

12P3 - 2APT - 102

AN 16-35AM14-3

HANDBOOK OF
MAINTENANCE INSTRUCTIONS

for

RADIO FREQUENCY
AMPLIFIER
AM-14/APT

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Departments and the Air Council of the United Kingdom*

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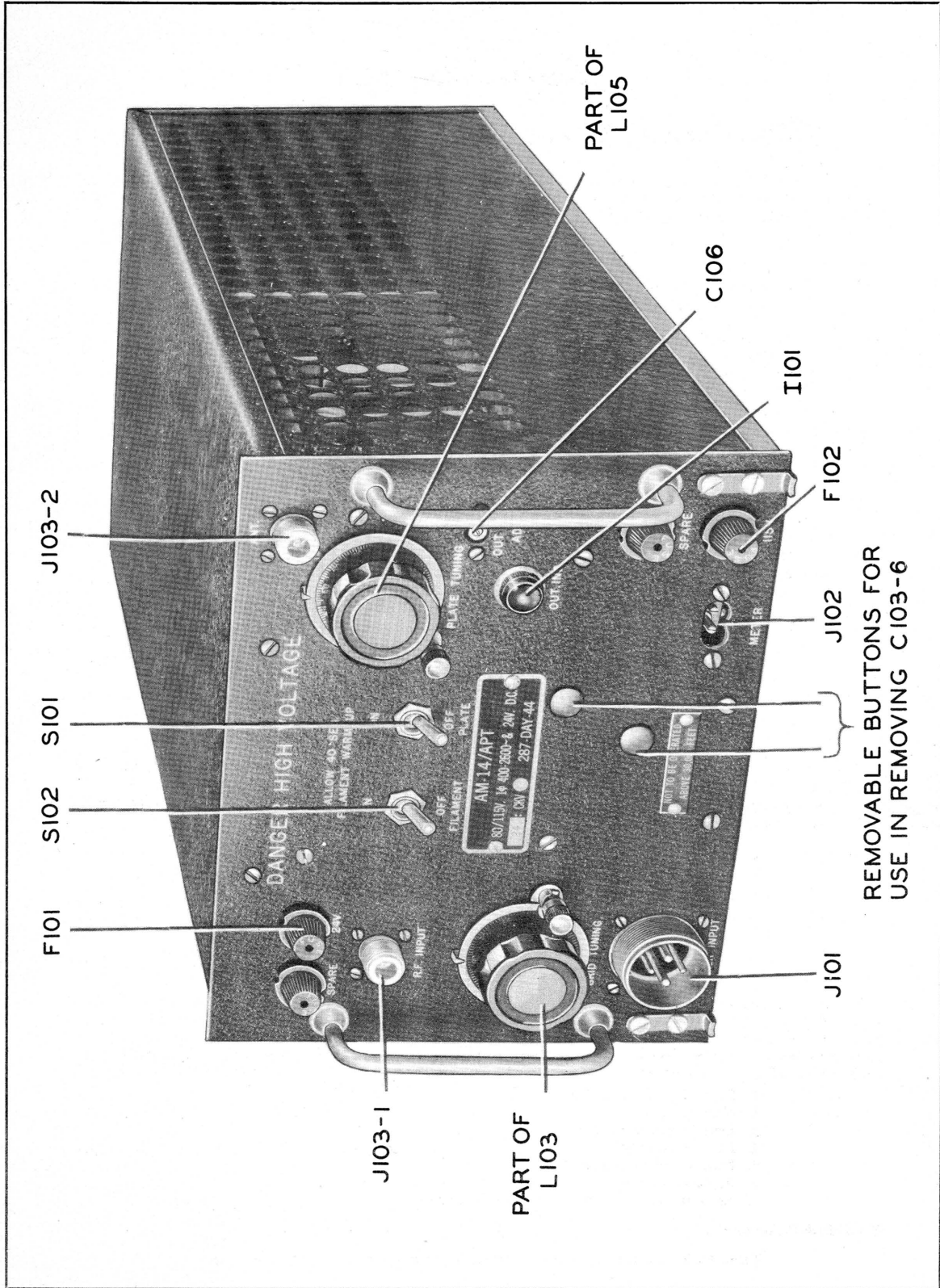


Figure 1-1 Radio Frequency Amplifier AM-14/APT—Exterior View

SAFETY NOTICE

This equipment employs high voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised while working with the equipment.

**SECTION I
GENERAL DESCRIPTION****I. GENERAL.**

a. Radio Frequency Amplifier AM-14/APT (see fig. I-1) is airborne equipment designed to amplify the r-f output of Transmitting Equipment AN/APT-1 or Radar Set AN/APT-3 to approximately 100 watts. However, the use of the amplifier with the radar set is not recommended except for spot-frequency operation. (Refer to sec. II, par. 6.)

b. Radio Frequency Amplifier AM-14/APT is contained in a size B1-D Standard Aircraft Radio Case.

c. The frequency range of the radio frequency amplifier is 85-150 megacycles. The amplifier can be tuned to pass a bandwidth of 1 to 4.5 megacycles. (Refer to sec. II, par. 6a.) On the front panel of each equipment is a nameplate stating the altitude above which the unit should not be operated.

2. EQUIPMENT SUPPLIED.

The equipment listed in the following table comprises Radio Frequency Amplifier AM-14/APT.

Quantity per Equipment	Name of Unit	Army Type Designation	Navy Type Designation	Overall Dimensions	Weight	Numerical Series of Ref. Symbols
1	Radio Frequency Amplifier	AM-14/APT	AM-14/APT	21 x 10-1/2 x 7-5/8	50	
1	Mounting Base	MT-171/U	MT-171/U	For standard Aircraft Radio Base size B1-D	2	
1*	Plug	AN3106-22-4S (PL-P230) or AN3108-22-4S (PL-Q230)	AN3106-22-4S or AN3108-22-4S		2-1/8 x 1-19/32 dia.	0.5
2	Radio Frequency Plug	UG-21/U	UG-21/U	1-5/8 x 5/8 dia.	0.3	
2	Radio Frequency Adapter	UG-27/U	UG-27/U	1-3/8 x 1-1/4 x 11/16 dia.	0.2	
1	Adapter	AN3057-12		1-3/16 x 1-3/8 x 13/16 dia.	0.1	

*Although reference is made throughout the text to plug AN 3108-22-4S, either plug AN 3106-22-4S (straight) or plug AN 3108-22-4S (right-angle) may be used.

3. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

a. The equipment listed in the following table is required for installation.

Quantity per Equipment	Name of Unit	Army Type Designation	Navy Type Designation	Required Characteristics
As Required	Radio Frequency Cable or Radio Frequency Cable	RG-8/U RG-31/U	RG-8/U RG-31/U	
As Required	Power Wiring			Refer to fig. 2-3

b. The equipment listed in the following table is required for maintenance.

