SECTION II

THEORY OF OPERATION

1. MECHANICAL THEORY.

The type 26W Limiter Amplifier is constructed on a sturdy aluminum panel notched to fit any standard relay rack or cabinet. It requires fourteen inches of vertical mounting space. The components are mounted on a vertical chassis using an inside-out type of construction. All wiring and components are accessible upon removal of a rear dust cover. The dust cover is provided with snap fasteners and requires no tools for removal.

2. ELECTRICAL THEORY.

a. GENERAL. - The signal channel of the 26W is composed of an input voltage amplifier, a limiter circuit, an interstage voltage amplifier and a push-pull Class A output amplifier stage. Refer to Figure 2-1.

b. INPUT AMPLIFIER. - The input line is transformer coupled by T101 to a Type 6N7 tube V101 employed as a voltage amplifier. Bias is obtained by means of the voltage drop across a resistor R113 in the cathode circuit. Refer to Figure 2-2.

c. LIMITER CIRCUIT. - The limiter circuit employs a Type 5814A ~~6N7GT/G~~ tube, V102, and a Type 6H6GT/G tube, V106. The Type 6N7GT/G tube is connected in a double resistance bridge circuit with the triode sections acting as the variable legs of the bridges. The double bridge circuit provides proper termination for the balanced output of the input amplifier. One bridge circuit consists of resistors, R118, R119, R123 and one triode section of V102. The second bridge consists of resistors R120, R121, R124 and the remaining triode section of V102. When the values of R123 x R119 = R118 x (the plate resistance of the vacuum tube leg of the bridge) and the values of R120 x R124 = R121 x (the plate resistance of the vacuum leg of the bridge), the loss across the bridge will be very high and only a very small portion of the output voltage of the input amplifier will be permitted to reach the primary windings of the coupling transformer T102. If, however, the resistance of one leg of the bridge is very high compared to the other three legs, the bridge will be unbalanced and the loss in the circuit will be small. The limiter control circuit employs a 6H6GT/G tube, V106, as a full wave rectifier connected in the primary circuit of T103. Voltage is applied to the plates of V106 through coupling condensers C107 and C108. As the audio level is increased, the voltage in the primary circuit of T103 increases, resulting in an increase of current flowing in the rectifier circuit. The current flowing through the rectifier, V106, develops a voltage across R152 which varies directly with the flow of current through the

rectifier and is opposite in polarity to the fixed bias that appears on the resistor. The sum of the fixed bias voltage and the developed voltage gives a voltage that is less negative than the fixed bias ordinarily applied to V102 and the result is a greater flow of current through the limiter tube. Increasing the flow of plate current through V102 results in a lower plate resistance and the resistance of the vacuum tube legs approaches the value that is necessary to balance the bridges. The loss across the bridge increases rapidly as balance is approached and as a result less voltage is permitted to reach the primary of the transformer T102.

The time required for the gain reduction to become effective upon application of a large input signal is determined by the charging rate of C109. A time interval of 0.1, 0.3, 1.0, 3.0, or 10 milliseconds may be selected by the operation of S101, which connects a resistance of the proper value, R138, R139, R140, or R141, in series with C109.

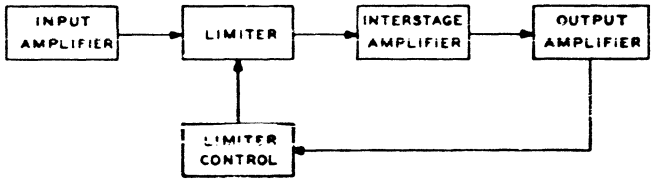


Figure 2-1. Functional Block Diagram

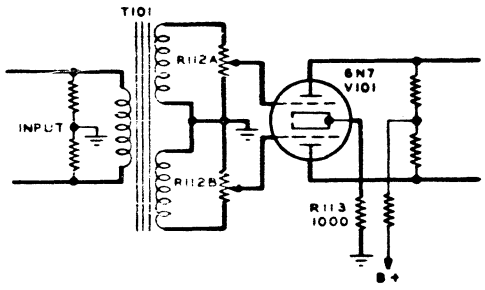


Figure 2-2. Input Amplifier Circuit

The time required for the gain to return to normal after the input signal level has been reduced is determined by the discharge time of C109 through resistors R142, and/or R143, R144, R145 and R146. The proper resistance value to give a release time delay of 0.1, 0.5, 1, 2.5 or 5 seconds may be selected by the operation of S102.

d. OUTPUT AMPLIFIER STAGES. - Refer to Figure 2-4. An interstage transformer, T102, couples the limiter to an interstage voltage amplifier using a 6N7 tube, V103. Bias for this stage is obtained by means of a voltage drop across resistor R125 in the cathode circuit.

