# V3 TELEPHONE REPEATER

# DESCRIPTION

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## 1. GENERAL

**1.01** This section describes the circuit, transmission characteristics, and equipment assembly of the V3 voice-frequency repeater. Bay layouts including the testing features are described in Section 332-103-101. The V3 repeater consists of two J68647A amplifiers and plug-ins and their mountings.

**1.02** This section is reissued to include information about the KS-21076 Hybrid Integrated Network (HIN) which replaces the 408A vacuum tube in the V3 repeater. To protect the HIN-equipped V3 repeaters from transient voltages, an ED-7C057 Lightning Surge Protector must be installed. This conversion will result in savings of electrical power, reduce maintenance cost, increase system stability, and reduce repeater outages.

## 2. CIRCUIT DESCRIPTION

**2.01** Fig. 1 is a schematic of one amplifier of the V3 repeater. It is a single stage amplifier with the usual input and output transformers, gain control, and feedback path. It can be either a tube or HIN-equipped amplifier. The KS-21076 HIN is a metal enclosed network consisting of a field effect transistor (FET) with internal fusing and an internal protection diode. The network is a solid state replacement for the conventional glass 408A or 403B pentode electron tube in the V3 repeater amplifier. It is recommended that no intermixing of the tube, solid state, and HIN amplifiers be allowed on the heater circuitry associated with any specific fuse panel. With this restriction, no heater voltage is required, thus precluding the need for voltage adjustments.

**2.02** Lightning Surge Protector ED-7C057 is an adapter which fits between a J68647 amplifier and its mounting shelf. It consists of an eleven pin plastic tube socket held together with a metal band. Physically, the surge protector is 1 inch deep (excluding pins) and 1-1/4 inch in diameter. It contains two 521B diodes which serve as bidirectional, symmetrical surge protectors. Electrically, the surge protector bridges separate 521B diodes across the amplifier input and output and effectively limits transient voltages applied to the amplifier at these points to 20-volts peak.

**2.03** The gain may be varied continuously from a maximum of about 36 dB to a small loss by a logarithmically tapered potentiometer having approximately 40-dB range connected across the secondary of the input transformer. The HIN-equipped amplifier in V3 repeater application has approximately 1.5-dB greater range than that of the tube equipped amplifier; however, to provide complete protection to the HIN, the maximum allowable amplifier gain should be limited to 35 dB. Feedback is obtained by coupling from the output to the input through a cathode resistance and feedback winding on the

TABLE A

| AMPLIFIER | HEATER | | | PLATE | | |
|---|---|---|---|---|---|---|
| | VOLT | CUR | POWER | VOLT | CUR | POWER |
| J64647A (408A Tube) | 20 | 50MA | 2W | 130 | 5MA | .65W |
| J64647A (HIN) | 0 | 0 | 0 | 130 | 4MA | .52W |
| J64647B (403B Tube) | 6.3 | 150MA | .95W | 130 | 5MA | .65W |
| J64647B (HIN) | 0 | 0 | 0 | 130 | 4MA | .52W |
| KS20378 L1, L2 (Solid State) | 20 | 50 | 1W | 0 | 0 | 0 |

*Note:* Several advantages are realized from the replacement of the amplifier electron tube with the HIN. Marked decrease (68%) in power consumption is readily evident from the above tabulations.

output transformer. The total amount of feedback over the voice-frequency band from the output to the input is about 14 dB and is independent of the gain adjustment. A network consisting of a small condenser in series with a resistor is connected from the plate to screen to by-pass the plate winding and prevent singing at high frequencies.

**2.04** The feedback path serves as an output impedance termination for the tube or HIN at all times thereby stabilizing the amplifier characteristics. By the use of a resistance-capacitance network in the grid circuit, the feedback is altered at low frequencies so that in conjunction with the mutual inductance of the output transformer it has a rising output impedance. The input impedance is independent of feedback and is made up of the input transformer and its associated 1200-ohms resistance and gain control potentiometer.

**2.05** An auxiliary winding on the output transformer is used for monitoring and is terminated in pin jacks on the amplifier. The monitoring winding has a loss of 12 dB with reference to the output level when both input and output are terminated in 600 ohms. A (P) pin jack is used for measuring the space current drop across the 300-ohm resistance in the cathode circuit for cathode activity tests of the tube type amplifier.