Quantity per Equipment	Name of Unit	Army Type Designation	Navy Type Designation	Required Characteristics
1	Radio Frequency Wattmeter	TS-118/AP	TS-118/AP	
1	Amplifier Alignment Unit	TS-92/AP	TS-92/AP	
1	Test Meter	TS-60/U (I-139-A)	TS-60/U	
1	Test Set	(I-56-K)		
1	Frequency Meter	TS-174/U	TS-174/U	
1	Frequency Meter	TS-175/U	TS-175/U	
1	Pickup Assembly	TS-131/AP	TS-131/AP	
1*	Monitor	BC-1255-A		
1*	Head Set	HS-23		
1*	Cord or Cord	CD-307 CD-307-A		

*These items may be used in lieu of Frequency Meter TS-174/U or Frequency Meter TS-175/U.

4. POWER SUPPLY.

The power sources needed to operate Radio Frequency Amplifier AM-14/APT are 80 or 115 volts, 400

to 2600 cycles-per-second, and 24 volts direct current. Alternating current input is approximately 700 watts at 0.80 power factor. The current required from the d-c source is 0.5 ampere.

SECTION II INSTALLATION AND ADJUSTMENT

I. BENCH TEST.

Radio Frequency Amplifier AM-14/APT cannot be tested without employing either Transmitting Equipment AN/APT-1 or Radar Set AN/APT-3, because the power input requirements of the amplifier preclude the use of any available test equipment. Consequently, the only test procedure that can be followed is that described in paragraphs 5 to 7 of this section.

2. INSTALLATION OF RADIO FREQUENCY AMPLIFIER AM-14/APT.

a. Install Mounting Base MT-171/U so that the following requirements will be met:

(1) The interconnecting cable between the transmitter and the amplifier will be as short as possible. (In no case let it exceed 2½ feet.) (See figs. 8-2 and 8-3.)

(2) There will be sufficient clearance around the equipment for good ventilation. (See fig. 8-1.)

(3) The front panel will be accessible to the operator.

(4) The equipment will be as close to the power source and antenna as possible. (See fig. 8-3 for limitations on wiring to power source.)

(5) There will be sufficient clearance for the amplifier to be secured to the mounting. (See fig. 8-1.)

(6) Sufficient illumination can be obtained for reading the dials in the front panel.

(7) There will be sufficient clearance in front of the panel for removal of plugs. (See fig. 8-1.)

b. Secure the radio frequency amplifier to Mounting Base MT-171/U as follows:

(1) See that the horizontal pins at the rear of the mounting enter the chassis through the holes in the amplifier housing.

(2) Tighten the two knurled thumb nuts at each side of the mounting over the lugs mounted on the front panel, and fasten the nuts with wire inserted through the holes provided in the thumb nuts.

3. CORDING INSTRUCTIONS.

(See figs. 8-2 and 8-3.)

Note

In the following cording instructions it is assumed that the driving transmitter has been connected according to the instructions in the handbook of maintenance instructions for that equipment.

a. ANTENNA CABLE.—Disconnect the plug from the "ANT." socket on the transmitter, and connect it to the "ANT." socket on the amplifier. (See fig. 8-2.)

b. POWER WIRES.

(1) Cut the power cable to reach from the radio frequency amplifier to the sources of supply, and install Plug AN 3108-22-4S on one end of the cable.

(2) Connect Plug AN 3108-22-4S to the "POWER INPUT" socket on the amplifier panel. (See fig. 8-2.) Connect the other ends of the cable to the sources of power. (See fig. 8-3 for identification of these wires.)

c. INTERCONNECTING CORD.

(1) Cut Radio Frequency Cable RG-8/U to reach from the transmitter to the amplifier, and install Radio Frequency Plug UG-21/U on each end of the cable. (See fig. 8-4.)

IMPORTANT

The cable between the amplifier and the transmitter must not exceed $2\frac{1}{2}$ feet in length.

(2) Connect one end of the cord to the "ANT." socket on the transmitter and the other end to the "R. F. INPUT" socket on the amplifier. (See fig. 8-2.)

Note

Do not disconnect the power wires from the transmitter.

4. GENERAL PRECAUTIONS.

a. Avoid contact with the deck plate when the radio frequency amplifier chassis is removed from the case. The deck plate is painted red to warn personnel of the existence of dangerously high voltage (2000 volts d-c to chassis.)

b. Do not operate the equipment longer than necessary to accomplish a specific purpose.

c. Do not operate the amplifier with the dust cover removed.

d. Do not alter the setting of any of the controls except as specifically directed in this handbook.

e. Do not turn on the plate switch if the antenna is disconnected unless a dummy load is employed.

5. PRELIMINARY AFTER-INSTALLATION CHECK.

WARNING

Never remove the amplifier from the dust cover with the a-c power connector attached. The operation of this unit involves the use of dangerously high voltages.

a. Remove the amplifier from the dust cover as follows:

(1) Loosen the two hold-down thumbscrews at each side of the front which hold the amplifier to the mounting. (See fig. 1-1.)

(2) Remove the two screws at the top of the front panel. (See fig. 1-1.)

(3) Loosen the Dzus fastener at the rear.

(4) Withdraw the amplifier with the handles.

b. Inspect the rolo coils. (See fig. 4-1.) See that they are free of corrosion. See that the roller contacts are on corresponding turns on each half of the coil. If the rollers are not in the correct position, adjust them according to instructions in section V, pars. 5 and 6.

c. See that all vacuum tubes and pilot lamps are in place.

d. Replace the amplifier in the dust cover and secure it to the mounting.

e. Inspect the front panel of the amplifier and see that the following are in place and securely fastened:

(1) Power Plug AN 3108-22-4S.

(2) "ANT." and "R. F. INPUT" Radio Frequency Plugs UG-21/U.

(3) 10-ampere "115V" fuse and 1-ampere "24V" fuse and one "SPARE" for each. (See fig. 1-1.)

(4) "OUT. IND." pilot lamp. (See fig. 1-1.)

(5) Safety wire on hold-down screws.

6. TUNING PROCEDURES.

a. GENERAL.

(1) Radio Frequency Amplifier AM-14/APT, when tuned with a driving transmitter, may be tuned for either spot-frequency operation or broad-band operation. The frequency range of the amplifier is 85-150 megacycles.

(2) When tuned for spot-frequency operation, the amplifier transmits a frequency band approximately 2 to 2.5 megacycles wide with a power output of about 125 watts.

(3) When properly tuned for broad-band operation, the amplifier transmits a frequency band approximately 3 to 4.5 megacycles wide with a power output of about 100 watts. However, with a bandwidth of 4.5 megacycles, the power may be between 60 and 75 watts if tuning is not done carefully.

