UHF MILITARY EQUIPMENT
CHAPTER SIX
ASSOCIATED EQUIPMENT

1.0 ANTENNAS

All antenna systems of the resonant type capable of operating over a wide frequency range have a diameter or other cross-section that is relatively large. The use of a large diameter does not affect radiation resistance appreciably, but it reduces the inductance and increases the capacity of the antenna elements (smaller L/C ratio), thereby lowering the "Q" of the antenna and permitting it to resonate over a broader frequency range. Antennas used with the military UHF equipment have these characteristics.

The discone antenna is composed of a metallic cone mounted so that the apex of the cone is uppermost and a metallic disc mounted with the flat sides in the horizontal plane directly above, but insulated from, the apex of the cone. Usually the lengths of the antenna elements for half wave resonance are considerably less for the discone than those for a dipole, and at each side of resonance the reactive component of the antenna impedance is less. The discone antenna will retain the low reactance characteristic over a wide range of frequencies and can be fed directly with a 52 ohm transmission line; it is therefore broadband and has the gain of a half wave dipole over a considerable range of frequencies. Also,the high angle radiation is much greater than that from a vertical dipole.

1.1 AT-197/GR Antenna

Referring to Figure 6-1, the AT-197/GR antenna is a discone type antenna consisting of 12 rods forming a simulated disc and 12 rods forming a simulated cone. The disc and cone are separated by a glass insulator. Radiation from the AT-197 is vertically polarized and is non-directional in the horizontal plane, with the signal strength

not varying more than 1/2 db about the azimuth. The vertical angle of maximum signal strength is at the horizon for lower frequencies and increases considerably above the horizon as the frequencies are increased from 225 to 400 megacycles. This antenna is the one primarily used for CAA installations. The radiation pattern of the AT-197/GR antenna at 300 mc is shown in Figure 6-3.

1.2 AS-505/GR Antenna

The AS-505/GR antenna is not used in CAA installations. However, since it was designed for use with UHF Military Equipment it will be described.

Referring to Figure 6-2, the AS-505/GR antenna is a stacked 4 bay antenna, the bays being mounted upon a vertical mast by metallic supports. These supports also serve as insulators due to the configuration of the antennas and the electrical lengths of the elements. Each bay is in effect a vertically polarized wide-band dipole, folded and fed so as to obtain non-directional radiation in the horizontal plane. The physical spacing between the bays of the antenna and the electrical lengths of their connecting cables are such that the vertical angle of the main lobe is 5 degrees. Smaller low power lobes are present in the pattern at higher vertical angles but these are of very low power when compared to the lower angle intensity. The gain of the antenna at the main lobe is 4 to 5.5 db over the range of 225 to 400 megacycles.

The design of the AS-505 is such then, that it is very efficient for broadband use where maximum distance coverage is desired and the sacrifice of good reliable overhead communications is not detrimental. The radiation pattern of the AS-505/GR antenna at 285 mc is shown in Figure 6-4.

2.0 REMOTE CONTROL UNIT, C-806/GR

Referring to Figures 6-5 and 6-6, the C-806/GR control unit is used in conjunction with the T-217 and R-278 equipment to provide a means of

