

Western Electric

117A

AMPLIFIER

GRAYBAR ELECTRIC COMPANY, INC.

NEWARK, N. J.

B. P. VAN INWEGEN



Instruction Bulletin No. 926P

117A AMPLIFIER

INSTRUCTIONS FOR USE

General

The 117A Amplifier is a multi-purpose line or voltage amplifier especially suited for use in public address installations. It is capable of amplifying the signals from low level sources such as microphones or phonographs to levels suitable for transmission over wire lines or for driving power amplifiers. It includes one mixer stage amplifier known as the 116B and has sufficient space for accommodating three additional 116B Amplifiers to provide a total of four electronic mixing channels. The 117A Amplifier incorporates such features as volume limiting to prevent overloading of the associated power amplifiers, volume expansion to obtain a more brilliant reproduction of recordings, adjustable "speech" or "scratch" equalization for modifying the frequency characteristic of a sound system to meet a wide range of sound reproduction conditions, provision for connecting adjacent or remote mixing and volume controls, complete magnetic shielding of all voice transformers to minimize magnetic pickup into the voice circuits, and a standard 600-ohm output circuit across which a volume indicator meter may be connected. It may be used to feed a power amplifier directly or a program "bus" across which a number of power amplifiers are bridged. One 117A Amplifier is capable of driving as many as 75 power amplifiers of the Western Electric 94, 118, or 124 type.

Power Requirements

The amplifier operates from a 105-125 volt, 50-60 cycle power source, with a consumption of approximately 50 watts. A fuse is provided on the amplifier chassis.

Typical Electrical Characteristics

Gain	82 db for 30-ohm source and 600-ohm load; 85 db for 250-ohm source and 600-ohm load.
Source impedance	Nominally 30 or 250 ohms; will operate satisfactorily from any impedance between 15 and 250 ohms.
Internal input impedance	High compared to nominal source impedances.

Load impedance	Nominally 600 ohms; will operate satisfactorily into any impedance between 300 and 1200 ohms.
Internal output impedance	Approximately 170 ohms.
Max. single freq. power output*	+ 20 db with volume limiting. + 25 db without volume limiting with 5% total harmonic distortion.
Output noise* (at max. gain)	- 32 db unweighted; - 42 db with program noise weighting.
Useful frequency range	35 to 15,000 cycles.
Output limiter characteristic*	Single frequency output limited at + 20 db for inputs as high as - 22 db.
Expander characteristics	Average expansion ratio 1½ to 1.

* All levels referred to .001 watt.

Mechanical Characteristics

Chassis length—18½ inches

Chassis height—6¼ inches

Chassis depth—10⅞ inches—over switch levers 11¼ inches

Approximate weight—20 lbs.

INSTALLATION

The mixer stage and blank mixer stage plates are furnished with the amplifier; volume controls, control panel, and bottom cover plate are not furnished. These parts are required for assembly when installing the amplifier.

Assembly of Mixer Stage

Assemble the mixer stage (116B Amplifier) on the chassis of the 117A Amplifier in the manner shown in the cross-sectional view, Fig. 1. Plates and screws are provided for closing up the unused mixer spaces on the 117A Amplifier. The connections between the mixer stage (outlined in solid lines) and the 117A Amplifier are shown in Fig. 3. The connection between the terminals designated with a green colored stripe should be as short as possible in order to minimize the pickup into this wire. As other mixer stages are added, they should be installed in a similar manner and connected as indicated by the 116B Amplifiers shown in dashed outline on Fig. 3.

Volume Controls

A potentiometer with switch which has a 10,000-ohm resistor connected across the switch terminals, is employed for volume control purposes. Volume controls may be mounted on a suitable panel such as that outlined in Fig. 2, which shows the volume controls and connections required for operation with one mixer stage in solid lines, and controls and connections for added mixer stages in dashed lines.