(4) The input circuit to the radio frequency amplifier is designed to have nearly the same loading effect on the driver as when the driver is connected directly to the antenna. Therefore, the same procedure is used in tuning the driver when it is connected to the radio frequency amplifier as when it is connected directly to an antenna.

b. TUNING FOR SPOT-FREQUENCY OPERATION.

(1) Use either Transmitting Equipment AN/APT-1 or Radar Set AN/APT-3 as a driver.

(2) If Transmitting Equipment AN/APT-1 is being used as a driver, turn on the equipment and adjust it for the desired frequency according to the instruc-

tions given in the *Handbook of Maintenance Instructions for Transmitting Equipment AN/APT-1*. Tune for maximum output at the desired frequency, but do not make any adjustments for correct bandwidth.

(3) If Radar Set AN/APT-3 is being used as a driver, turn on the equipment and adjust it for spot-frequency operation as directed in the *Handbook of Maintenance Instructions for Radar Set AN/APT-3*.

Note

The current values listed in the tuning procedure for Radar Set AN/APT-3 are not necessarily correct when the set is being used as a driver. This is not important, however, as long as the maximum allowable values are not exceeded.

(4) Tune whichever driving-transmitter is being used with the antenna connected directly to it. Then connect the driving transmitter to the Radio Frequency Amplifier AM-14/APT, and connect the antenna to the output of the amplifier. When the grid circuit of the amplifier has been brought into tune, the output circuit of the driver may have to be readjusted, because the amplifier grid circuit presents a slightly different load to the driving-transmitter than did the antenna.

(5) Plug Test Set I-139-A into the "METER" socket on the front panel of the amplifier.

(6) Turn on the "FILAMENT" switch of the radio frequency amplifier. Wait about 40 seconds; then turn on the "PLATE" switch.

(7) Check the current as indicated on the test set meter; it should not exceed 0.70 milliamperes at this time whether the amplifier is tuned or not. If the indication exceeds 0.70 milliamperes, the amplifier requires repairing.

(8) Adjust the "GRID TUNING" knob on the amplifier for a maximum reading on Test Set I-139-A, but do not exceed 0.70 milliamperes. If the maximum reading tends to exceed this value, leave the "GRID TUNING" knob so adjusted at this limit and proceed with the following instructions.

Note

During the tuning procedures the "OUT. IND." lamps on the driver and amplifier will vary in brightness. Do not be concerned with these variations unless specifically directed in this handbook.

(9) Adjust the "PLATE TUNING" on the amplifier until a dip is observed on Test Set I-139-A. At this time the amplifier "OUT. IND." lamp should become lighted. If it does not, the "OUT. IND. ADJ." screw is incorrectly adjusted, or the lamp is burned out.

Note

For any given output, the brilliance of the "OUT. IND." lamp can be adjusted by the "OUT. IND. ADJ." screw. If the lamp burns

excessively bright or dim, turn this adjusting screw with a screw driver.

(10) Adjust the "PLATE TUNING" on the amplifier for maximum brilliance of the amplifier "OUT. IND." lamp. If a reading on Test Set I-139-A, of 0.70 milliamperes does not result, adjust the "GRID TUNING" on the amplifier for a maximum reading not to exceed 0.70 milliamperes. If a reading of 0.70 milliamperes cannot be obtained by this action, try to drive the amplifier harder by readjusting the driver output circuit. If Radar Set AN/APT-3 is used, only the "LOADING" control on that transmitter will be used for this readjustment. If Transmitting Equipment AN/APT-1 is being used, only the "AMP. PLATE" control will be used for this readjustment.

Note

If the proper input is being delivered from the driver, Test Set I-139-A should not read less than 0.45 milliamperes or more than 0.70 milliamperes.

c. TUNING FOR BROAD-BAND OPERATION.

Best broad-band operating conditions are achieved when Transmitting Equipment AN/APT-1 is used as a driver, and Amplifier Alignment Unit TS-92/AP is used for tuning. The following procedure applies specifically when the transmitting equipment is used as a driver. If other drivers are used, a thorough study of the amplifier alignment unit is required to determine whether or not it can be used to advantage. For example, the amplifier alignment unit could not be used with any accuracy to assist in tuning Radar Set AN/APT-3 for broad-band operation, with or without Radio Frequency Amplifier AM-14/APT. An alternate procedure for use when the amplifier alignment unit is not available is also given below.

(1) Tune the driver and radio frequency amplifier for spot-frequency operation according to the instructions in paragraph 6b of this section. Leave the power on.

(2) Obtain Amplifier Alignment Unit TS-92/AP. (For a brief description of this equipment, refer to section VI of this handbook.) Set the gain control of the alignment unit to extreme counterclockwise position. Turn meter control switch to the "HIGH" position. No special setting of the bandwidth dial is required.

(3) Loosely couple the probe antenna of the alignment unit to the antenna cable of the amplifier.

CAUTION

Start the coupling on the cable about 5 feet away from the amplifier, as too much coupling will burn out the crystal in Amplifier Alignment Unit TS-92/AP.

(4) Plug the alignment unit into the power source, and turn on the power switch. After the equipment warms up, adjust the "GAIN" control until the meter reads about half-scale. If no reading is obtained, in-

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crease the coupling between the amplifier and the alignment unit, or increase the gain control. It may be necessary to do both. If still no reading results, turn the bandwidth dial on the alignment unit toward 0.7 megacycles. No reading at this point indicates a faulty alignment unit.

(5) Set the bandwidth on the alignment unit to 3 megacycles. A bandwidth of 3 megacycles indicated on the alignment unit corresponds to an amplifier bandwidth of 4 megacycles at half-power points.

(6) Simultaneously rock the driver "AMP. PLATE" dial and the amplifier "GRID TUNING" dial back and forth until a maximum reading is obtained on the amplifier alignment unit meter. At the same time try to keep the brilliance of the "OUT. IND." lamp constant, but do not adjust the "OUT. IND. ADJ." control to maintain a constant brilliance. (Decrease the gain control on the alignment unit as required to prevent the meter from going off scale.) This tunes these two overcoupled circuits so that maximum bandwidth is obtained. Some decrease in power output will result as indicated by the brightness of the amplifier "OUT. IND." lamp.

Note

The power output will decrease about 30 percent for a decrease in brilliancy of the lamp of about $\frac{1}{2}$ to $\frac{3}{4}$ of its original full brilliancy. Therefore, if the light is observed carefully and the reading of the meter on the amplifier alignment is noted at the same time, it will serve to indicate the amount the power output has fallen due to broad-band tuning. It is recommended that the system be tuned to secure the greatest reading possible on the meter of the alignment unit without reducing the power output more than 30 percent.