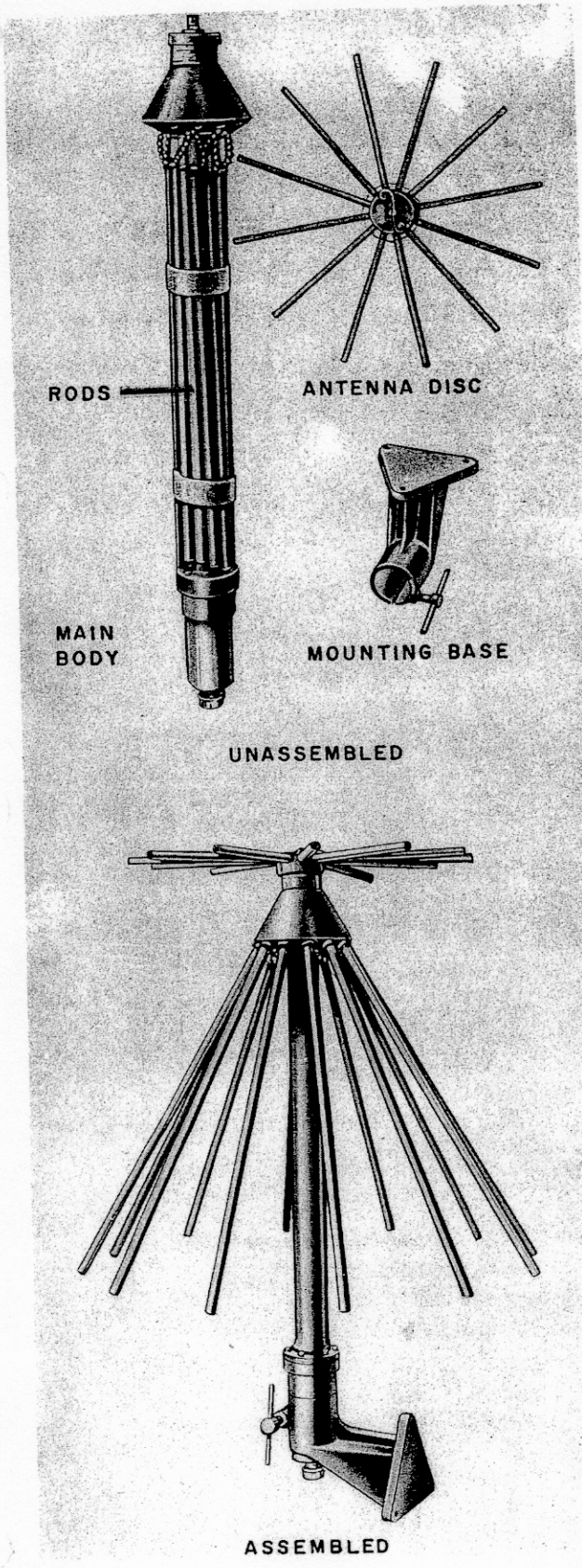


Figure 6-1. Antenna AT-197/GR

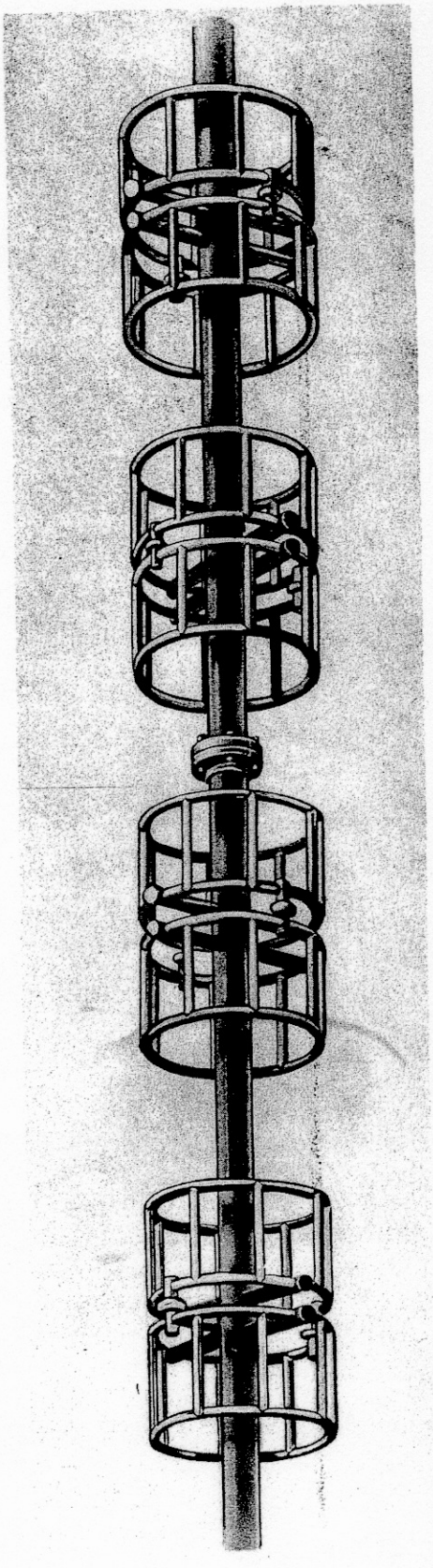


Figure 6-2. Antenna AS-505/GR

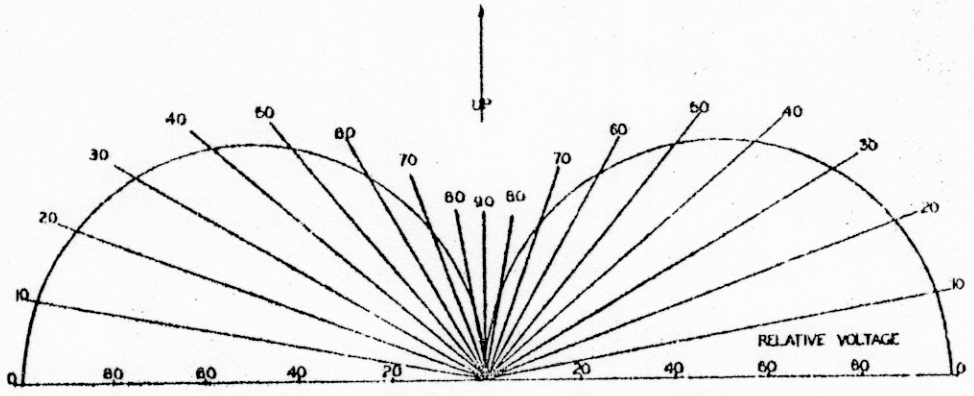


Figure 6-3.

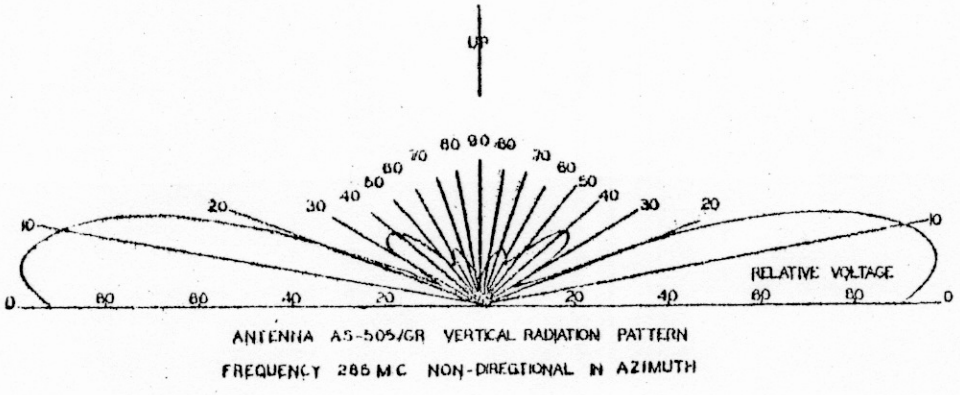


Figure 6-4.

selecting the desired pre-set channels on the transmitter and receiver. The control indicator, which uses a type 991 neon lamp, is used as a visual monitor for the transmitter. The headset jack is used for monitoring the receiver output and the monitor jack is used for aural monitoring of the transmitter.