Mounting

The amplifier is designed for either horizontal mounting in a cabinet or vertical mounting on a standard 19-inch relay rack. In either case the safety precautions described below should be adhered to. When the amplifier is not mounted in a metal cabinet or when it is mounted on a relay rack adjacent to other equipment a metal bottom plate should be used to provide adequate electrical shielding. The mounting holes are spaced for standard 19-inch vertical relay rack mounting and when it is so mounted, a standard 12-inch bottom cover plate should be used.

Safety Precautions

The local inspection authority should be consulted regarding requirements for installation and use. In general, in order to meet these requirements no terminals or wiring involving the a-c supply or the secondary power should be exposed to accidental contact. This may be accomplished as follows:

- (1) When the amplifier is mounted in a cabinet with front or rear doors, switches operated by these doors should be provided to cut off the a-c voltage supply when the cabinet is open for service.
- (2) When the amplifier is mounted on a relay rack or in an open type cabinet or on a shelf, the terminal strip with the a-c terminals should be covered with an insulating plate and the wiring side of the amplifier should be covered with a metal bottom plate at least $\frac{1}{8}$ inch thick attached to the chassis flanges. With this form of mounting, power and output connections should be made to the rear of the covered terminal strip through the $\frac{3}{4}$ -inch pipe knockout hole provided in the nearest end wall of the chassis. A similar knockout hole is provided at the other end of the chassis for connections to the input terminal strip.

CONNECTIONS

Input Terminals

The input source to the first mixer stage amplifier should be connected to either terminals 1 and 2 or 1 and 3 of the 117A Amplifier. 15-60 ohm sources should be connected to the nominal 30-ohm source terminals, 1 and 2, and 60-250

ohm sources to the nominal 250-ohm source terminals, 1 and 3. When additional mixer amplifiers are installed, 15-60 ohm sources should be connected to the terminals to which the red and red-white wires of the input transformer on the mixer amplifier have been connected. 60-250 ohm sources should be connected to the terminals to which the red and blue-white wires of the input transformer on the mixer amplifier have been connected. The external input circuits should be connected to the input terminals by means of shielded and twisted paired wires in order to obtain the lowest noise level, and the shield should be connected to an amplifier ground terminal (8, 18, or 20). Wherever possible, one side of each input circuit should be grounded individually at the amplifier by connecting to an amplifier ground terminal (8, 18, or 20) the input terminal to which the red wire from the input transformer is connected.

Output Terminals

The amplifier should be operated into a 300 to 1200 ohm load. The terminals to which this load should be connected are 26 and 32. When the load to which the amplifier is to be connected is greater than 1200 ohms, a proper termination may be obtained for the amplifier by strapping terminals 24 and 25. This connects a 600-ohm resistor directly across the output terminals 26 and 32. In general, it is advisable to operate the output circuit unbalanced and grounded. This may be accomplished by strapping output terminal 32 to ground terminal 31.

Ground

Connect a good building ground to terminal 31.

Power Supply

The power should be connected to the terminals marked "AC." The amplifier supply is fused on the chassis with an 0.6-ampere Buss Fustat. Maximum protection is provided by a thermal cut-out type of fuse, such as the Fustat provides, and it is inadvisable to employ any other type of fuse with this amplifier. Refer to the distributor or dealer from whom the apparatus was purchased for sources of supply of Buss Fustats.

Vacuum Tubes

2—1612 Type Amplifier Tubes (see note F on page 10)

1—6J7 Type Amplifier Tube

1—6H6 Type Audio Rectifier Tube

1—6F8G Amplifier Tube (see note F on page 10)

1—6X5 Type Rectifier Tube

One additional 1612 type amplifier tube is required for each additional mixer stage (116B Amplifier).

Either metal or glass tubes may be used. When glass tubes are employed, tube shields should be used at the positions provided with the shield bases. Shield

grid caps should be used on the metal tubes having the grid connection on the top. Vacuum tubes, vacuum tube shields, and grid cap shields are not furnished with this amplifier.

