount of gain which will be encountered. The use of shielded connecting cords is specified. This should aid materially in avoiding errors due to stray coupling between input and output circuits when measuring gain.

2.08 Gain is usually measured using 600-ohm measuring sets and the 600-ohm input and the output circuit of the amplifier which has a 600-ohm internal output impedance. If the low-impedance "600-ohm" output is used the gain will measure approximately 6 db higher; if the 16-ohm output is used the gain will measure approximately 10 db lower. The tests of amplifier gain and gain-frequency characteristics are made with the amplifier operating at an output level of +20 dbm (0.1 watt).

2.09 Apparatus: The following equipment is required for these tests:

1 — 21A Transmission Measuring Set

2 — W3AE Shielded Cord or equivalent equipped with a 241A plug

2.10 The 21A TMS contains an oscillator and a power measuring system. Other oscillators and measuring sets may be used provided they have or can be arranged with additional equipment so as to have the accuracy, frequency range and power handling capability of the 21A TMS. In all such cases an attenuator such as the 5A should be employed between the source of testing power and the amplifier. The oscillator and transmission measuring set should be connected together, and the oscillator adjusted until a reading of 0 dbm is obtained on the measuring set; this should be done at each test frequency listed in Table 1. If any adjustment of oscillator output is required to obtain a reading of 0 dbm on the transmission measuring set the same adjustment must be made when the amplifier is tested.

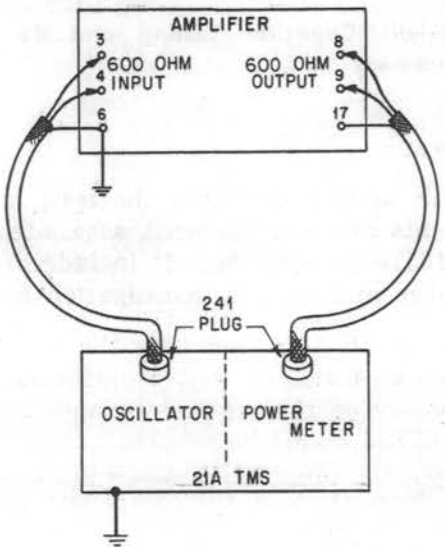

Fig. 1 – Gain and Gain-Frequency Testing Arrangement

2.11 Procedure: Energize the amplifier and the transmissoin measuring set and adjust the oscillator for an output of –40 dbm at 1000 cycles. Connect the oscillator to the 600-ohm input circuit (terminals 3 and 4) of the amplifier. (See Fig. 1.) Adjust the measuring set power meter for an input level of +20 dbm and

connect it to the 600-ohm internal output impedance circuit (terminals 8 and 9) of the amplifier. Adjust the amplifier gain controls to maximum. The gain of the amplifier is equal to the sum of the loss in the oscillator-attenuator circuit (below 0 dbm) and the reading of the measuring set (above 0 dbm).

Requirement: The 1000-cycle gain (G_a) should be 58 db ±2 db. The gain at all other frequencies should be within the limits listed in Table 1.

TABLE 1

FREQUENCY (CYCLES)	LIMIT (db)
20	G_a ±0.8
50	G_a ±0.5
100	G_a ±0.5
500	G_a ±0.5
1,000 = G_a	58 db ±2.0
5,000	G_a ±0.5
10,000	G_a ±0.5
15,000	G_a ±0.8
20,000	G_a ±0.8

Note: A small margin is included in the limits given above in order to provide for inaccuracies in test equipment and procedure.

2.12 Make a 1000-cycle attenuation test by observing that the gain reduces as the gain controls are turned from maximum to minimum. The amplifier is equipped with two gain controls. One provides 4.5 db of attenuation in 0.5 db steps and the other 40 db of attenuation in 5 db steps. In order to keep the transmission measuring set reading nearly constant, compensate for the change in gain control attenuation by a corresponding change of the attenuator in the 21A TMS oscillator section.

Requirement: The 5 db steps should be within 1.0 db of the indicated attenuation and the 0.5 db steps should be within 0.3 db of the indicated attenuation.