The control unit is mounted in the air-ground console at the communications stations and at the operating positions in towers. The C-806 control unit has a self contained power supply using a 6X4 type tube and RC filtering for its B+ supply. The control indicator, the microphone jack and the headphone jacks are in the center of the front panel with the receiver channel selection switch to the left of these and the transmitter channel selection switch to the right.

Figure 6-5. Control-Indicator C-806/GR Panel Controls

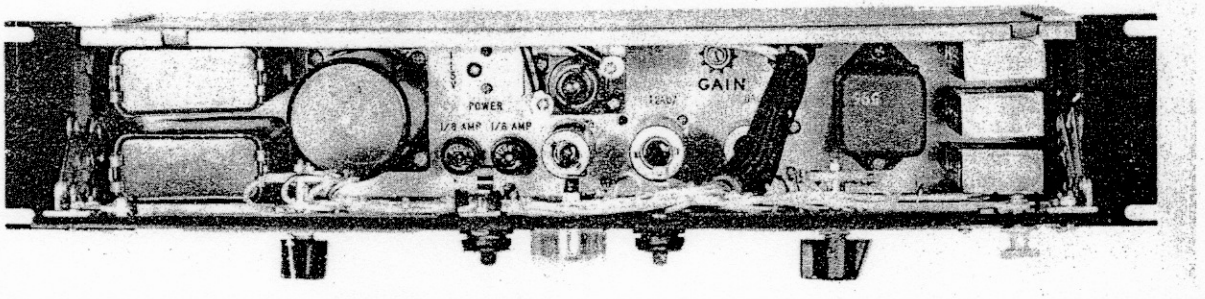


Figure 6-6. Control-Indicator C-806/GR Front Panel Open

Remote channel selection has been covered thoroughly in section 3.8 of Chapter 4, (R-278 Receiver), and will not be repeated here. The microphone and headset connections are brought out to the terminal strip, thence to the equipment and needs no further discussion. The monitoring circuits however, contain some unusual applications of some basic circuits.

Referring to Figure 6-7, the transmitter monitoring and control indicating circuitry consists of 2 tubes, a 12AU7 and a 6AL5. The "A" section of the 12AU7 acts either as an amplifier supplying output at the plate, or as an amplifier with output taken from both the plate and the cathode. This may be verified by obsering that when headphones are not plugged into the monitoring jack the closed-circuit type jack connects the lower end of capacitor C-503 to ground, causing it to serve as a bypass for R-502 in the cathode circuit. With these connections, the output will be developed across the plate load resistor and fed to the 6AL5 for rectification. When headphones are plugged into the monitor jack the lower end of the capacitor is removed from ground and the capacitor is then used to couple the audio developed across R-502 to the headphones for aural monitoring of the transmitter output.

The operation of the visual indicating circuitry can best be analyzed by first considering no signal across the primary of T-501. With this condition no signal is present at the grid of the DC amplifier V-501B. With the grid of V-501B at groung potential the current through the tube will be relatively high causing a substantial voltage drop across R-508 and R-509 in parallel. The neon lamp, V-504, is connected in series with a current limiting resistor between the plate of the tube and ground. The plate voltage, under these conditions, is too low to cause ionization of the gas in the lamp and it will not light.