The output amplifier stage uses two 1621 tubes, V104 and V105, connected as triodes in push-pull Class A operation. The input is resistance coupled through a transformer T103 to the output load terminals. Taps on the primary windings of T103 provide a source of voltage for the limiter control circuits.

e. METERING CIRCUITS. - The arrangement of the metering circuits provides a continuous visual indication of operating conditions. Refer to Figure 2-6. The meter, M101, may be connected to measure any one of the following by the operation of the metering selector switch S103, (A) amount of compression, (B) input amplifier cathode current, (C) interstage amplifier cathode current, (D) V104 cathode current, (E) V105 cathode current and (F) plate supply voltage. The resistors, R114, R122, R126, R134, R135, are used as meter shunts when measuring the cathode currents. A series multiplier resistor, R150, is used when measuring the plate supply voltage. A VU level indicator, M102, is connected across the output load terminals. A range multiplier, R137, is provided. The output level of the amplifier is obtained by adding the setting of the OUTPUT LEVEL attenuator algebraically to the reading of the scale of the VU level indicator M101. For example, if the OUTPUT LEVEL attenuator is set on 10 and the meter swings up to -3 on its scale, the output level is plus 7 VU.

f. POWER SUPPLY CIRCUITS. - The power supply is self contained. Refer to Figure 2-5. A 5V4G tube, V107, is employed as a full wave rectifier. The filter system consists of L101, L102, C110, C111, C112. A fixed bias voltage for the limiter circuit is obtained from the voltage drop across R149 and filtered by R151 and C113.

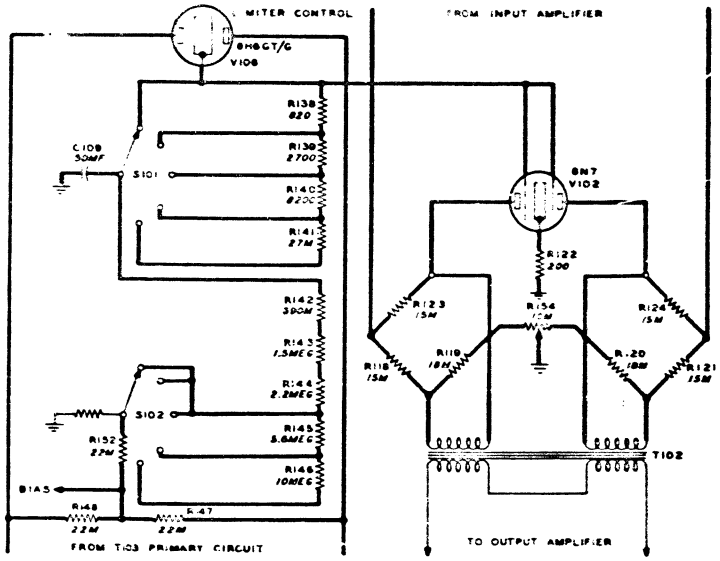


Figure 2-3.