Noise Test

2.13 This test is made to verify that the ratio of maximum single-frequency signal to steady noise is at least 90 db.

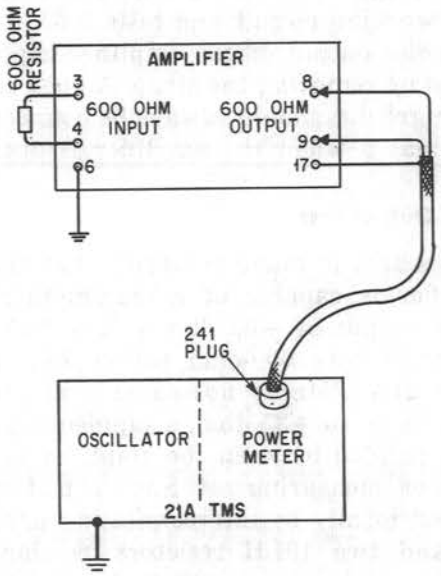

Fig. 2 – Noise Test Arrangement

2.14 Apparatus:

1 — 21A Transmission Measuring Set

1 — 600-ohm Resistor, 106A or equivalent

1 — W3AE Shielded Cord or equivalent equipped with a 241A plug

2.15 Procedure:

(1) Terminate the 600-ohm input of the amplifier (terminals 3 and 4) under test with the 600-ohm resistor as indicated in Fig. 2.

(2) Connect the 600-ohm output circuit (terminals 8 and 9) to the measuring set input.

(3) Adjust amplifier controls for maximum gain.

(4) Adjust the "hum balance" potentiometer for minimum reading on the transmission measuring set.

(5) Read the noise power indicated on the TMS.

Requirement: The noise should not exceed –55 dbm.

Note: As indicated on the schematic diagram (Fig. 5), the amplifier circuit ground is normally connected to the amplifier chassis ground by means of a strap between

terminals 6 and 7. This strap should be in place except when the amplifier is connected to a working circuit and tests indicate that the noise output of the amplifier can be reduced by removing the strap. A good central office ground should always be connected to terminal 6 when the amplifier is operated.

Maximum Output Test

2.16 This test is made to verify that the amplifier is capable of a maximum single-frequency output of +35 dbm (3.2 watts) from the output having 600-ohm source impedance. Since the 21A TMS is not capable of reading power levels up to +35 dbm, a supplemental pad must be provided between the amplifier and the transmission measuring set. Such a pad can be constructed locally by interconnecting one 18GJ resistor and two 19LH resistors as shown in Fig. 3. This pad provides 20 db loss with good accuracy and is capable of dissipating the required amount of power.

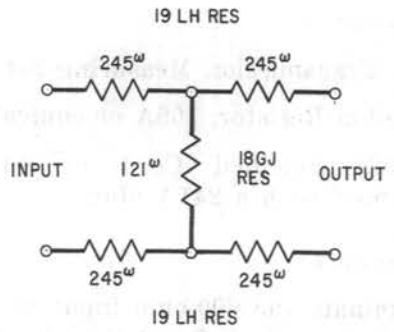

Fig. 3 – Output Pad

2.17 Apparatus:

1 — 21A Transmission Measuring Set

1 — Output Pad as described in Paragraph 2.16

1 — Oscilloscope, Dumont 304 or equivalent

2 — W3AE Shielded Cords or equivalent equipped with a 241A plug

2.18 Procedure:

(1) Set up the testing arrangement as described in Paragraph 2.11 but with the pad input connected to amplifier terminals 8 and 9 and the pad output connected to the TMS.

Note: Do not use tinsel conductor cords between the amplifier and the pad.

(2) Connect the oscilloscope to the output of the pad (in parallel with the power measuring section of the TMS).

(3) Adjust the measuring set to read levels up to +20 dbm.

(4) Adjust the oscillator output to that value (about –23 dbm) required to give an amplifier output of +35 dbm. (20 db pad loss and +15 dbm read on the TMS.)

(5) View the wave form at the amplifier output; view also the wave form at the amplifier input (terminals 3 and 4) increasing the oscilloscope vertical gain to give as great a deflection as that obtained when viewing the signal at the amplifier output.

Requirement: The wave form as viewed on the oscilloscope should show no peak clipping or other distortion. The wave form should appear exactly the same at the amplifier output as at the amplifier input except for a change in amplitude.

3. TROUBLE LOCATING TESTS

3.01 When the amplifier fails to meet test requirements and the cause is not due to defective tubes, the amplifier should be checked ***(with the power disconnected)*** for visible evidence of malfunction due to defective components. Fig. 5, page 7, shows a schematic diagram of the amplifier. If any component part appears to be damaged or defective, it can be identified with the parts location diagram. This diagram is shown in Fig. 6, page 8.