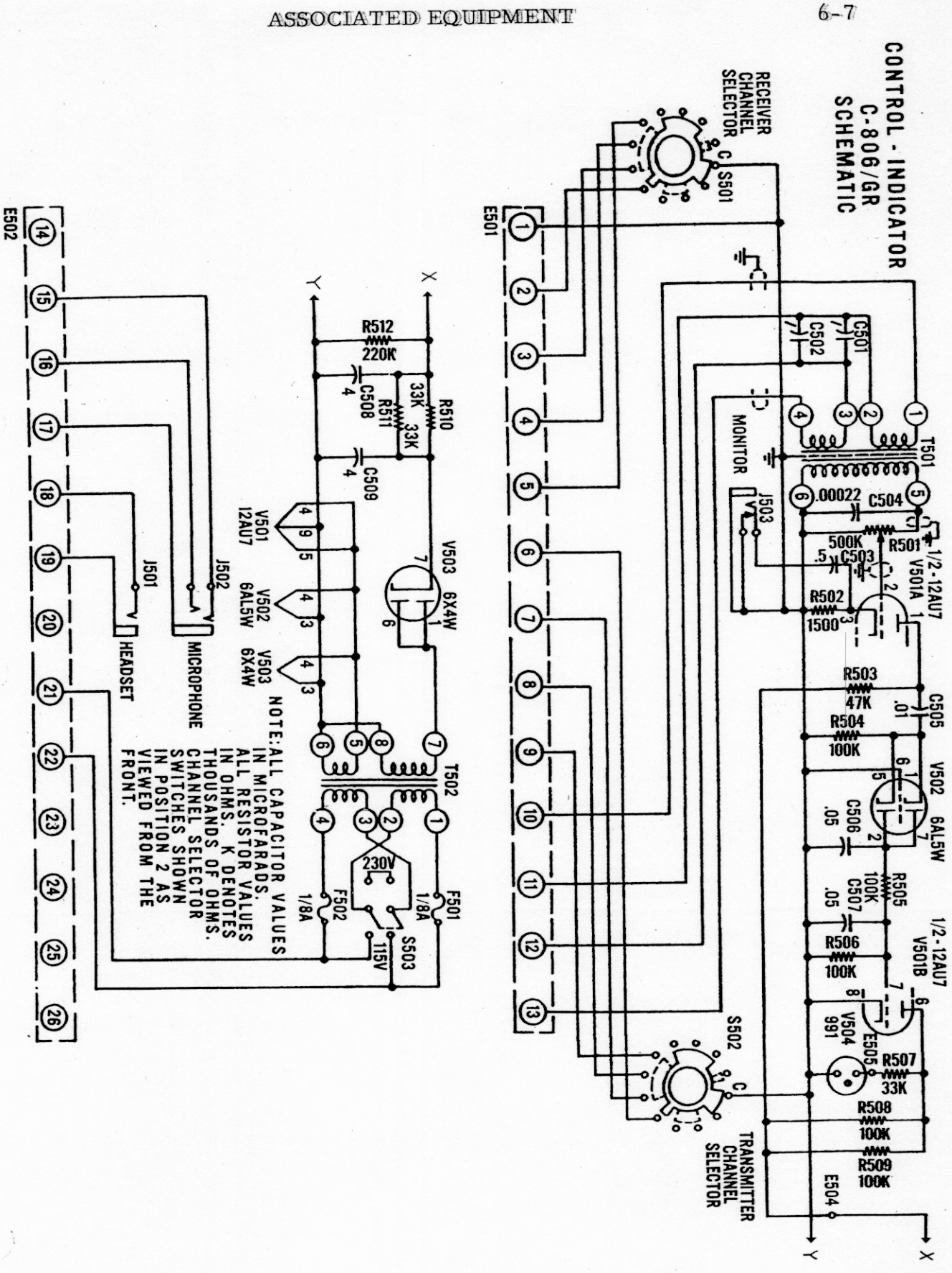


Figure 6-7. Control-Indicator C-806/GR

When the transmitter is modulated an audio signal is supplied from a winding on the modulation transformer to the primary of T-501. The secondary winding of T-501 is terminated into a variable resistor with the variable contact supplying input to the grid of V-501A, which amplifies the signal and feeds it to the rectifier circuit of V-502. The negative output from the rectifier, applied to the grid of V-501B, will cause a decrease in the plate current of this tube and the plate voltage will rise. The increase in plate voltage is sufficient to cause ionization in V-504, therefore a visual indication is obtained as the transmitter is modulated. The variable resistor, R-501, is adjusted so the audio level applied to the rectifier circuit is high enough to cause proper operation of the lamp. With correct adjustment of resistor R-501 the addition of the headphones for aural monitoring should not affect the visual functions of the unit.

3.0 DISTRIBUTION PANEL, J-390/GR

A distribution panel, J-390/GR, is mounted in each rack used for UHF military equipment. The purpose of the panel is to furnish a junction from which primary power can be distributed and from which audio and control connections between the rack equipment and external units can be made. Referring to Figure 6-8, three horizontal metallic bars are mounted in the left end of the distribution panel and are used for primary power and distribution. The center and bottom bars are used for 115 volt operation; the top and bottom bars for 230 volt operation, with the center bar used as neutral. The center bar may be grounded by a slotted link provided for this purpose when using 230 volt primary power. Two 115 volt convenience outlets are mounted on the back of the unit. Forty terminals occupy the remainder of the space in the distribution panel and are used for control and audio connections to the rack equipment. An external earth ground should be connected to the stud located between the convenience outlets on the rear of the unit.

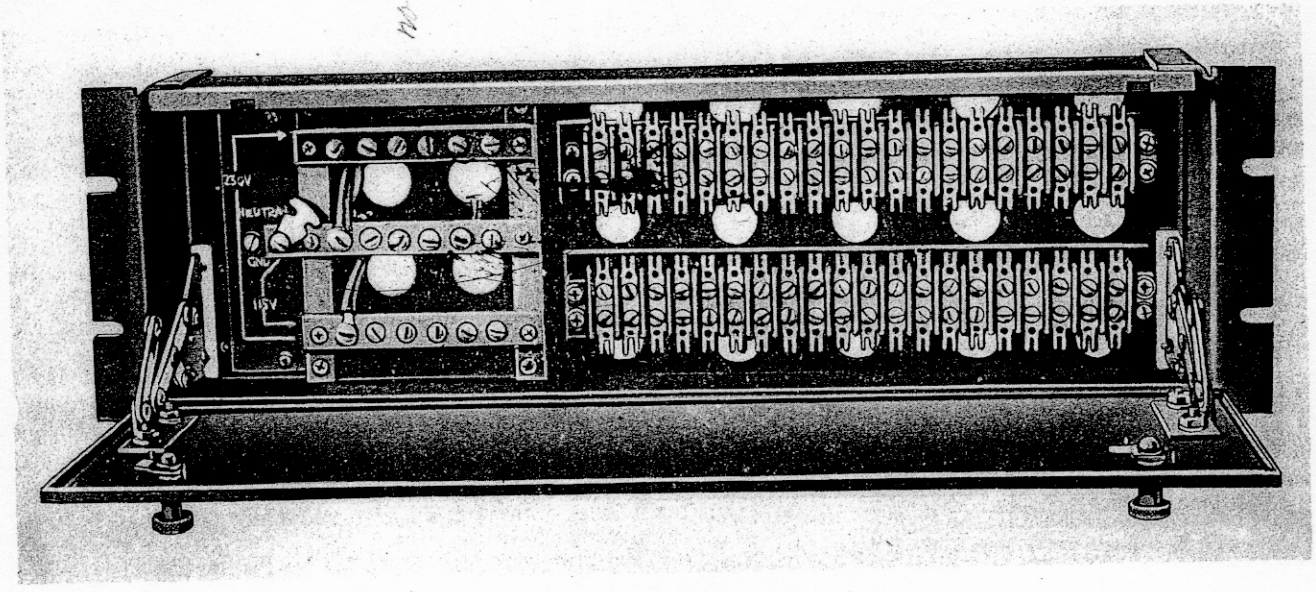


Figure 6-8. Distribution Panel J-390/GR

4.0 AF AMPLIFIER, AM-447/GR

The AF amplifier AM-447/GR is a complete unit with a self-contained power supply. Operating controls are accessible from the front panel. Connections to the unit are made through a connector plug on the rear of the chassis that mates with a connector jack on the mounting panel, MX-1125/G, when the amplifier is in the mounting panel.