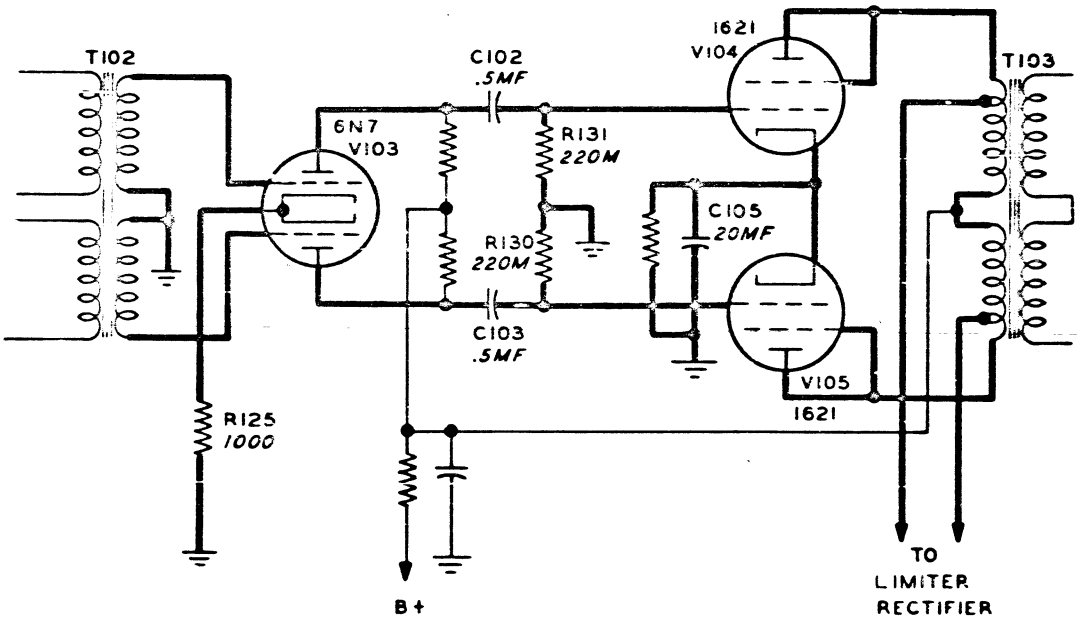


Figure 2-4. Output Amplifier Circuit

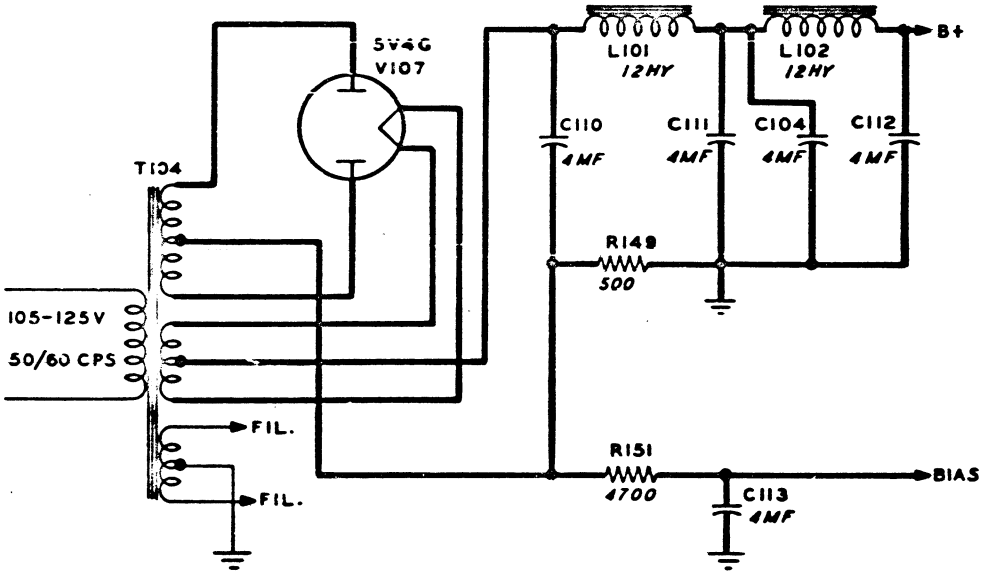


Figure 2-5. Power Supply Circuits

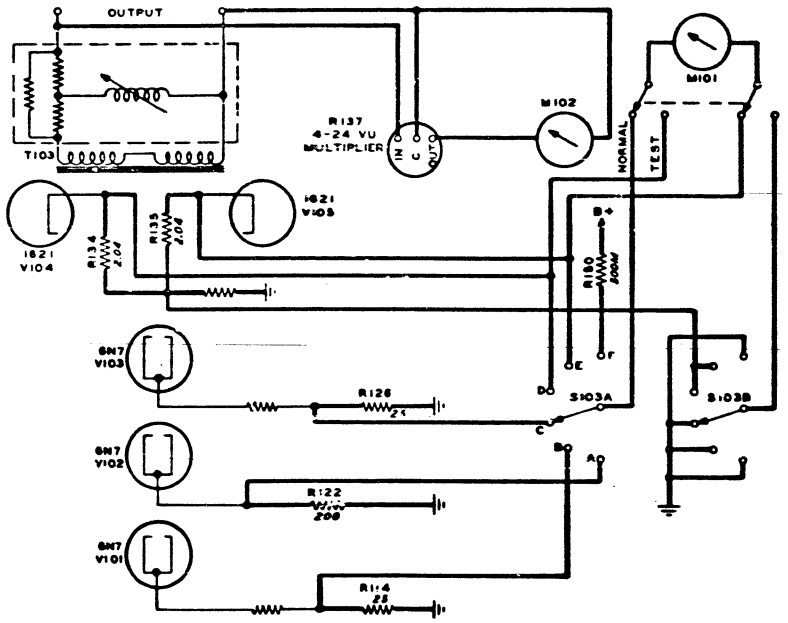


Figure 2-6. Metering Circuits

SECTION III

INSTALLATION AND INITIAL ADJUSTMENTS

1. INSTALLATION.

a. PRELIMINARY.