**2.06** For comparison between tube- and HIN-type amplifiers, see Table A.

## 3. TRANSMISSION CHARACTERISTICS

**3.01** The HIN is directly interchangeable with the electron tube affording transmission characteristics equal to or better than the electron tube. Frequency response, harmonic levels, compression, power output, and input and output impedances meet the amplifier requirements. The surge protector (ED-7C057) has an insertion loss of less than 0.1 dB and has no other discernible effects on the transmission characteristics of the V3 amplifier with the HIN.

TABLE B

NOISE SUSCEPTIBILITY OF V3

| FREQUENCY | INPUT LONGITUDINAL UNBALANCE-MICROAMPS PER VOLT | DB LOSS-PLATE BATTERY TO 600-OHM OUTPUT |
|---|---|---|
| | V3 | V3 |
| 100 | 0.1 | 38 |
| 200 | 0.1 | 44 |
| 500 | 0.25 | 53 |
| 1000 | 0.5 | 52 |
| 2000 | 1.0 | 45 |
| 3000 | 1.5 | 41 |
| 5000 | 2.0 | 37 |

### A. Impedance

**3.02** The input and output impedances of the V3 repeater are nominally 600 ohms varying somewhat with the frequency. (See Fig. 2 and 3.)

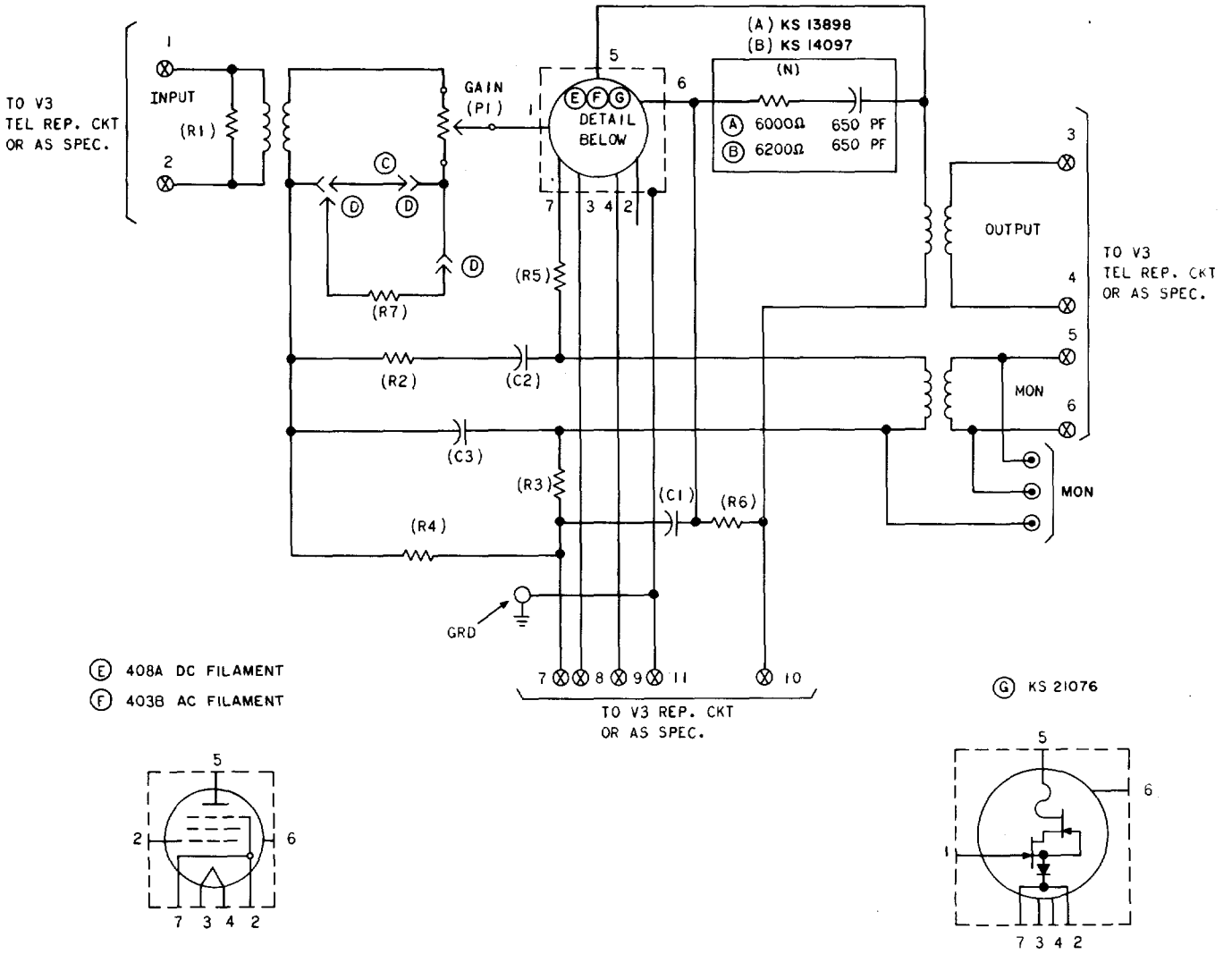



**Fig. 1—V3 Amplifier Schematic**

### B. Gain-Frequency

**3.03** The gain frequency characteristic is essentially flat from 300 to 5000 Hz. (See Fig. 4.)

### C. Output Carrying Capacity

**3.04** The output carrying capacity for the V3 is adequate for a +10 dB level with respect to the transmitting toll switchboard. (See Fig. 5.)

### D. Noise

**3.05** The input longitudinal noise unbalance of the V3 as a function of frequency is given in Table B in terms of microamperes in the metallic path per volt of longitudinal electromotive force (emf). The susceptibility of the amplifier to noise on the plate battery is given in Table B as a function of frequency. Susceptibility in this case is defined as the dB loss ratio of the noise voltage in series with the plate battery to the noise voltage across the 600-ohm output line. The output noise of the V3 is expected to be less than 17 dBrn with C-message weighting. If the output noise exceeds 29 dBrnc, the amplifier is considered to be too noisy. See Section 332-103-500 for noise tests.