(7) Simultaneously adjust the "MIXER PLATE" and "AMP. GRID" dials (both on the driver) for maximum reading on the alignment unit meter. (Again decrease the gain control on the alignment unit as required to prevent the meter from going off scale.) As before, the power output will probably be decreased after this adjustment is made, and will be indicated by a decrease in the brilliancy of the "OUT. IND." lamp.

(8) Adjust the amplifier "AMP. PLATE" dial for maximum reading on the alignment unit meter. After these tuning adjustments have been made, check the "OUT. IND." lamps on both the driver and the amplifier to be sure they are lighted and thus indicate some power output. The power at this time is about 70 to 100 watts at 4 megacycles bandwidth, depending on how carefully the tuning was done.

(9) If Amplifier Alignment Unit TS-92/AP is not available, use Frequency Meter TS-174/U loosely coupled to the antenna. Make the same consecutive adjustments on the driver and amplifier as on the alignment unit, while continually tuning the frequency meter over

the desired band of frequencies. Note the bandwidth by observing the range of frequencies over which an indication on the frequency meter is observed. An absorption wavemeter may also be used if available.

(10) Check the frequency of the signal according to the instructions given in paragraph 7, this section.

7. FINAL AFTER-INSTALLATION CHECK.

After tuning Radio Frequency Amplifier AM-14/APT for spot-frequency operation (*refer to par. 6b*), or broad-band operation (*refer to par. 6c*), check the frequency of the signal according to the following instructions.

a. FREQUENCY CHECK INSIDE THE AIRPLANE.

(1) Place Frequency Meter TS-174/U, or equivalent, inside the airplane near Radio Frequency Amplifier AM-14/APT.

(2) Turn on the frequency meter by rotating the selector switch to "OPERATE", and allow the equipment to warm up.

(3) Plug Headset HS-23 into the "PHONES" jack on frequency meter panel.

(4) Connect about $1\frac{1}{2}$ feet of flexible wire to the "ANTENNA" post of the frequency meter. Wind 3 or 4 turns of this wire around the antenna cable of the amplifier (not more than 5 feet away from the "ANT." socket of the amplifier).

(5) Refer to the calibration chart supplied with the frequency meter, and set the frequency meter dial on the desired frequency.

(6) Listen in the frequency meter headset. A low, rough hiss indicates that the signal is exactly or nearly tuned to the desired frequency.

(7) Turn the frequency meter dial above and below the setting to see if the signal is equally distributed about the frequency desired. The signal should be heard over a range of about 1.5 to 4.5 megacycles for spot-frequency operation or about 3.5 to 4 megacycles for broad-band operation.

b. FREQUENCY CHECK OUTSIDE THE AIRPLANE.

(1) Place the frequency meter on the ground outside the plane about 15 feet from the antenna.

(2) Extend the antenna of the frequency meter. Be sure there are no obstructions in the line of sight between the frequency meter antenna and the transmitter antenna.

(3) Using Pickup Assembly TS-131/AP, determine whether or not the transmitter is operating.

(*a*) Before turning on the transmitter, set the rheostat on Control Box C-111/AP at "0" (minimum sensitivity).

CAUTION

To prevent burning-out of the crystal, it is necessary to employ Pickup Assembly TS-131/AP at least 15 feet from the antenna.

(b) Turn on the transmitter and amplifier as directed in section III.

(c) Adjust the rheostat on Control Box C-111/AP so that Pickup Assembly TS-131/AP has a deflection of approximately one-half scale, indicating operation of the transmitter.

(4) Turn on the frequency meter by turning the selector switch to "OPERATE", and plug Headset HS-23 into the "PHONES" jack.

(5) Refer to the calibration chart supplied with the frequency meter, and set it to the desired frequency indicated by a low, rough hiss

(6) Tune the frequency meter dial below and above the frequency on which the meter is to be operated. The signal should be heard over a range of about 1.5 to 2.5 megacycles, for spot-frequency operation, or about 3.5 to 4 megacycles for broad-band operation.

Note

If the frequency meter can pick up any signal at 60 feet from the transmitter antenna, regardless of bandwidth, the equipment is operating in a fair manner and may be partially effective for emergency operation.

SECTION III OPERATION

WARNING

Avoid contact with the deck plate when the radio frequency amplifier chassis is removed from the case. The deck plate is painted red to warn personnel of the existence of dangerously high voltage (2000 volts d-c to chassis).

I. STARTING AND STOPPING PROCEDURE.

a. STARTING THE EQUIPMENT.

(1) Turn on the transmitter according to the instructions given in the corresponding handbook of maintenance instructions.

(2) Turn the "FILAMENT" switch on the amplifier panel to "ON". Wait about 40 seconds.

(3) Turn the "PLATE" switch on the amplifier to "ON".

IMPORTANT

Do not turn on the "PLATE" switch until the "FILAMENT" switch has been on for about 40 seconds.

b. STOPPING THE EQUIPMENT.

(1) REMOVAL OF SIGNAL DURING TACTICAL USE.—Instructions for removing the signal without shutting down the equipment are given in the *Handbook of Maintenance Instructions for Transmit-*

ting Equipment AN/APT-1 or Radar Set AN/APT-3. Both the "FILAMENT" and "PLATE" switches on the amplifier are to be left in the "ON" position.

(2) SHUTTING DOWN EQUIPMENT COMPLETELY.

(1) Turn off driving-transmitter.

(2) Turn "PLATE" switch off on the amplifier.

(3) Turn the "FILAMENT" switch off on the amplifier.

2. OPERATION.

The "OUT. IND." lamp indicates by its brilliance that the equipment is operating.

IMPORTANT

Do not alter the setting of any of the controls except as specifically directed in this handbook.

a. Adjust the lamp to a low brilliance by the "OUT. IND. ADJ." screw. If the brilliancy of the lamp is turned very low or the exterior illumination is high, it may be necessary to remove the lamp-assembly cover to see if the lamp is lighted.

b. Make no other adjustments during flight unless emergency repairs are necessary.

SECTION IV

THEORY OF OPERATION

I. PRINCIPLE OF OPERATION.

a. Radio Frequency Amplifier AM-14/APT receives radio frequency energy from Transmitting Equipment AN/APT-1 or Radar Set AN/APT-3 through a 50-ohm input transmission line of coaxial type. This energy is impressed on the grids of the push-pull amplifier tubes through a tuned circuit.

b. The output circuit of the amplifier consists of a tuned circuit which is balanced to ground and is inductively coupled to the 50-ohm output coaxial transmission line.

c. The unit is intended to function as a linear radio frequency class "B" amplifier. Such a characteristic is necessary in order to reproduce the modulation characteristics of the input signal to a satisfactory degree.