3.02 If the amplifier can be operated without harm (such as by arcing or overheating), then there is one simple test which may help to locate the trouble. With the amplifier set up as described in Paragraph 2.11 and with the amplifier gain adjusted so as to supply +10 dbm (10 milliwatts) to the transmission measuring set bridge an 8-ohm resistor (such as type 18 FW) across the 8-ohm output circuit (terminals 14 and 16). If this change from a light load condition to a more than full load condition causes the transmission measuring set reading to decrease more than 1 db, a trouble condition is indicated. If the trouble is indicated by excess

amplifier gain the feed-back circuit should be checked for continuity.

Operating Voltage Measurements

3.03 If the tests mentioned above fail to reveal the trouble, it will be necessary to measure the operating voltages in the amplifier. The values of voltages on the various elements of the electron tubes may be measured at the tube sockets on the underside of the chassis. The voltages should be measured between the point indicated and the amplifier circuit ground (terminal 6). Table 2 lists the voltages to be found at the various circuit points when the amplifier is operating normally and without input signal applied. Fig. 4 shows the pin numbering arrangements for electron tube sockets as viewed from the wiring side.

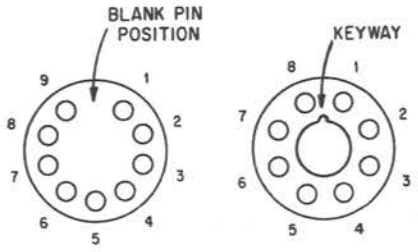

Fig. 4 – Tube Socket Pin Numbering System

3.04 Apparatus:

KS-14510 Volt-Ohm-Milliammeter or Weston 779A Analyzer

3.05 Procedure:

(1) Switch on the amplifier and wait for at least one minute.

(2) Verify that the line voltage and power connections are proper (Paragraph 2.03).

(3) Obtain voltage readings, beginning at the output of the power rectifier tube, and working through the circuit to the elements of the other tubes until an indication of the trouble location is obtained.

Caution: In making these tests, care should be taken to avoid contacts with live terminals.

3.06 As noted in Table 2 there are several tube pins which are not connected to tube elements. These pins may be used as circuit tie points and voltages may be present on them. Voltages which are present at important circuit points but not present at any tube pin are noted on the schematic diagram.

Resistance Measurements

3.07 Measurement of resistance can be made from the various tube pins to circuit ground. In making these measurements the ac power should be disconnected from the amplifier and pin 2 of the 5U4GB connected to circuit ground. The normal values of resistance are shown in Table 3.

Caution: Do not apply power to the amplifier while pin 2 of the 5U4GB is grounded.

TABLE 2

OPERATING VOLTAGES

Tube	Pin # 1	2	3	4	5	6	7	8	9
V_1 12AX7	72	0	0.8	H	H	0	0	0	H
V_2 12AU7	165	72	80	H	H	168	33	80	H
V_3 12BH7	215	0	11	H	H	215	0	11	H
V_4 6L6GB	0	H	270	270	0.3	NC	H	19	
V_5 6L6GB	0	H	270	270	0.3	NC	H	19	
V_6 5U4GB	NC	315	NC	375AC	NC	375AC	NC	315	

Note: Voltage is measured with a 20,000 ohms per voltmeter using the lowest appropriate range; voltages are dc unless otherwise indicated.

(H) Indicates heater connection.

(NC) Indicates pin is not connected to tube elements.

TABLE 3

RESISTANCE MEASUREMENTS

Tube	Pin # 1	2	3	4	5	6	7	8	9
V_1 12AX7	320K	*10K	3.3K	H	H	0	0	0	H
V_2 12AU7	40K	320K	18K	H	H	40K	2.5 Meg.	18K	H
V_3 12BH7	15K	220K	1.2K	H	H	15K	220K	1.2K	H
V_4 6L6GB	0	H	300	300	560K	NC	H	280	
V_5 6L6GB	0	H	300	300	560K	NC	H	280	
V_6 5U4GB	NC	0	NC	100	NC	100	NC	0	

Note: Resistance is measured from the point indicated to circuit ground. The ac supply should be disconnected and pin 2 of the 5U4GB connected to circuit ground.

(H) Resistance to ground of heater connections will vary from 0 to 70 ohms depending on the setting of the hum adjust control.

(K) Indicates "000" omitted.