### E. Crosstalk

**3.06** The crosstalk coupling loss at 1000 Hz between adjacent amplifiers on a panel is

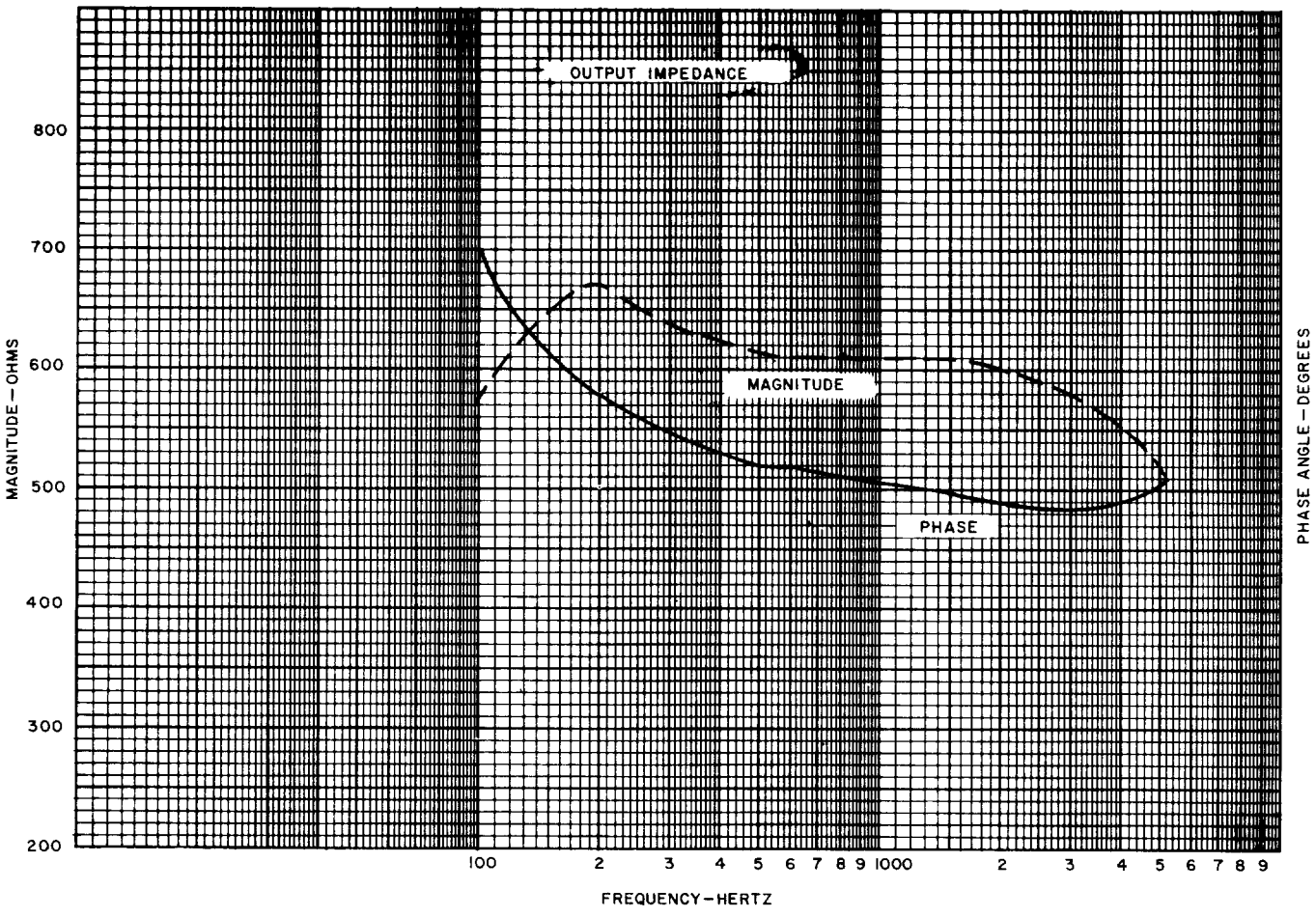



**Fig. 2—Output Impedance**

not expected to be less than 75 dB at points of equal level. See Section 332-103-500 for crosstalk coupling loss tests.

## 4. EQUIPMENT ASSEMBLY

**4.01** Fig. 6 is a view of an amplifier equipped with a tube and a HIN-equipped amplifier with the surge protector.

**4.02** The amplifier unit is a plug-in type. The plug-in feature affords a means of quick replacement of a defective repeater and facilitates the testing and maintenance of repeaters at a central location if desired. The socket, with proper cords and associated jack circuits, permits access to the circuit for transmission tests. With the provision of pin jacks on the repeater for monitoring and for testing cathode activity, jacks can, if desired, be eliminated at the repeater bay, being retained only when required for patching purposes. A special testing arrangement is used in all cases where jacks are omitted which will give complete access for testing purposes. This is discussed in more detail in Section 332-103-101.

**4.03** The amplifier components with tube or HIN and the pin jacks mount on 1-3/4 inch centers on a 1-3/4 inch mounting plate. The components are mounted in the following manner:

(a) A U form structure supports all components except the top plate by spring compression. The top plate is mounted by three self-tapping screws.

(b) The cover is a rectangular thin wall extruded aluminum tube.