ACCESSORIES

The following accessories, not furnished with the amplifier, are required:

1—Master Gain Control. A suitable control is a 1700-ohm International Resistance Company Type CS Potentiometer Curve A with switch.

1—Mixer Gain Control for each mixer stage amplifier. A suitable control is a 2600-ohm International Resistance Company Type CS Potentiometer Curve A with switch.

1—10,000-ohm $\frac{1}{2}$ -watt Resistor for use on master gain control.

1—10,000-ohm $\frac{1}{2}$ -watt Resistor for each mixer gain control. International Resistance Company BT $\frac{1}{2}$ Type Resistors are suitable for use on the mixer and master gain controls.

1—Control panel for mounting gain controls adapted to the particular installation.

Tube shields, as required, if glass tubes are used, diameter, $1\frac{3}{8}$ inch.

Grid caps, as required, if metal tubes are used.

When the amplifier is mounted on a shelf or a relay rack, the following additional items are required:

1—Bottom Cover Plate $18\frac{1}{8}$ x $10\frac{7}{8}$ x $\frac{1}{8}$ inch.

1—Insulated Cover for the exposed a-c terminals.

OPERATION

The best results will be obtained from this amplifier when it is operated as outlined below. In normal operation (with volume expansion switched out) the gain should be so adjusted that on speech or music the amplifier will deliver a level of +13 vu to a 600-ohm load. To assure proper relation of power outputs from the 117A Amplifier and its associated power amplifiers, the gain of the associated power amplifiers should be adjusted in the following manner: With a steady noise input source, such as a buzzer placed before a microphone or needle scratch from the unrecorded part of a phonograph record, adjust the 117A Amplifier gain to provide an output level of +13 db with reference to .001 watt (+5 db with reference to .006 watt or 3.3 volts across the 600-ohm load). This measurement may be made with a power-level indicator or an a-c test set voltmeter. Then, adjust the power amplifier gain to obtain an output power from it 12 db below its maximum single frequency power output level rating or $\frac{1}{8}$ of its maximum single frequency power rating in watts. The power amplifier gain adjustment should remain in this position, and any further gain adjustments should be made with the 117A Amplifier mixer and-master gain controls. For

minimum harmonic generation and optimum signal-to-noise ratio; the mixer and master volume controls should be set at about the same point.

Volume Expansion

A more brilliant reproduction of recorded music may, at times, be obtained by the use of "volume expansion." This feature is provided on the 117A Amplifier and is controlled by the switch marked "EXP." To use volume expansion, set the mixer volume control for maximum gain and the master volume control for nearly minimum gain. Set the "EXP" switch to "ON" and increase the sound level by means of the master volume control. For the most effective use of the volume expansion circuit, increase the gain of the master volume control only the amount necessary to achieve the desired sound level.

Volume limiting remains in operation when the volume expansion is switched on. It acts to prevent the 117A Amplifier or its associated power amplifiers from becoming overloaded by high input levels.

Equalization

An equalizer, controlled by the switch marked "EQUAL", is incorporated in this amplifier so that the frequency characteristic of a sound system may be easily modified to obtain a more pleasing effect under a wide variety of field conditions. Through the use of different terminal strappings either an attenuation of the low frequencies, designated "speech" equalization, or an attenuation of the high frequencies, designated "scratch" equalization, may be obtained. The amount of attenuation is controlled by the setting of the potentiometer located between the 6H6 and the 6X5 vacuum tube sockets.