2. POWER SUPPLY UNIT.

The power supply unit located in rear of chassis of Radio Frequency Amplifier AM-14/APT (see fig. 4-1) consists of the following:

a. A high voltage rectifier power supply composed of power transformer T101 supplying alternating voltage to the plates of the two rectifier tubes (see fig. 4-2), which operate into a single section choke input filter L101 and C102. (See figs. 4-2 and 8-1.) The positive side of the power supply is grounded through resistor R102. This unit is capable of delivering a current of 300 milliamperes at 1800 volts d-c. Filament current for the rectifier is obtained from the rectifier filament transformer T102. (See figs. 4-2 and 8-5.)

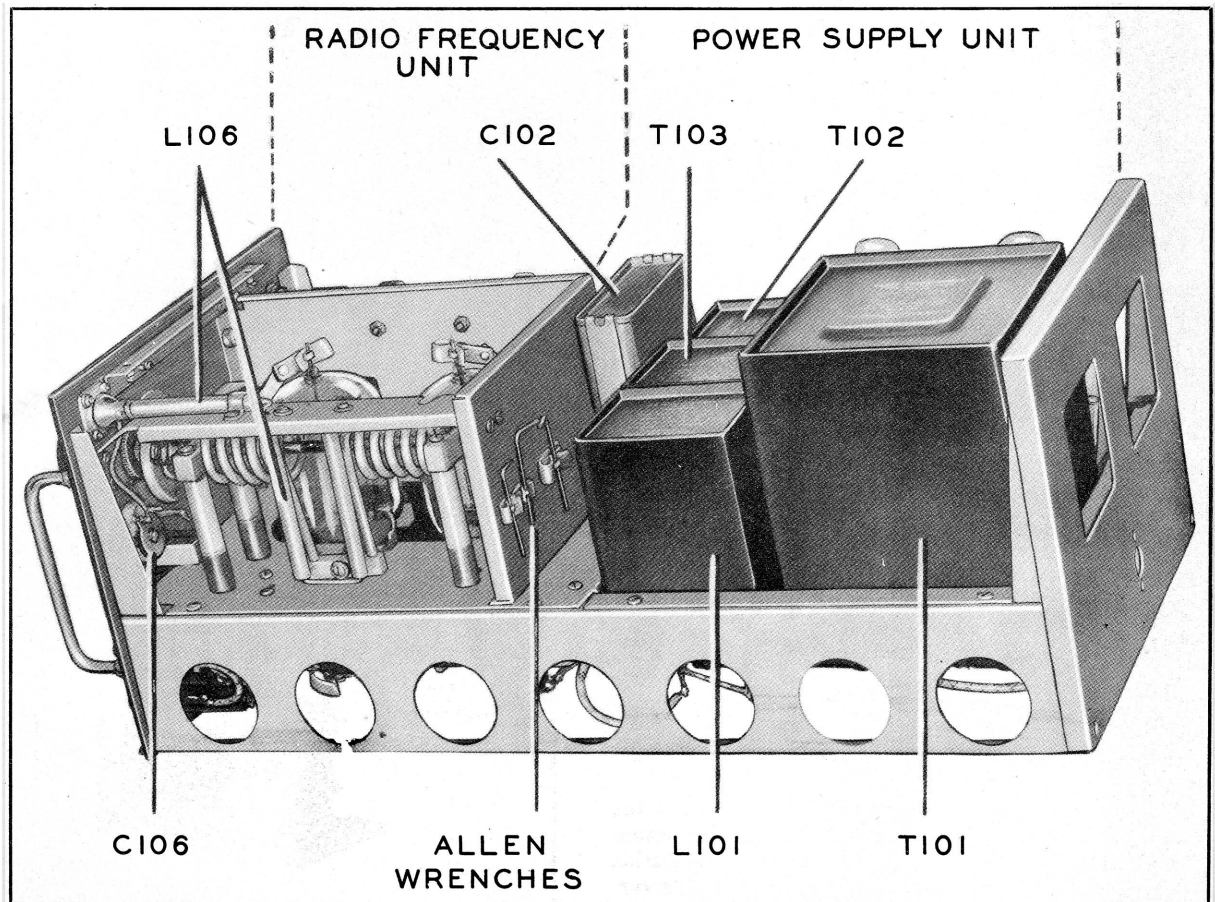


Figure 4-1. Radio Frequency Amplifier AM-14/APT—Power Supply Unit and Radio Frequency Unit