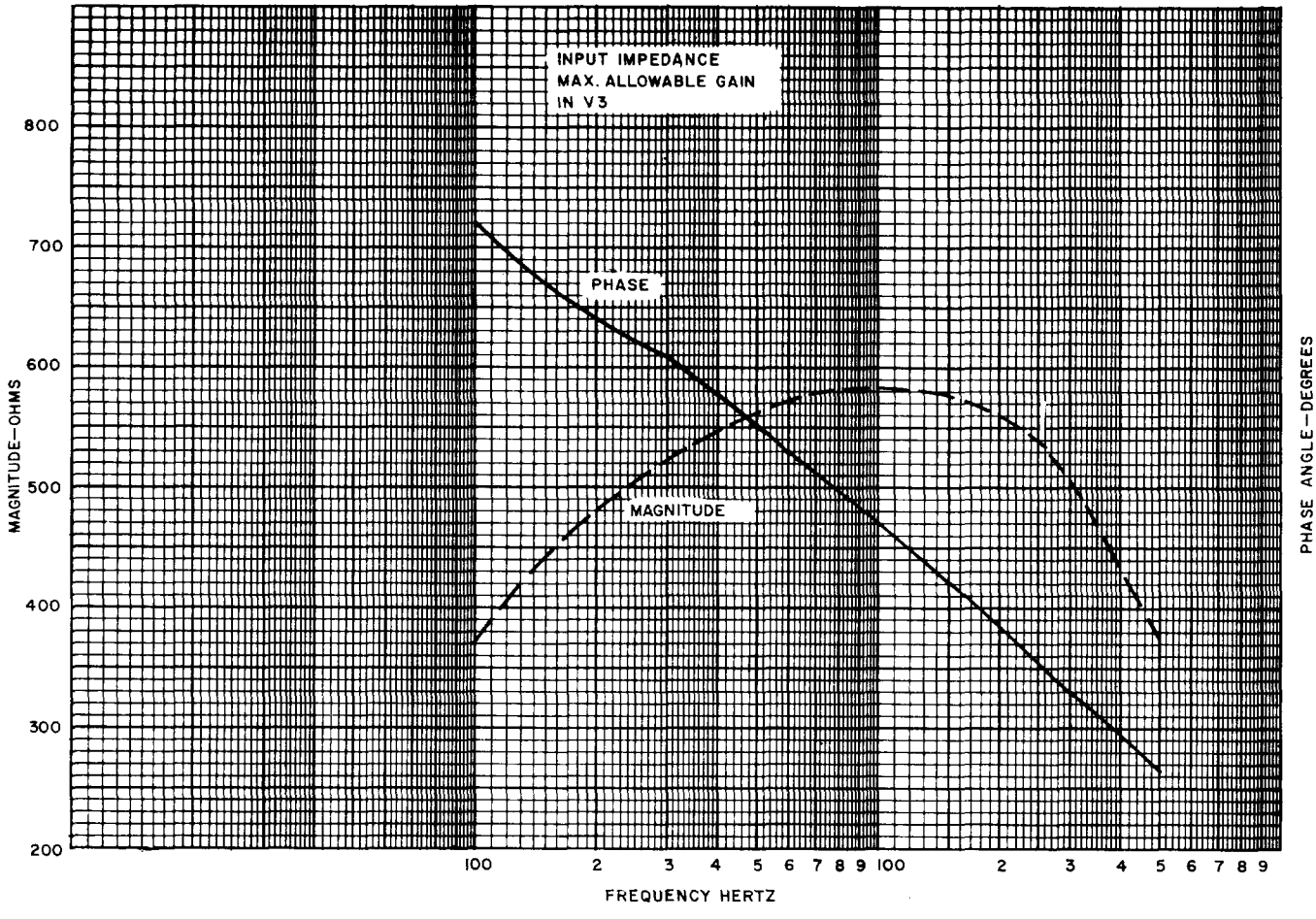



**Fig. 3—Input Impedance**

(c) The top plate is a molded part mounting the tube socket, potentiometer, monitoring jacks (pin type), and cathode activity test jack (pin type). The amplifier code, tube code, potentiometer index, and jack designations are molded into this plate. The HIN is the replacement for the 408A tube and is not designated by a code stamp. A small rough surface is also available in the top right corner for pencil notations. A total of ten amplifiers mount on one 1-3/4 inch mounting plate.