As delivered, the amplifier is strapped to provide "speech" equalization beginning at a "low" frequency. The equalizer is in the circuit when the "EQUAL" switch is in the "B" position. "Speech" equalization is employed in indoor public address systems on speech reproduction in cases where the room acoustics have a tendency to make the reproduction sound "boomy." Rotating the shaft of the potentiometer located between the 6H6 and 6X5 vacuum tube sockets clockwise increases the attenuation at low frequencies. Through a proper strapping of the terminals, four different ranges of low frequency attenuation may be obtained. These various terminal strappings are tabulated below:

<i>Attenuation Begins at Frequency That Is</i>	<i>Terminals 23 and 28 Strapped to</i>	<i>Terminals 24 and 29 Strapped to</i>
very low	21 and 27	22
low	21	22
intermediate	27	22
high	21	27

Through a change in the strapping connections on the terminal strip of the amplifier, the equalizer controlled by the "EQUAL" switch may be used as a tone control or as a high frequency "scratch" reducing equalizer when reproducing records. To utilize this feature remove the interconnecting straps, on the external side of the terminal strip, from terminals 21, 22, 23, 24, 27, 28, and 29. Strap terminal 23 to 24. In addition use the strapping tabulated below to obtain the desired degree of control:

<i>Degree of High Frequency Control</i>	<i>Terminal 28 Strapped to</i>	<i>Terminal 30 Strapped to</i>
minimum	21	27
intermediate	21	22
high	27	22
maximum	21 and 27	22

With a particular strapping arrangement, the amount of high frequency attenuation may be controlled by the potentiometer between the 6H6 and the 6X5 vacuum tube sockets. Rotating the shaft of this potentiometer counter-clockwise increases the attenuation of the high frequencies. When connected for this purpose the "scratch" equalizer is placed in operation by switching the "Equal" switch to the "A" position, and is turned off in the "B" position.

MAINTENANCE

No routine maintenance is required other than the occasional replacement of vacuum tubes.

If the amplifier fails to operate properly, all connections should be checked in detail with the aid of the schematic and wiring diagram. If it is impossible to locate the cause of the trouble the matter should be taken up with the nearest distributor or dealer.

For additional information refer to the distributor or dealer from whom the apparatus was purchased.

This equipment designed and developed for

Western Electric Company

by

BELL TELEPHONE LABORATORIES, INC.

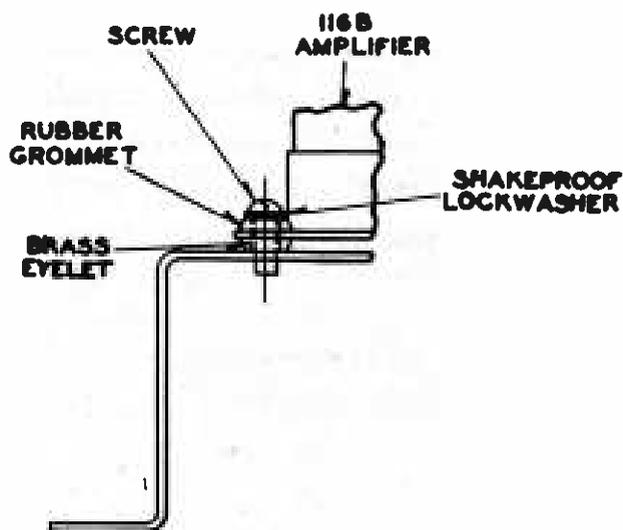


FIGURE 1—Screws, nuts and washers which are furnished with each 116B Amplifier shall be used as shown in this illustration in assembling the amplifier on the top of the chassis of the 117A Amplifier.