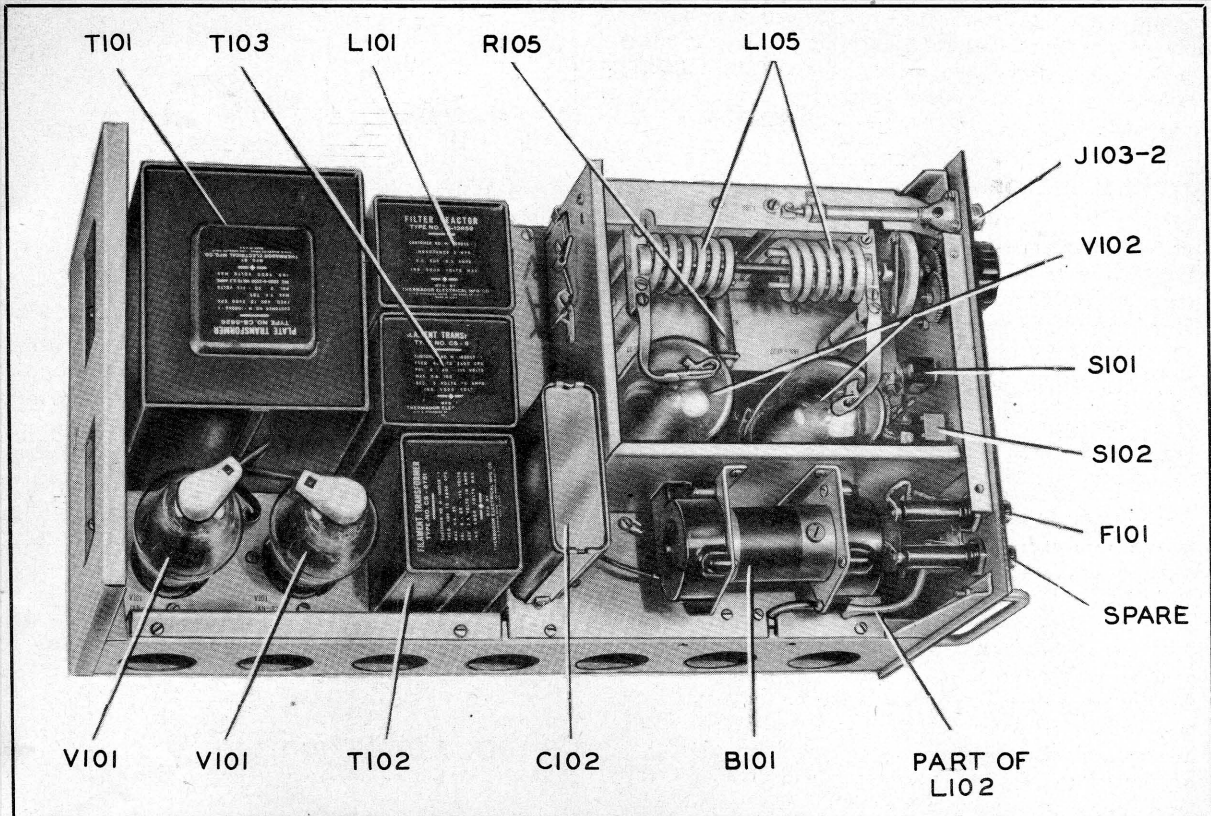


Figure 4-2. Radio Frequency Amplifier AM-14/APT—Top View

b. A filament heating transformer T103 (fig. 4-2) supplies filament power to the amplifier tubes.

3. RADIO FREQUENCY UNIT.

a. The radio frequency unit located in front of chassis is similar to that of the conventional class B radio frequency amplifier except that the positive side of the power supply is at ground potential, and the filament and grid circuits are at 1700 volts negative to ground. (See fig. 4-1.)

b. Radio frequency power is delivered to the grids of the power amplifier tubes through an unbalanced to balanced r-f transformer L102, the tuning inductance L103, and grid blocking condenser C104. (See figs. 4-3 and 8-5.) Bias is obtained from the negative leg of the power supply through resistor R104 and radio frequency choke L104. Screen voltage from the power amplifier tubes is obtained through a tap on bleeder resistor R101. The suppressor grids are connected to one side of the filament circuit. The plate circuit of the power amplifier consists of the output tuning inductance L105. Resistor R105 (see fig. 4-2) serves as a parasitic suppressor and at the same time provides a direct current path in the plate circuit. The output circuit consists of coupling loop L106 (see figs. 4-4 and 8-5) and is connected to feed an unbalanced transmission line.

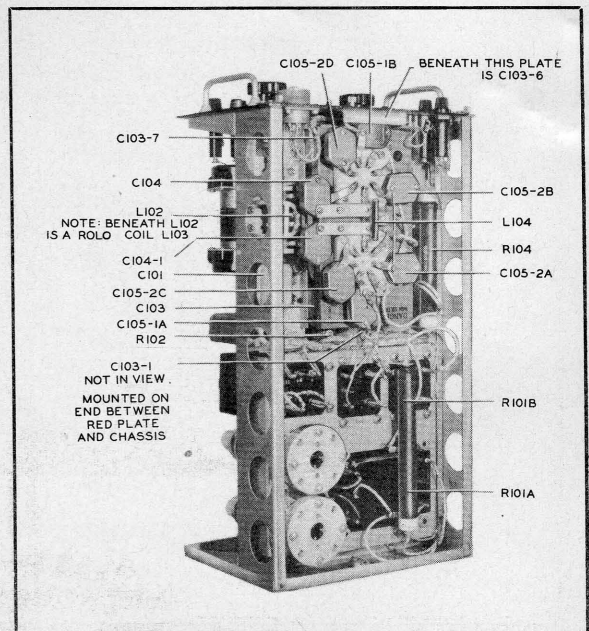


Figure 4-3. Radio Frequency Amplifier AM-14/APT—Bottom Viewed from Right

c. The output circuit coupling is a compromise (fixed at one value at the factory) which provides broad, though not optimum, coupling throughout the frequency range of the equipment as long as the antenna transmission line-load does not produce more than a 2 to 1 standing wave ratio on a 50-ohm line.

4. ROLO COILS.

a. **PLATE ROLO COILS.**—The power amplifier plate tuning coil L105 (see fig. 4-2) is a rolo coil wound in two sections. Extending through the center of the coil is a common shaft and on each side of this shaft, but extending only the length of each coil section, are stub shafts on which are mounted contact wheels or rollers. As the common shaft is turned by the tuning knob, the stub shafts are rotated about the common shaft, and the contact wheels follow the turns of wire. The contact wheels act as movable taps, thus allowing the inductance of the coil to be varied. (See fig. 4-2.)

b. **GRID ROLO COILS.**—The power amplifier grid tuning coil L103 (see fig. 4-3) is a rolo coil wound in two sections on an insulated form. Extending through the center of the form is a common tuning shaft which turns in bearings mounted at the ends of the coils. The coil ends are connected to slip rings which are securely mounted on the coil form. Metallic brushes held against the slip rings by spring pressure provide electrical contact to the coil. On one side of each coil section is an external stub shaft on which are mounted contact wheels or rollers. As the common shaft is turned with the turning knob, the contact wheels follow the turns of wire and allow the inductance of the coil to be varied.

5. TUNING CONTROLS.

There are two tuning dials mounted on the front panel. The "GRID TUNING" control is for adjusting the grid circuit of the power amplifier to resonance and the "PLATE TUNING" control is for tuning the plate circuit. (See fig. 1-1.)

6. FUSES.

Radio Frequency Amplifier AM-14/APT contains a 10-ampere fuse E102 in the primary source of a-c power and a 1-ampere fuse F101 for the 24-volt motors.