(*) With attenuator S2 in the "off" position.

(NC) Indicates pin is not connected to tube elements; it may be used as a circuit tie point, however.

Distortion

3.08 Measurement of the several kinds of amplifier distortion involves the use of equipment and techniques which are not usually a part of test room operation. The presence of distortion can be detected as described in Paragraph 2.17. If such distortion is not found to be due to faulty electron tubes the amplifier circuit components must be investigated for faulty operation. After the source of the trouble has been found remedial measures can be taken.

Electrolytic Capacitor Testing and Replacement

3.09 It may be necessary to attempt to re-form the film in the electrolytic capacitors in the amplifier if the latter has not been in use for several months. This may be done by following the method described in Section 032-110-701.

3.10 If the hum level of the amplifier is high after an attempt has been made to re-form the capacitor film, the capacitors should be tested as described in Section 032-110-701, and replaced where the need is indicated. The capacitors can be assumed to be in satisfactory condition if the amplifier meets the noise requirements specified in Paragraph 2.15.

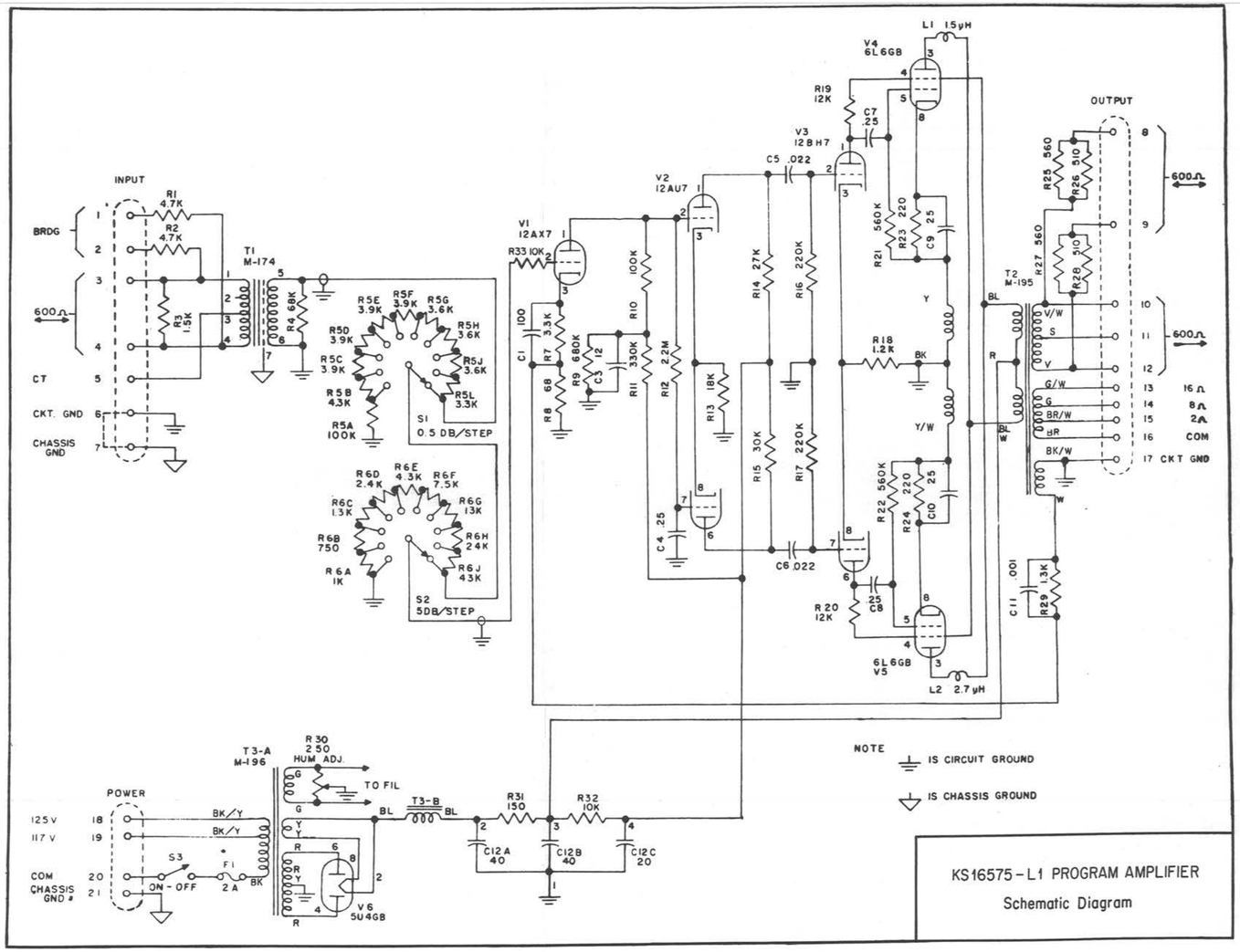

Fig. 5 – Schematic Diagram

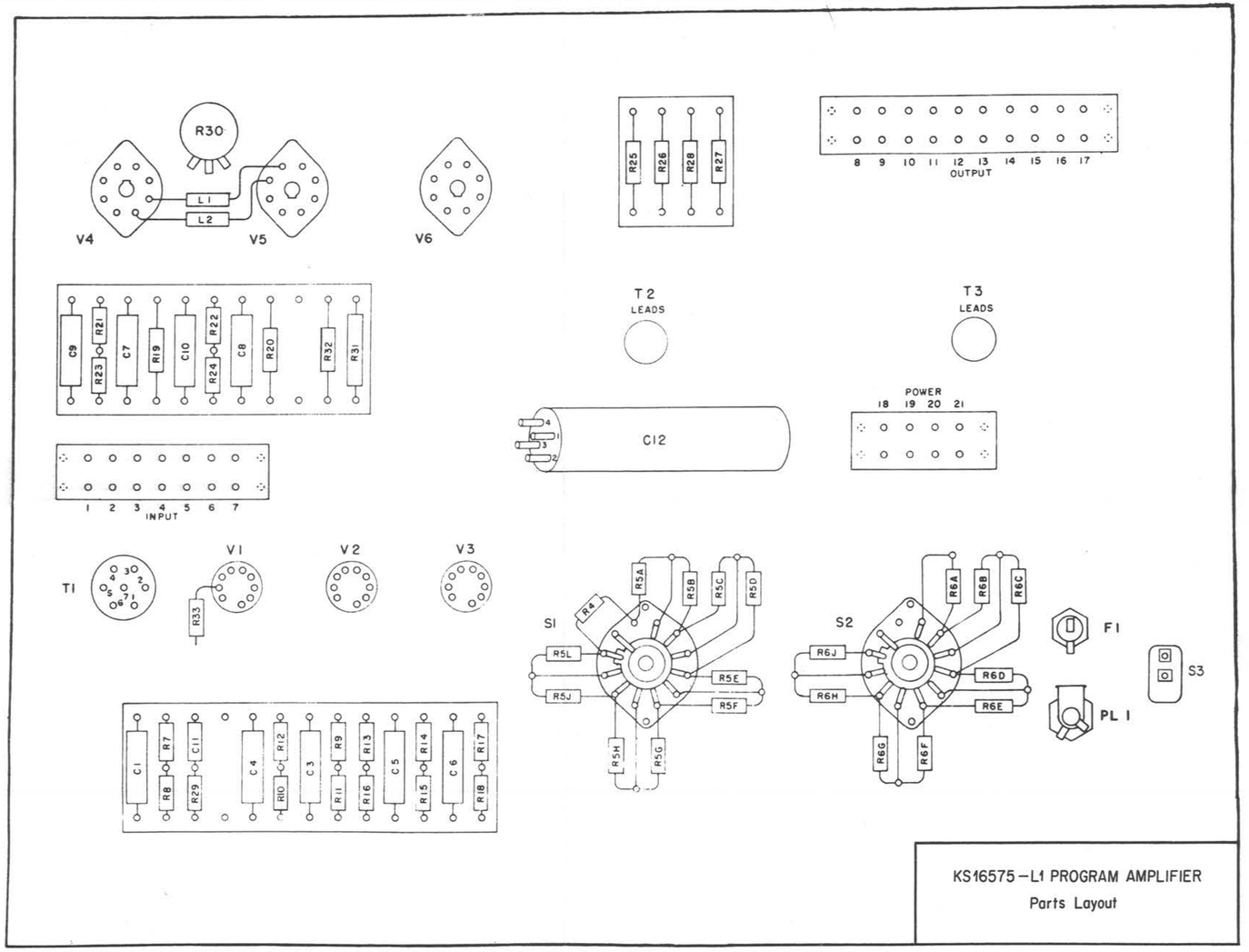

Fig. 6 – Parts Location Diagram