The Amplifier requires an AC power source of 107 to 120 volts, 50 to 60 cycles, single phase. The input level may be either -10 dbm to +10 dbm or -20 dbm to 0 dbm with no more than 5 miles of cable between the equipment supplying the signal and the Amplifier. The output level may be adjusted for any level up to 3 watts (+34 dbm) and will hold the level constant within 2 db for all levels of input signals within the limits previously stated. Some distortion may be expected in the output, however, if the Amplifier is adjusted for extremely low output levels.

4.1 Theory of Operation and Circuit Analysis

Referring to Figure 6-9, the output from the first audio stage is dependent upon two variables, the amount of signal applied to the grid from the input circuit and the bias supplied from the limiter, and will be held constant by adjustments of these variables. The constant level audio is then further amplified by the second amplifier and output stages to produce an audio output of a predetermined level up to 3 watts.

Taps on the input transformer, T-102, provide for connection of the Amplifier input to either a 300 or 600 ohm line. A phone jack, J-102, connected across the 600 ohm tap of T-102 provides a convenient connection for monitoring or measuring the level of the input signal. The secondary of T-102 is terminated into a series-parallel resistance using a variable resistor, R-103, to adjust the signal level applied to the grid of V-102, first amplifier stage.

The first audio amplifier stage is the variable-gain stage of the unit. The tube is self-biased by R-106 in the cathode circuit and in addition a negative voltage from the limiter is applied to the grid. This limiter voltage varies with signal level and is adjustable to obtain the desired output from the AM-447/G. The limiter circuit will be discussed later in this chapter. The audio output from the first stage is developed across resistor, R-110 and coupled to the grid of the second stage by capacitor C-107.

The second audio amplifier stage and the audio output stage are normal audio amplifiers and no unusual circuitry is used in their application in this unit. The output of V-104 is developed across a parallel circuit composed of the primary of the output transformer, T-103, and resistors R-121 and R-122. These resistors are connected in series. One secondary winding of T-103 provides taps for a balanced output of either 200 or 600 ohms impedance. The other secondary winding has 5000 ohms impedance and is terminated into a resistive load consisting