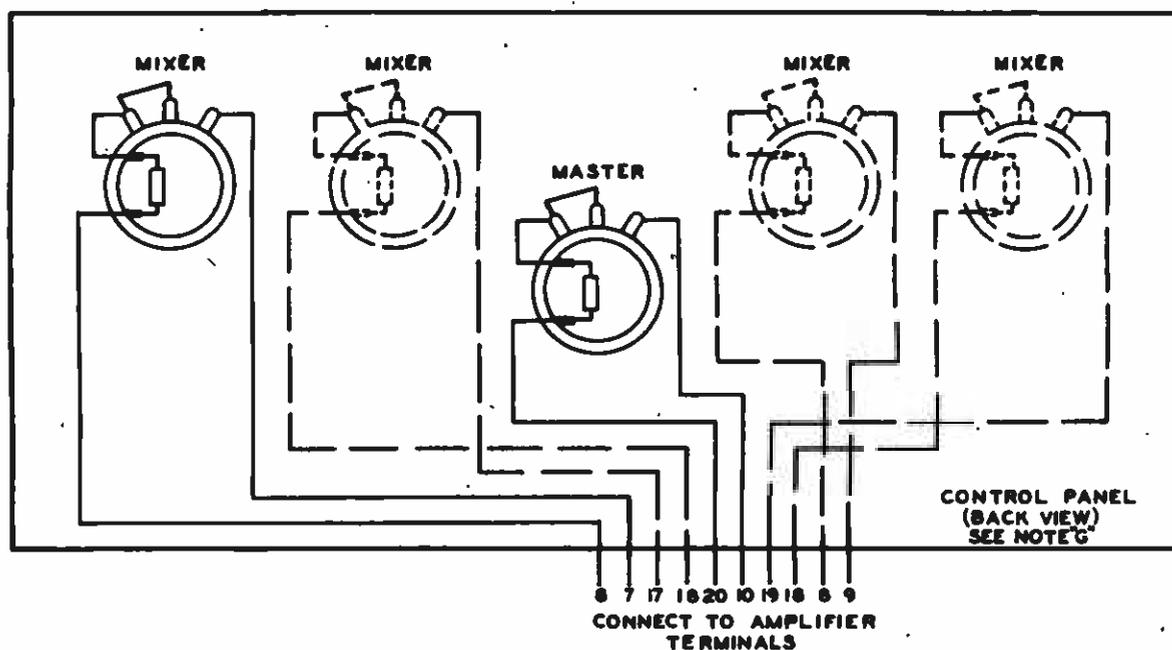


FIGURE 2—Method of assembling volume controls on a panel. Volume controls and connections required for operation with one mixer stage are shown in solid lines, and controls and connections for added mixer stages are shown in dashed lines.