(1) UNPACKING. - All equipment supplied with the Type 26W unit is shipped in one crate. The crate is marked with arrows to indicate the upright position. Remove crate cover only. Use a nail puller to remove nails, a bar or hammer may damage the equipment within. Remove all packing material and lift unit out carefully. Inspect unit for loose screws or bolts. Be certain all controls, such as switches, dials, etc., work properly. All claims for damage should be filed promptly with the transportation company. If a claim for damage is to be filed, the original packing case and material must be preserved.

b. INSTALLATION PROCEDURE.

(1) MOUNTING. - Place the unit in position in a Collins Type 19G-3 cabinet or similar standard relay rack cabinet.

(a) Secure the unit with hexagon or round head screws and flat washers. The oval head screws and cupped washers often used, are not satisfactory.

(2) POWER AND AUDIO LINE CONNECTIONS. - The input, output and power source terminal strips are located at the rear lower edge of the chassis and are accessible upon removal of the dust cover.

(a) Remove rear dust cover. It is provided with snap fasteners and no tools are required.

(b) Connect the incoming line to the two terminals on the INPUT terminal strip. This line should be completely shielded to prevent hum pickup.

(c) Connect the outgoing line to the two terminals on the OUTPUT terminal strip.

(d) Connect the power leads to a 105 - 125 volt, 50/60 cycle, single phase power source. These leads should be at least equivalent to No. 16 B & S.

(e) An input attenuator strip located in the lower left-hand corner of the chassis provides three different input impedances. Refer to Figure 3-1. Interconnect the proper terminals to give the desired impedance.

(3) INSERTING TUBES. - Open the tube access door located in the front panel by turning the door button counterclockwise. Refer to the tube locating diagram Figure 5-1. Insert tubes in their proper sockets.

2. INITIAL ADJUSTMENTS.

a. GENERAL. - After power and audio line connections have been made, the equipment is ready for operational adjustments. The following paragraphs explain the functions of the controls and the adjustments necessary in placing the equipment in operating condition.

b. CONTROL FUNCTIONS. - The following operating controls are located on the front panel. Refer to Figure 4-1.

(1) INPUT LEVEL. - A step by step attenuator located in the grid circuit of V101. It is adjustable in 30 steps of 1 db each.

(2) METER SELECTOR. - Operation of the meter selector knob connects M101 in any one of the following circuits: (A) limiter cathode, (B) input amplifier cathode, (C) interstage amplifier cathode, (D) push-pull output amplifier cathode, (E) push-pull amplifier cathode, (F) plate voltage.

(3) VOLUME UNITS. - A 4-24 VU attenuator, R137, serves as a range multiplier for M102.

(4) OUTPUT LEVEL. - A step by step T network attenuator, R136, is located in the output circuit of the push-pull class A amplifier.

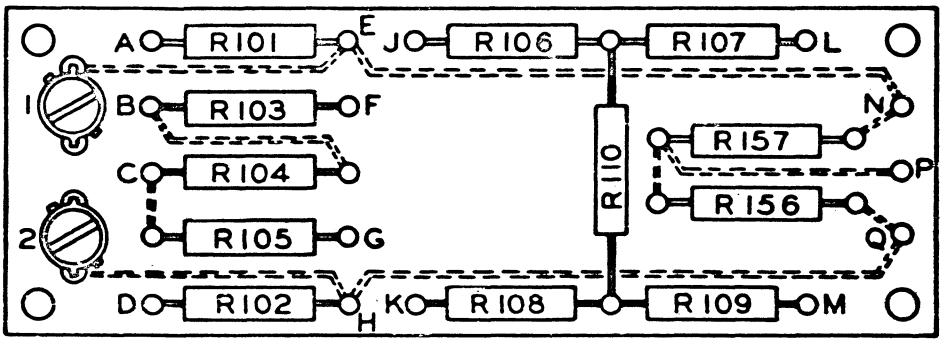
(5) The following adjustments are located at the rear of the chassis and are accessible upon removal of the dust cover. Refer to Figure 3-2 and Figure 3-3.

(a) LIMITER BALANCING. - This adjustment is a dual variable resistance located in the plate circuits of the limiter tube V102.

(b) OPERATE TIME. - The proper resistance - capacitance circuit is selected by S101. Operate time is adjustable in steps of 0.3, 1.0, 3.0, or 10.0 milliseconds.

(c) RELEASE TIME. - The limiter release time is adjustable in steps of 0.1, 0.5, 1.0, 2.5 or 5 seconds by operation of switch S102.