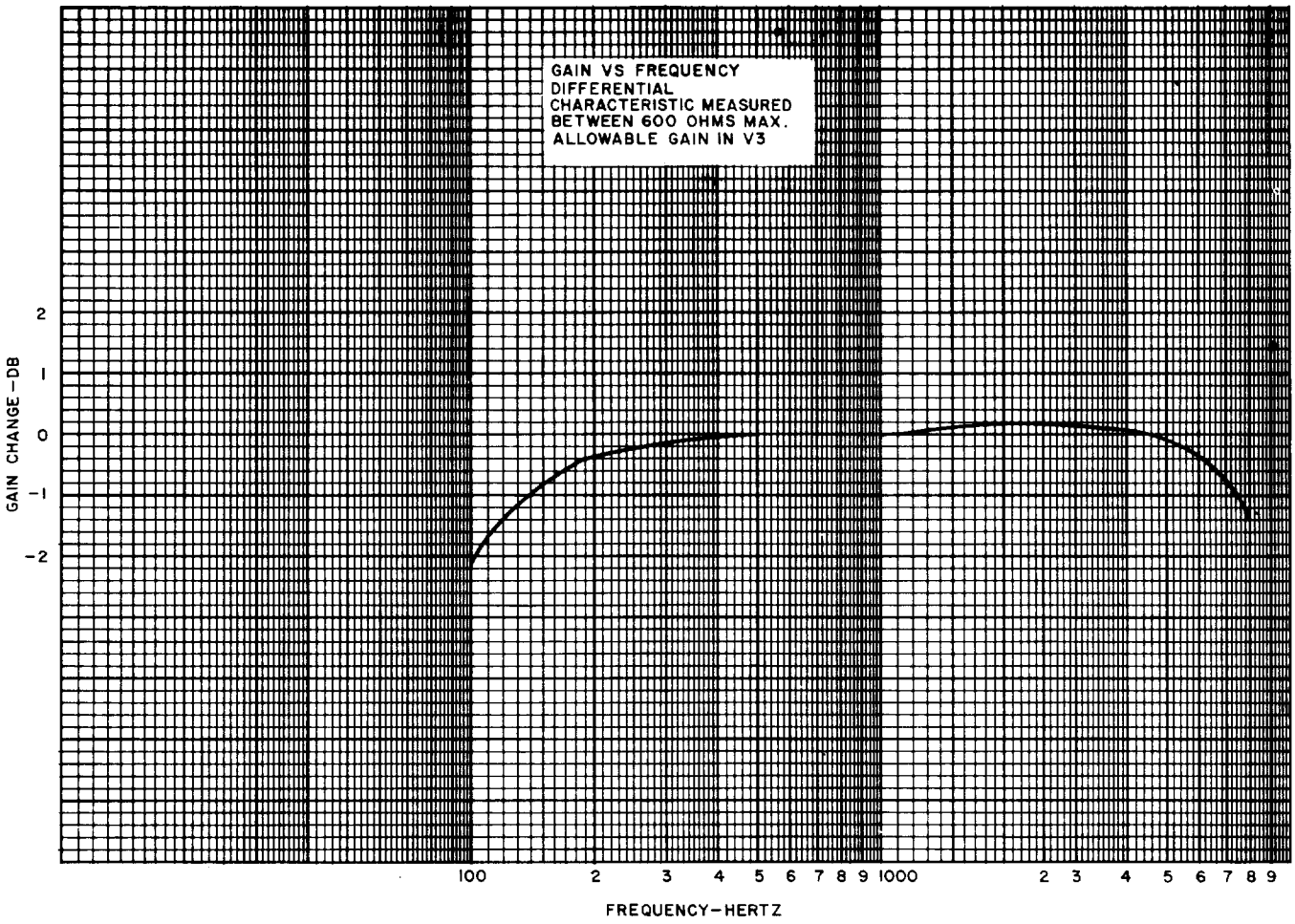



**Fig. 4—Gain vs Frequency**

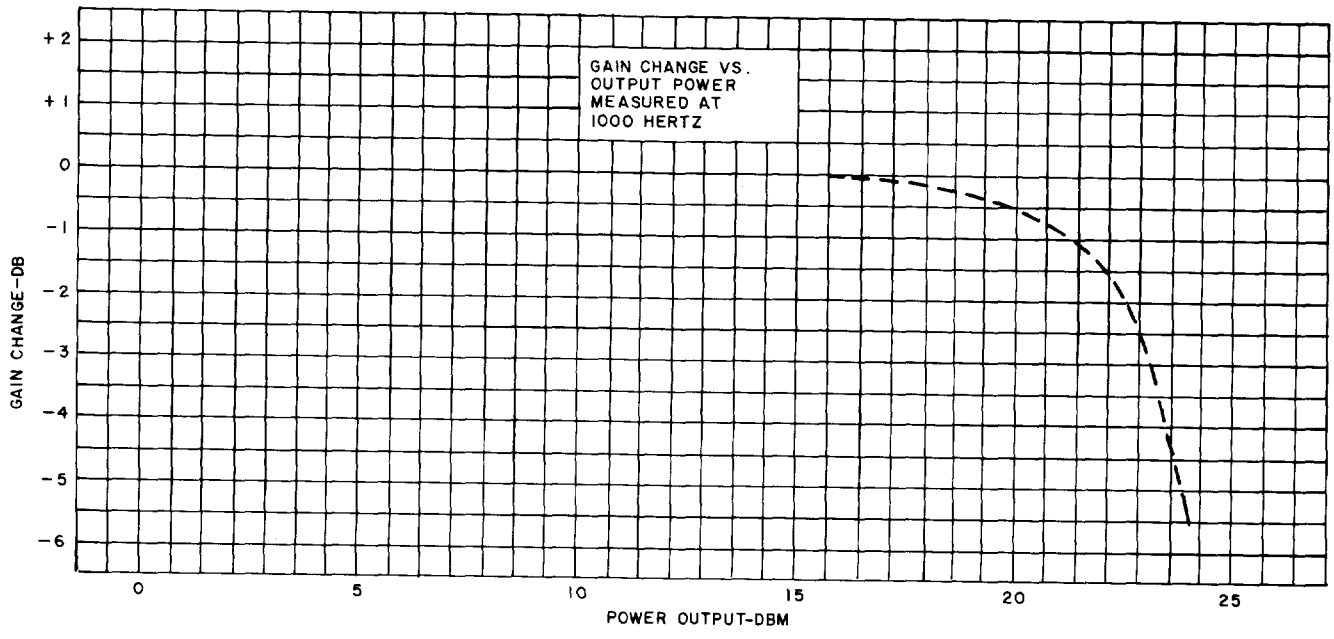
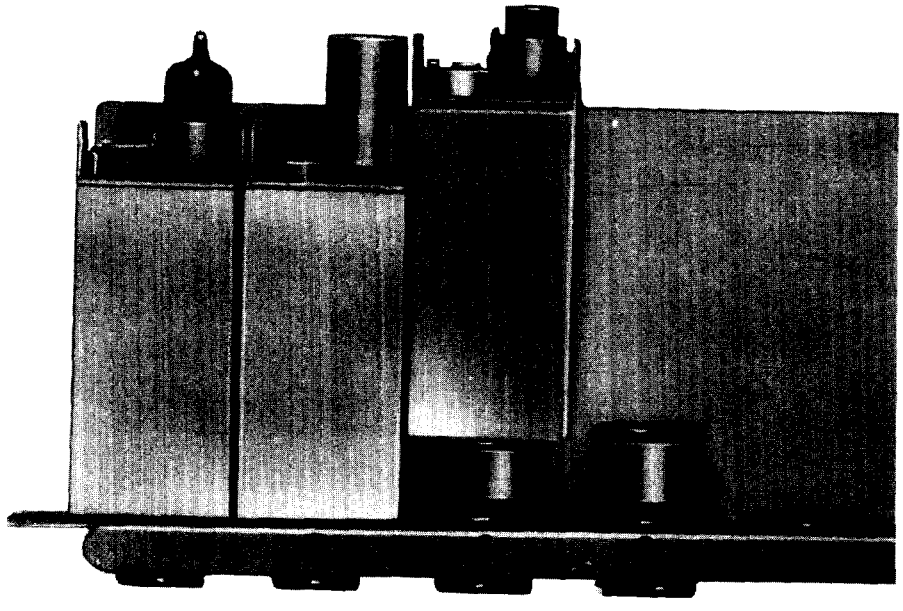



**Fig. 5—Gain Change vs Output Power**



A. REPEATER WITH TUBE
B. REPEATER WITH TUBE AND SHIELD
C. REPEATER WITH HIN AND SURGE PROTECTOR
D. SURGE PROTECTOR

**Fig. 6—V3 Telephone Repeater**