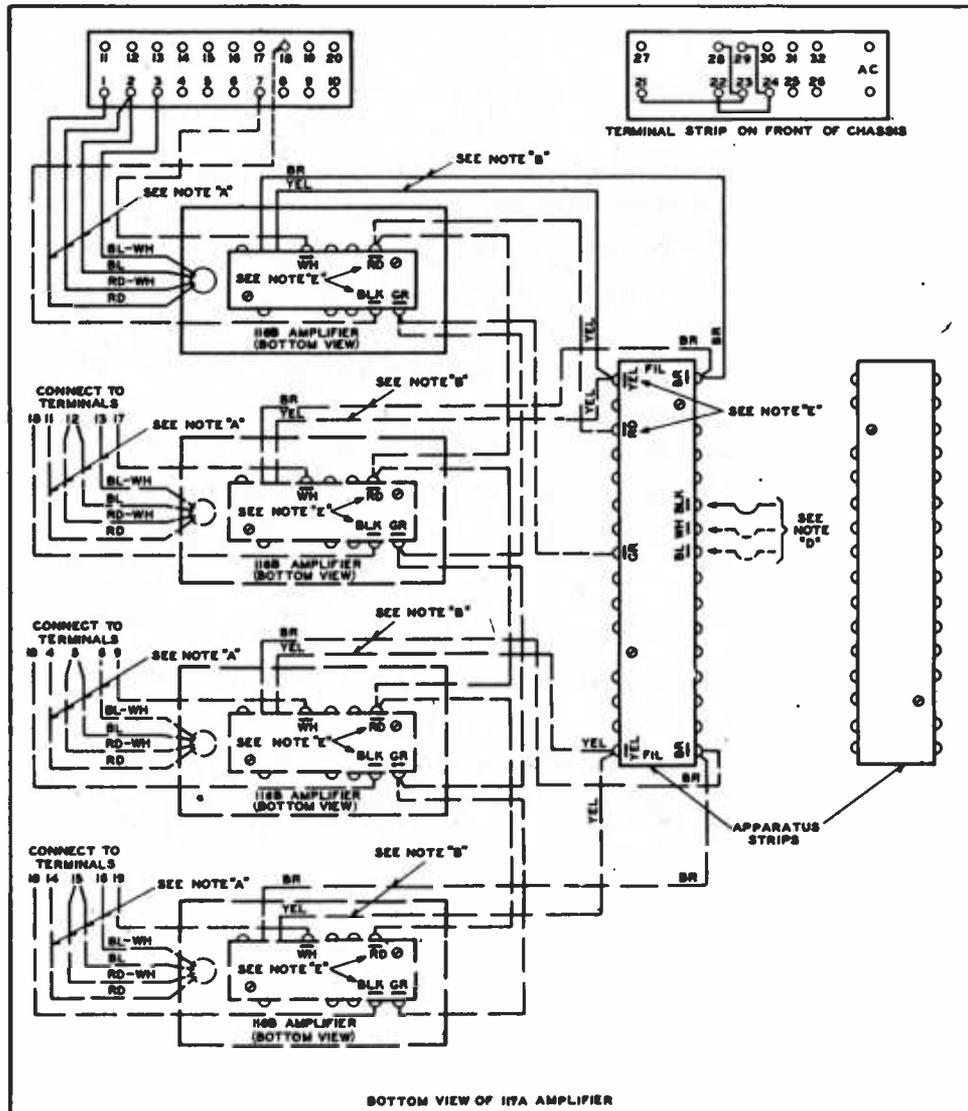


FIGURE 3—Connections for additional 116B Amplifiers are shown in dashed lines.

NOTES

- A. These wires are a part of the mixer stage (116B Amplifier). They should be twisted before being connected to the terminals on the terminal strip of the 117A Amplifier.
- B. This pair of wires should be twisted before being connected to the 117A Amplifier.
- C. Wires designated (— —) are not furnished. These connections should be made with No. 20 gauge fixture wire.
- D. Gain may be increased by moving grid lead of master control tube from terminal with black stripe to terminals with either white or blue stripe. Changing from black to white stripe terminal increases gain approximately 8 db. Changing from black to blue stripe terminal increases gain approximately 1.2 db. This increase in gain causes a corresponding increase in the output noise level.
- E. Colors on apparatus are for use as a guide in connecting mixer stage amplifiers to the 117A Amplifier and in making gain adjustments of the 117A Amplifier. These designations are in the form of a stripe of the color indicated. Abbreviations of colors do not appear on the strip.

- F. If the 1612 Type Tubes are not available, the 6L7 Type Tubes may be substituted without wiring changes.

If the 6F8G Tube is not available, the 6SN7GT Tube may be substituted by making the following wiring changes on socket VS3:

- Remove the two black leads from prong No. 1, splice together and tape.
- Transfer grid cap connection to prong No. 1.
- Transfer prong No. 3 connection (RD) to prong No. 2.
- Transfer prong No. 4 connection (BL) to prong No. 3.
- Transfer prong No. 5 connection (WH) to prong No. 4.
- Transfer prong No. 6 connection (GR-WH-YEL-RD) to prong No. 5.
- Transfer prong No. 8 connection (two GR) to prong No. 6.
- Transfer prong No. 2 connection (two YEL) to prong No. 8.