(d) NORMAL - TEST SWITCH. - Operation of switch, S104, produces a transient current for checking the limiter balance.



INPUT CONNECTIONS

A. FOR 200 OHM LINE
   (1) REMOVE STRAP FROM 1 TO E, 2 TO H.
   (2) CONNECT 1 TO B, 2 TO C, F TO E, G TO H.
   (3) CONNECT E TO F, G TO H.

B. FOR 600 OHM LINE – USE AS FURNISHED.

C. FOR 10,000 OHM BRIDGING.
   (1) REMOVE STRAP FROM 1 TO E, 2 TO H.
   (2) CONNECT 1 TO A, 2 TO D.

D. FOR LEVELS EXCEEDING OVU.
   (1) REMOVE STRAP FROM E TO N, H TO Q.
   (2) CONNECT N TO L, E TO J, H TO K, M TO Q.

Figure 3-1. Input Attenuator Connections

c. PRINCIPLE OF OPERATION. - The Type 26W equipment is a general purpose program amplifier incorporating a means of peak amplitude control. It is designed for use in any AM or FM speech input installation.

d. ENERGIZING THE EQUIPMENT. - The initial electrical adjustments are outlined in the following paragraphs.

(1) LIMITER BALANCE. - The limiter balance adjustment and NORMAL - TEST switch are located at the rear of the chassis. The rear dust cover should be removed.

(a) Apply power to the amplifier.

(b) Place the INPUT LEVEL control in the OFF position.

(c) Set OUTPUT LEVEL control to 30 (maximum clockwise position).

(d) Set VOLUME UNITS CONTROL to 4.

(e) Adjust OPERATE-TIME control to the 0.1 millisecond position.

(f) Adjust RELEASE TIME control to the 0.1 second position.

(g) Snap the NORMAL-TEST switch several times, while rotating the limiter balance control, a position should be found where the OUTPUT LEVEL meter needle will indicate a minimum deflection when the switch is operated.

NOTE

Some selection of tubes V101 and V102 may be necessary for best results in balancing.

(2) GAIN CONTROLS. - Because two gain controls are provided and since the input-output relation is not linear over part of the operating range, the method of adjusting the controls differs from that of the conventional amplifiers. The following is a convenient method which may be used if desired.

(a) Turn INPUT LEVEL to the OFF extreme, extreme counterclockwise position.

(b) Turn OUTPUT LEVEL to maximum, extreme clockwise position.

(c) Apply power to amplifier.

(d) Turn meter selector knob to position A, limiter cathode current.

(e) With the audio signal applied to input terminals of amplifier, advance input control until there is a slight indication on meter, M101. The amount of cathode current depends on the amount of gain reduction in effect. This can be controlled with the INPUT LEVEL control.

(f) Advance OUTPUT LEVEL until the desired output is obtained, as indicated by the volume indicator meter, modulator meter, etc.

3. AMOUNT OF CONTROL.

The maximum amount of automatic control which the Type 26W amplifier can provide is equivalent to about 20 db reduction in gain. This limit gives a wide margin of safety under practically any condition of operation.

In voice or communication service, it may be found desirable to use a high degree of control with a short release time. In high quality broadcast service, however, a slow release time is desirable. The recommended setting of the timing controls is 0.3 millisecond LIMITER OPERATE time and 2.5 seconds for the LIMITER RELEASE time. The compression should be held to 5 db or less under typical program conditions.

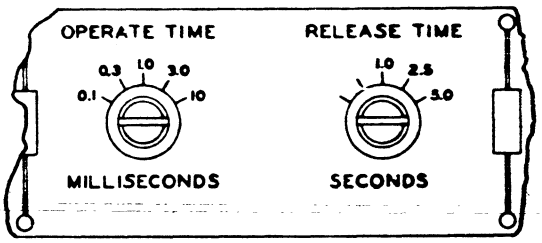


Figure 3-2. Operate and Release Time Controls

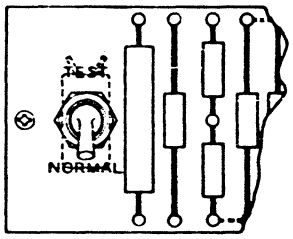


Figure 3-3. Normal Test Switch

It should be clearly understood that the Type 26W Limiting Amplifier cannot replace the control operator in broadcast service. The Type 26W does supplement his efforts, and makes for a better regulated program by reducing the bad effects of sudden high signal amplitudes which the operator cannot control. If the OPERATE TIME is set at the 0.1 millisecond position, the limiting action of the amplifier is fast enough so that outages caused by modulator overload should be almost completely eliminated.