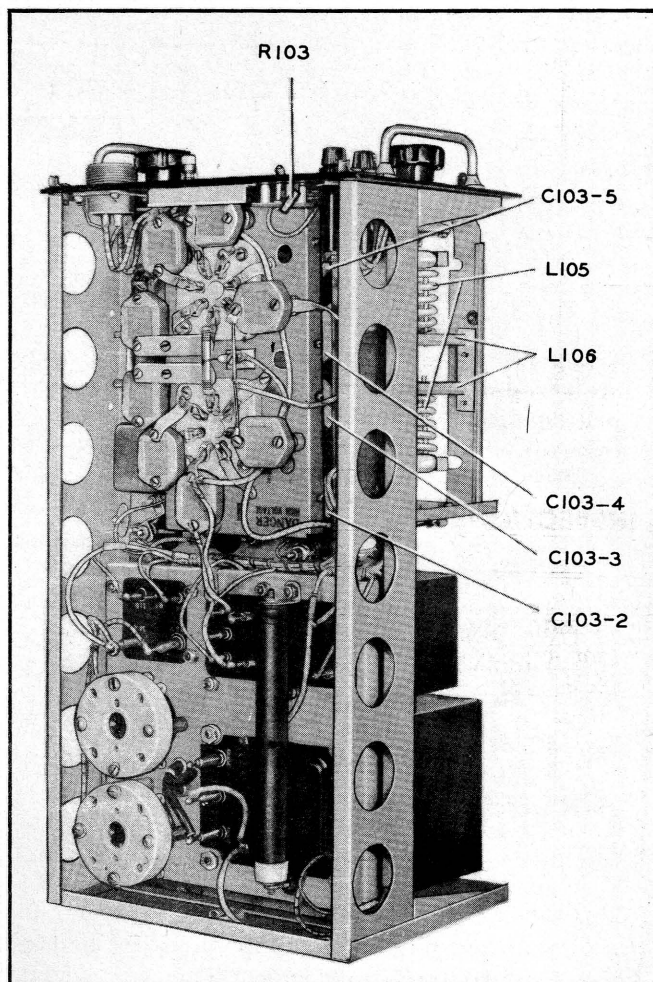


Figure 4-4. Radio Frequency Amplifier AM-14/APT—Bottom Viewed from Left

Two spare fuses are mounted on the front panel. (See fig. 1-1.)

7. "OUT. IND." LAMP.

The "OUT. IND." lamp is a small pilot light arranged in series with a low capacity variable condenser and connected across the r-f output to the antenna connector. The brightness of the lamp is an indication of transmission line output power. (See fig. 1-1.)

SECTION V MAINTENANCE

WARNING

When the chassis is removed from the case, avoid contact with the deck plate. The deck plate is painted red to warn personnel of the existence of high voltage.

I. INSPECTIONS.

IMPORTANT

Periodic inspections prescribed herein represent minimum requirements. If, because of local conditions, peculiarities of equipment, or abnormal usage they are found insufficient to assure satisfactory operation of equipment, local authorities should not hesitate to increase their scope or frequency.

a. PREFLIGHT TESTS.

(1) Turn on the driver-transmitter according to instructions in the corresponding handbook of maintenance instructions for this equipment.

(2) Turn the "FILAMENT" switch of the amplifier to the "ON" position, and wait about 40 seconds before proceeding. Listen for operation of the fan motors located inside the equipment.

(3) Turn the "PLATE" switch to the "ON" position.

(4) See if the "OUT. IND" lamp on the amplifier is lighted. Adjust the lamp to a low brilliance by the "OUT. IND. ADJ." screw. If necessary, remove the lamp-assembly cover to see if the lamp is lighted.

(a) If the lamp is not lighted, turn the "OUT. IND. ADJ." screw through its range to see if this is changing the brilliance.

(b) If the lamp still does not light, replace the "115V" fuse.

(5) When the preceding tests are completed, turn the "FILAMENT" and "PLATE" switches to the "OFF" position. Turn the transmitter off.

b. DAILY INSPECTION.

(1) Inspect the fuses. (*Refer to paragraph 7, this section.*)

(2) Inspect the tubes to see that they are firmly in place, and that top connections are secure.

(3) Inspect the pilot lamp to see that it is firmly in place.

(4) Inspect the grid and plate rolo coils to be sure that the rollers are in the proper position on the coils and that they are making good contact with the coils. If the rollers are not an equal number of turns from the center, adjust them as directed in paragraphs 5 and 6, this section.

c. 25-HOUR INSPECTION.

(1) Inspect the fuses. Replace them if defective. (*Refer to par. 7.*)

(2) Check the vacuum tubes in a transmitter known not to be operative to see that they are in good condition. See that they are firmly in place. Replace any weak tubes.

(3) Check the pilot light to see that it is in place and operative.

(4) Inspect the grid and plate rolo coils for dirt and corrosion. Clean the coils with carbon tetrachloride or equivalent.

(5) Inspect the grid and plate rolo coils for proper position of the rollers on the coils and to see that the rollers and the stationary brushing contacts are making good contact with the coils. If the rollers are not an equal number of turns from the center, adjust them as directed in paragraphs 5 and 6, this section.

(6) Inspect the transformer terminals for dirt, corrosion, and cracked or broken glass insulators. If the insulators are badly damaged, replace the transformers. Cracked insulators, if not serious, may affect only the altitude limit of the equipment and may not necessitate replacement of the transformers.

d. 250-HOUR INSPECTION.

(1) Make a complete 250-hour inspection of the equipment.

(2) Using Radio Frequency Wattmeter TS-118/AP (if available), test the output of the transmitter following the instructions given in paragraph 8, this section.

(3) If the power output is less than 70 watts, recheck the vacuum tubes and the rolo coils.

(4) If neither the tubes nor the coils are at fault, completely overhaul the equipment as directed in paragraph 9, this section.

2. TROUBLE LOCATION CHART.

WARNING

If resistance R105 opens up the high voltage appears on coil L105.

<i>Trouble Indication</i>	<i>Checks</i>
<p>a. No plate voltage.</p>	<p>Check the fuses.</p> <p>Check the resistance of grid resistor R104.</p> <p>Check the resistance of bleeder resistor R101.</p>
<p>b. The color of the plate of one tube becomes much brighter than that of the other; the unit fails to tune properly; the power output is low.</p>	<p>Check the grid input rolo coil to see that the contact wheel is in proper position on the coil and that it is making good contact with the coil. Check for possible shorting on one side. If there is need for adjustment, refer to paragraph 6, this section. Change the tubes V102, if this condition persists, to see if the condition is caused by tube irregularities.</p>
<p>CAUTION</p>	
<p>TAKE CARE NOT TO DAMAGE THE PLATES OF THE AMPLIFIER TUBES V102 WHEN REMOVING THE FAN STOCK CLIPS.</p>	
<p>c. The amplifier refuses to take power from the driver.</p>	<p>Check the radio frequency connections on the cable connecting the amplifier to the driver.</p>
<p>d. There are signs of insufficient output as indicated by the "OUT. IND." lamp (the lamp will give only a dim light or fail to light at all), or the amplifier fails to tune.</p>	<p>Check the position of the rollers on the plate and grid rolo coils. If adjustment of the rollers is necessary, adjust as directed in paragraphs 5 and 6, this section.</p>
<p>e. The equipment fails to operate at high altitudes.</p>	<p>Check the transformers for broken or cracked insulator.</p>
<p>f. The blower motors do not run.</p>	<p>Check the fuses.</p>
<p>g. The "OUT. IND." lamp fails to light after it has been tested and found operative.</p>	<p>Check the fuses.</p>

3. VOLTAGE AND RESISTANCE MEASUREMENTS.

WARNING

Voltmeter leads and the voltmeter may be 2000 volts d-c or 4000 volts a-c above the chassis ground. Stay away from the voltmeter and leads after turning on voltage.