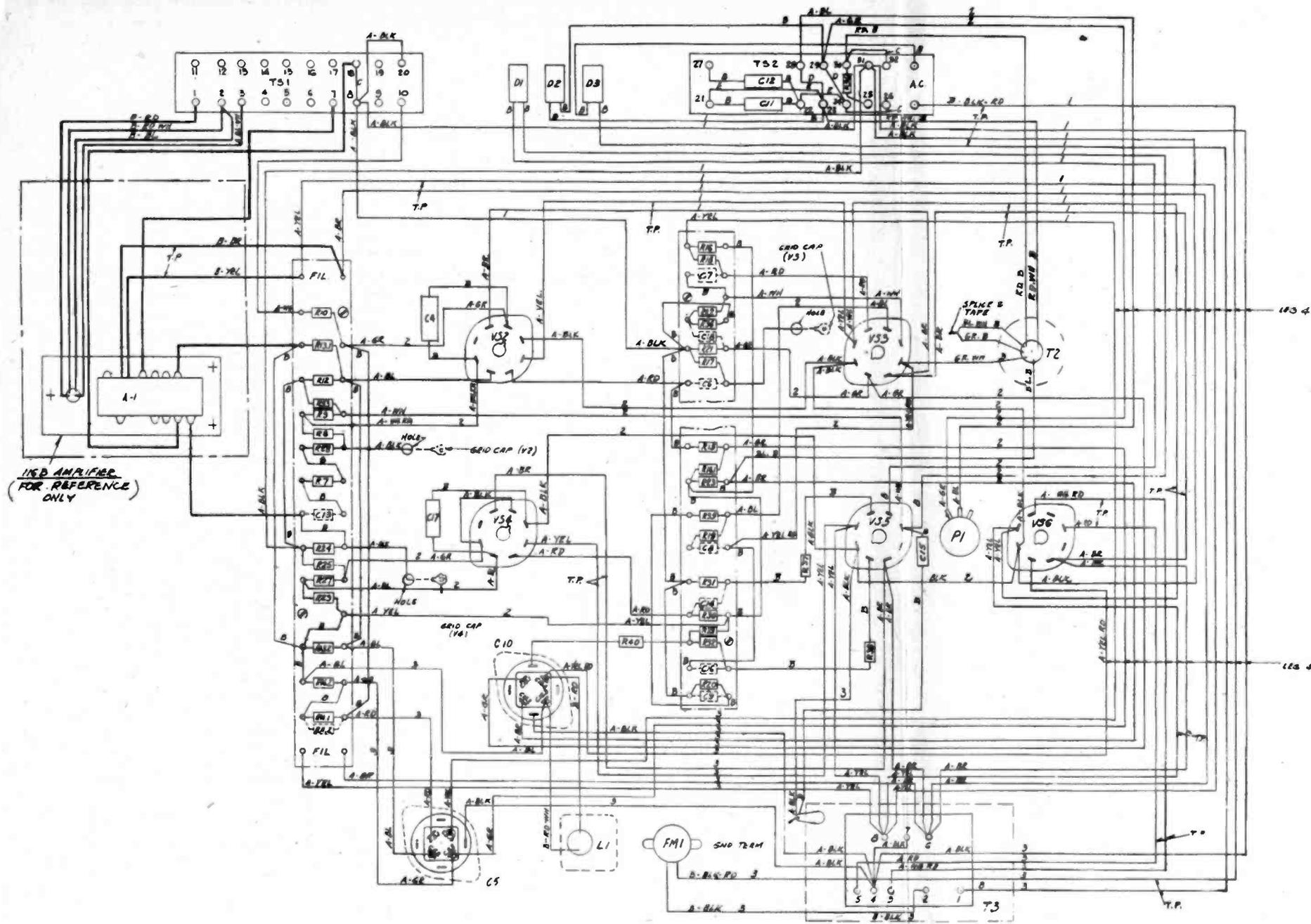
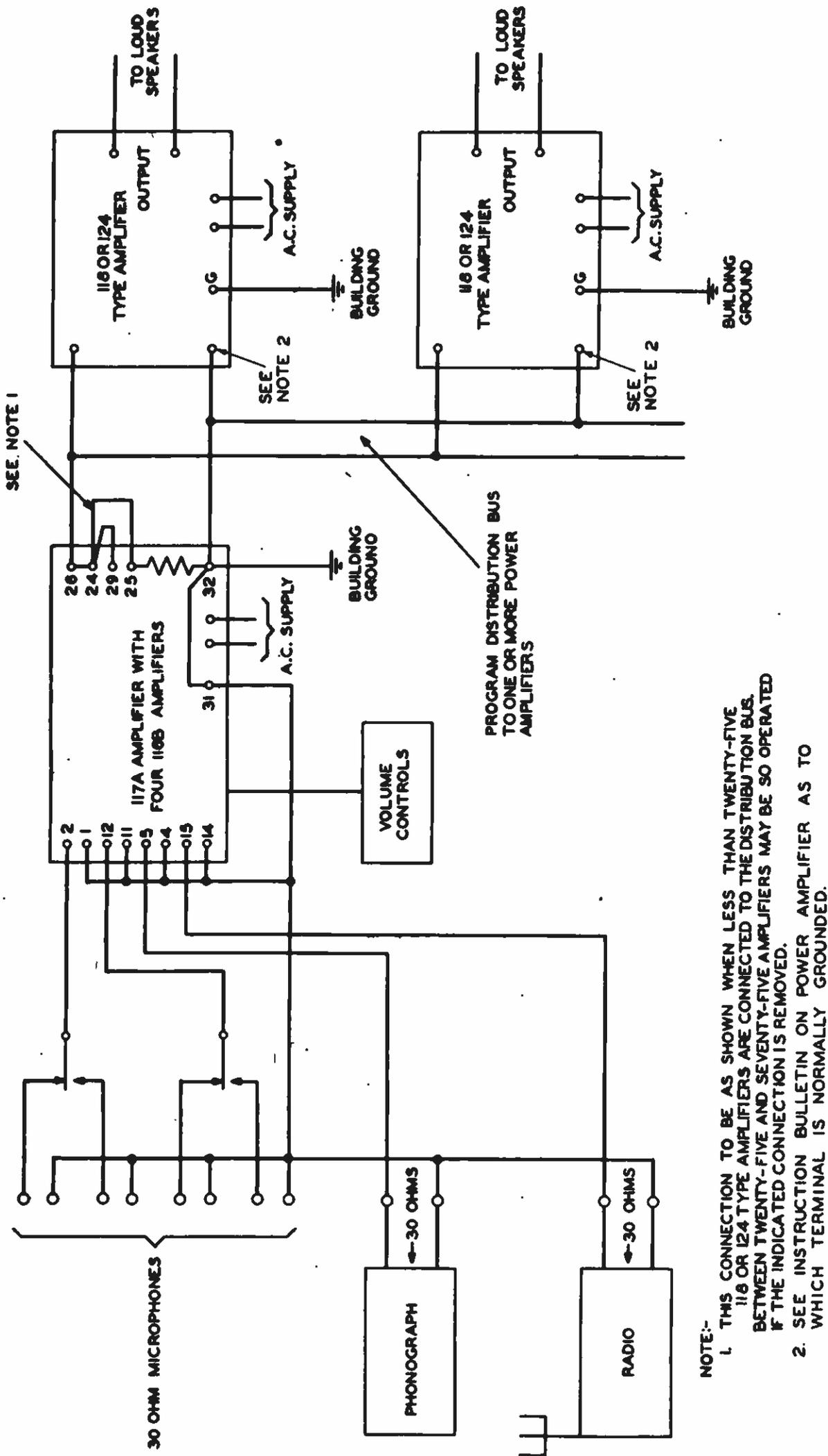


FIGURE 5-117A Amplifier Wiring Diagram.



NOTE:-

1. THIS CONNECTION TO BE AS SHOWN WHEN LESS THAN TWENTY-FIVE 118 OR 124 TYPE AMPLIFIERS ARE CONNECTED TO THE DISTRIBUTION BUS. BETWEEN TWENTY-FIVE AND SEVENTY-FIVE AMPLIFIERS MAY BE SO OPERATED IF THE INDICATED CONNECTION IS REMOVED.
2. SEE INSTRUCTION BULLETIN ON POWER AMPLIFIER AS TO WHICH TERMINAL IS NORMALLY GROUNDED.

FIGURE 6—Connections for typical system employing bus program distribution to one or more 94, 118 or 124 type amplifiers.

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