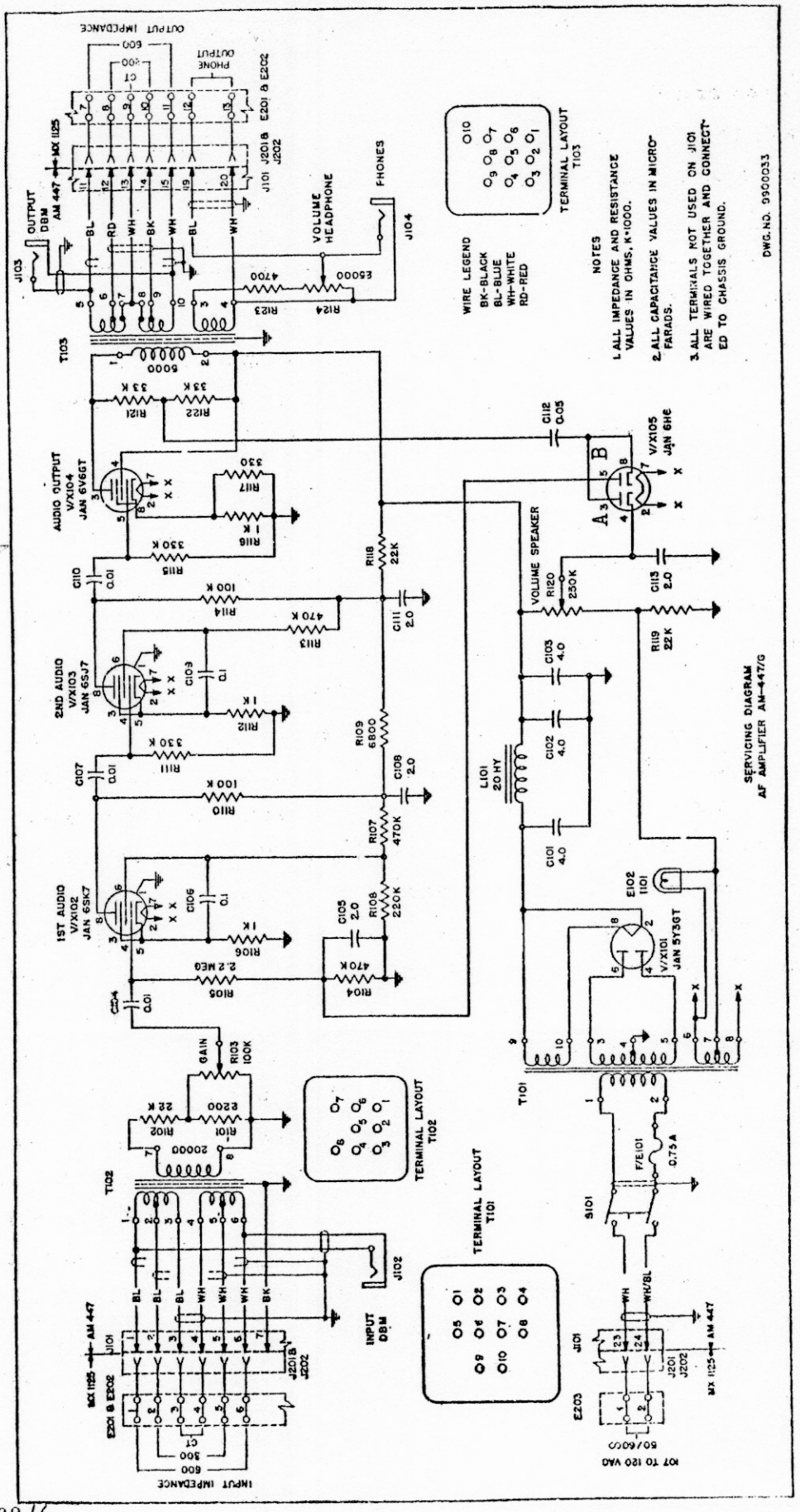

SERVICING DIAGRAM
AF AMPLIFIER AM-447/G
DWG. NO. 9900033
NOTES
1. ALL IMPEDANCE AND RESISTANCE VALUES IN OHMS, K=1000.
2. ALL CAPACITANCE VALUES IN MICRO-FARADS.
3. ALL TERMINALS NOT USED ON J101 ARE WIRED TOGETHER AND CONNECTED TO CHASSIS GROUND.
WIRE LEGEND
BK-BLACK
BL-BLUE
WH-WHITE
RD-RED
TERMINAL LAYOUT T103
TERMINAL LAYOUT T102
TERMINAL LAYOUT T101
OUTPUT IMPEDANCE
INPUT IMPEDANCE
VOLUME HEADPHONE
PHONES
VOLUME SPEAKER
AUDIO OUTPUT V/X104 JAN 6V6GT
2ND AUDIO V/X103 JAN 6SJ7
1ST AUDIO V/X102 JAN 6SK7
V/X105 JAN 6HE
V/X101 JAN 5Y3GT
GAIN
OUTPUT DBM
INPUT DBM
HOT
CT
PHONE OUTPUT
NOT TO 120 VAC 50/60CS
AM 447
MX 1125
E201 & E202
J101 J201 & J202
J102
J103
J104
T101
T102
T103
S101
E203
F/E101
0.75A
L101 20 HY
R101 22K
R102 2200
R103 100K
R104 470K
R105 2.2 MEG
R106 1K
R107 470K
R108 220K
R109 6800
R110 100K
R111 330K
R112 1K
R113 470K
R114 100K
R115 330K
R116 1K
R117 330
R118 22K
R119 22K
R120 250K
R121 33K
R122 33K
R123 4700
R124 65000
C101 4.0
C102 4.0
C103 4.0
C104 0.01
C105 2.0
C106 0.1
C107 0.01
C108 2.0
C109 0.1
C110 0.01
C111 2.0
C112 0.05
C113 2.0
5000
20000
200
600

Figure 6-9

of R-123 and R-124 in series. R-124, a variable resistor, is used to vary the level of the audio supplied to the headphone jack, J-104, mounted on the front panel. Another jack, J-103, is mounted on the front panel also, and is connected across the 600 ohm winding to provide a convenient method of measuring the audio output while making the gain and limiter adjustments of the unit.

The volume limiting circuits maintain the output of the Amplifier at a preset level by varying the gain of the first audio amplifier stage. V-105 in the limiter circuit is a 6H6 (duo-diode).

The plate of diode "A" is connected to the cathode of diode "B" and to one side of the coupling capacitor C-112. Potentiometer R-120, which is in the bleeder circuit of the power supply, applies a positive bias to the cathode of diode "A". When the audio voltage developed across resistor R-122 is negative, diode "B" will conduct and a negative voltage will be developed across resistor R-104. This negative voltage is filtered by C-105 and is applied to the grid of the 1st audio stage, which will provide a certain amount of automatic gain control. When the audio voltage developed across resistor R-122 is positive and when this voltage is greater than the positive bias on the cathode of diode "A", this diode will conduct. When diode "A" conducts, capacitor C-112 will charge to a voltage that is equal to the difference between the positive bias on the cathode of diode "A" and the positive voltage across R-122. The voltage developed across C-112 is of a polarity that will add to the negative voltage that is developed across R-122 during the negative half cycle of the audio signal. This will cause diode "B" to conduct heavier and will produce a higher negative voltage across R-104. Therefore, a greater gain reduction is provided for the higher level audio signals and will limit the level of the audio output of the amplifier. The amount of limited output level is adjusted by potentiometer R-120. R-120 varies the positive bias on the cathode of diode "A", which in turn varies the voltage to which C-112 will be charged during the positive half cycle of the audio signal.

4.2 Adjustment of AM-447/G

For normal operation the limiter bias control, R-120, (This control is labeled "VOLUME SPEAKER" on the front of the amplifier), is adjusted full clockwise to provide maximum bias voltage to the "A" section of V-105 thus disabling its limiter action. An audio signal of normal level (mid-point of the input limits) is applied to the input of the Amplifier and the gain control, R-103, adjusted for an output level 2 db greater than the desired output. The "VOLUME SPEAKER" control is then adjusted counter-clockwise until limiter action reduces the Amplifier output to the desired level. These adjustments sets the limiter action so that input signals may vary $\pm$ 10 db without a change of more than 2 db in the Amplifier output level. To change the level of the audio supplied by the AM-447 to the line, or other terminating equipment, both the gain control and the limiter action must be readjusted as above, otherwise severe distortion in the output may result.

Several views of the AM-447/G amplifier is shown in Figures 6-10 through 6-13.

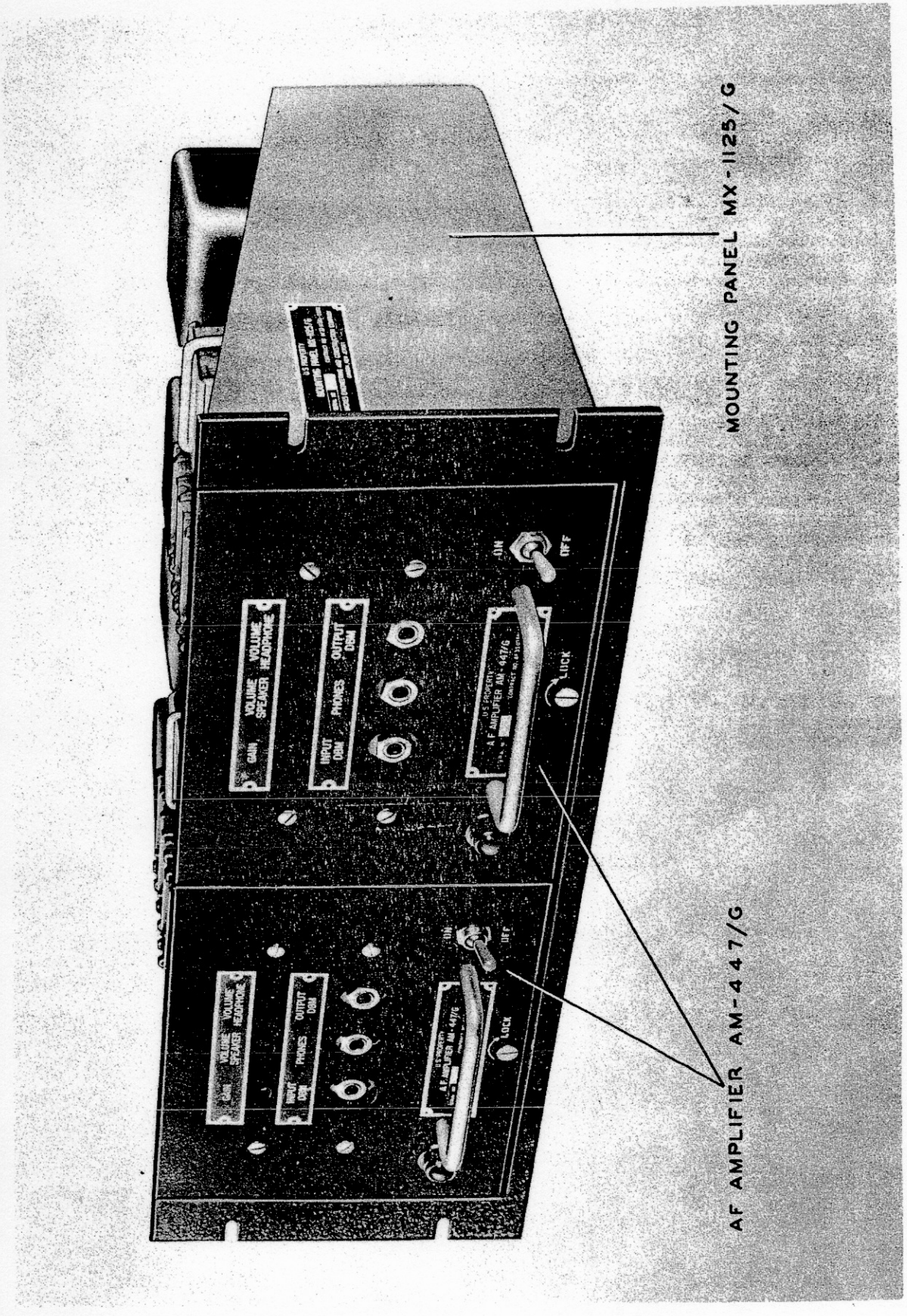


Figure 6-10. AF Amplifier AM-447/G and Mounting Panel MX-1125/G

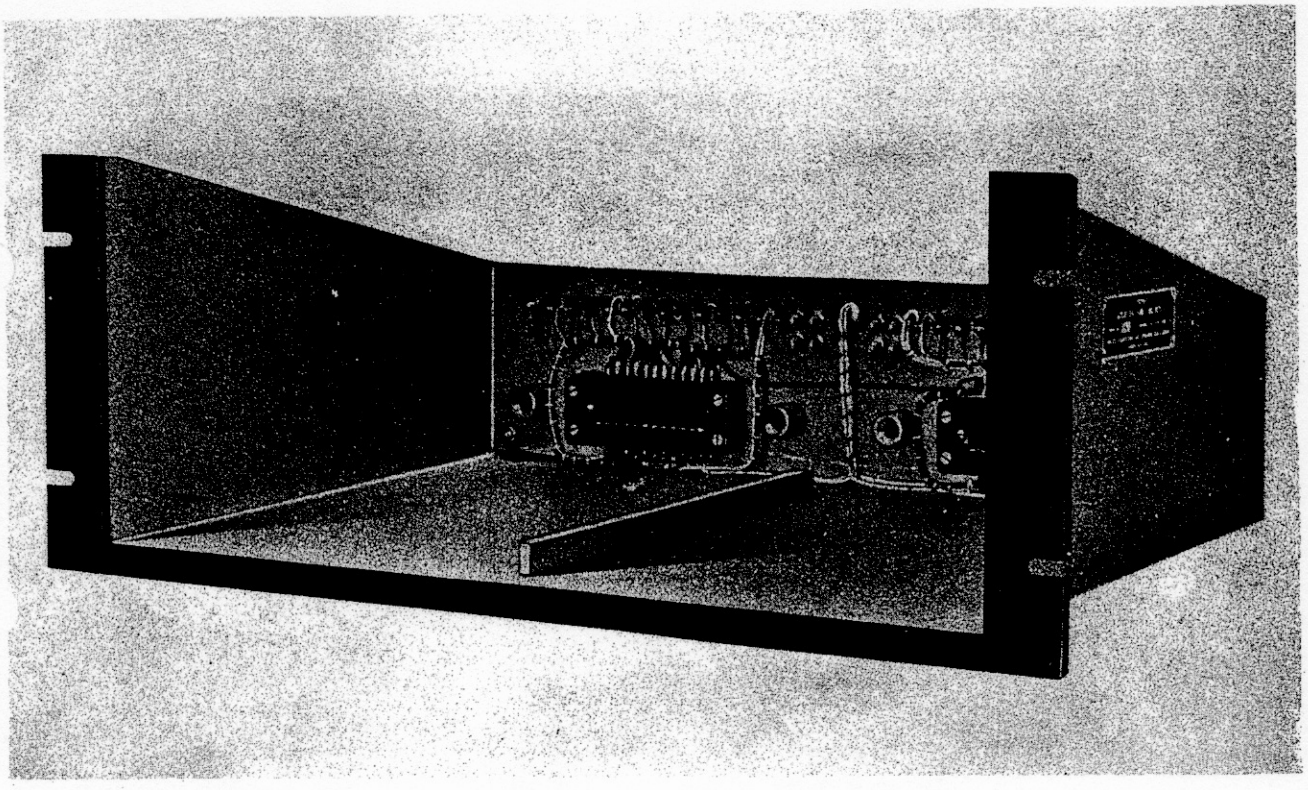
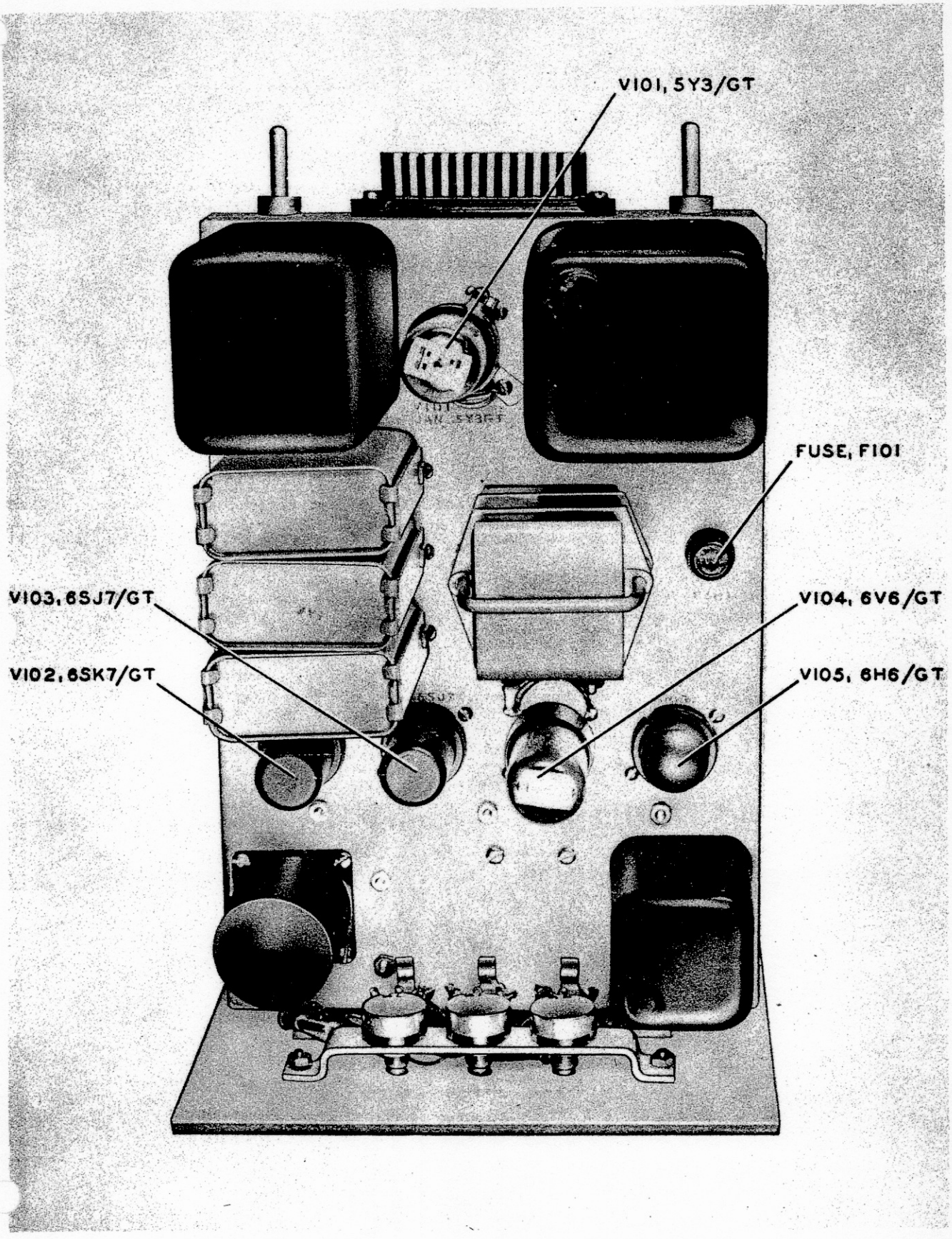


Figure 6-11. Mounting Panel MX-1125/G

Figure 6-12. AF Amplifier AM-447/G, Panel View



138/6
11/58 Figure 6-13. AF Amplifier AM-447/G, Top View