See figure 5-1 for the voltage and resistance values measured at the tube socket. These values were measured with a 20,000 ohms-per-volt d-c meter and a 1000 ohms-per-volt a-c meter with all tubes in their sockets.

4. ALLEN WRENCHES.

There are three Allen wrenches (*see fig. 4-1*), located behind the radio frequency unit of the amplifier, to be used for the following purposes:

a. To remove the "PLATE" and "GRID TUNING" knobs and to remove capacitor C103 and capacitor C105.

b. To adjust the coupling setscrew between the "PLATE TUNING" knob and the plate rolo coils.

c. To adjust the coupling setscrew between the "PLATE TUNING" knob and the plate rolo coils.

5. ADJUSTMENT OF PLATE ROLO COIL.

a. Take the amplifier out of the dust cover after removing the two screws at the top on the front and loosening the Dzus fastener at the rear.

b. Loosen the locking thumbscrew at the side of the "PLATE TUNING" dial.

c. Turn the "PLATE TUNING" dial toward the high frequency end until it reaches the stop. (At this point the contact wheels should be at the outer ends of the coil.) Watch the contact wheels while turning the "PLATE TUNING" dial to be sure they do not reach the end of the coils and drop off before the dial reaches the stop.

CAUTION

Do not force the dial too far for the stops may be sheared off.

d. The contact wheels must always be an equal number of turns from the center of the coils and reach either end of the coil at the same time that the stop on the tuning dial is reached. A difference of even one turn between the positions of the rollers on the coil will cause a serious decrease in output. If the contact wheels are not in the proper position, loosen the two coupling setscrews with the Allen wrench located behind the radio frequency unit of the amplifier. Making sure the dial rests against the stop, adjust the contact wheels by carefully turning by hand the shaft on which the coil is mounted until the contact wheels reach the outer ends of the coil.

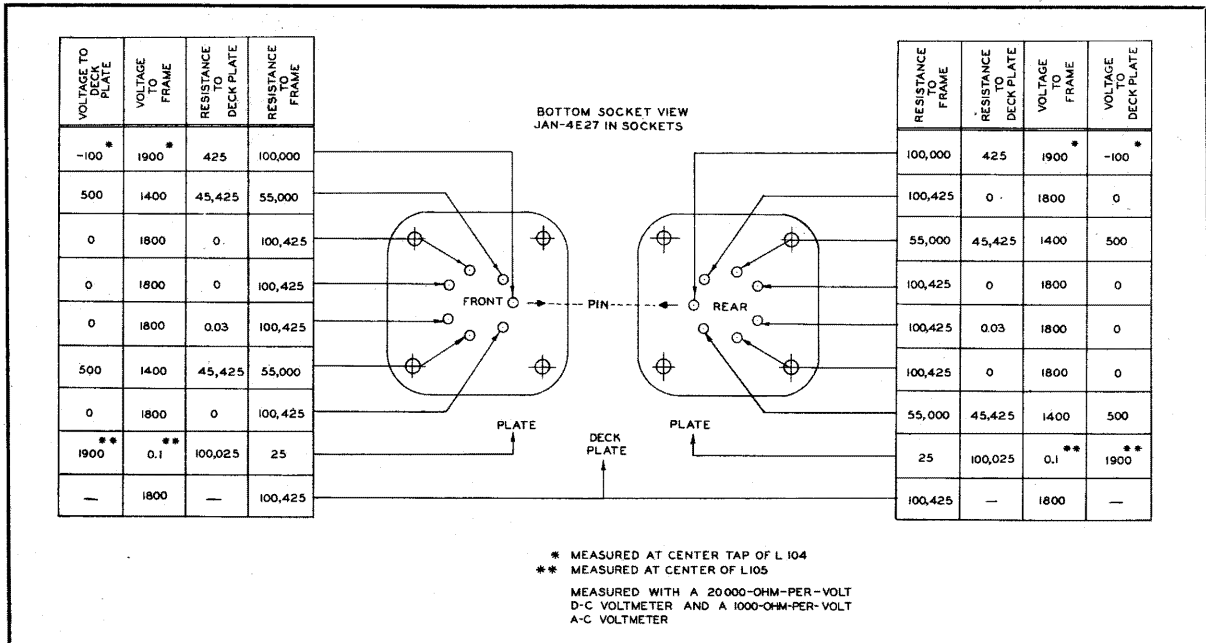


Figure 5-1. Radio Frequency Amplifier AM-14/APT—Voltage and Resistance Measurements

e. Tighten the coupling setscrews.

6. ADJUSTMENT OF GRID ROLO COIL.

a. Take the amplifier out of the dust cover after removing the two screws at the top on the front and loosening the Dzus fastener at the rear.

b. Loosen the locking thumbscrew at the side of the "GRID TUNING" dial.

c. Turn the "GRID TUNING" dial toward the low frequency end until it reaches the stop. (At this point the contact wheels should be at the inner ends of the coil.) Watch the contact wheels while turning the "GRID TUNING" dial to be sure they do not reach the end of the coils and drop off the wire before the dial reaches the stop.

CAUTION

Do not force the dial too far for the stops may be sheared off.

d. The contact wheels must always be an equal number of turns from the center of the coils and reach either end of the coil at the same time that the stop on the tuning dial is reached. A difference of even one turn between the positions of the rollers on the coil will cause a serious decrease in output. If the contact wheels are not in the proper position, loosen the universal joint coupling setscrew with one of the Allen wrenches. Making sure the dial rests against the stop, adjust the contact wheels by carefully turning by hand the shaft on which the coil is mounted until the contact wheels reach the inner ends of the coil.

e. Tighten the coupling setscrews.

7. REPLACEMENT OF FUSES.

The equipment contains one 1-ampere Type 4AG 250-volt fuse and one 10-ampere 4AG 250-volt fuse on the front panel. Spare fuses are also mounted on the front panel.

Note

The 10-ampere fuse goes in the 115-volt supply circuit and the 1-ampere fuse in the d-c circuit.

8. TEST OF TRANSMITTER POWER OUTPUT. (USING RADIO FREQUENCY WATTMETER TS-118/AP.)

a. Turn off the transmitter.

b. Plug the proper thermocouple unit into the "ANT." output connector of the amplifier.

Note

Three thermocouple units are supplied with Radio Frequency Wattmeter TS-118/AP. One has a power unit of 0-35 watts up to 750 megacycles, one has a power limit of 30 to 200 watts up to 750 megacycles, and the other 175 to 400 watts up to 750 megacycles. Use the medium range unit with Radio Frequency Amplifier AM-14/APT.

c. Connect Radio Frequency Plug UG-21/U (located on the end of the 10-foot high loss cable connected to the wattmeter) to the thermocouple unit.

d. Connect 24 to 28 volts d-c to the power connector on the wattmeter.

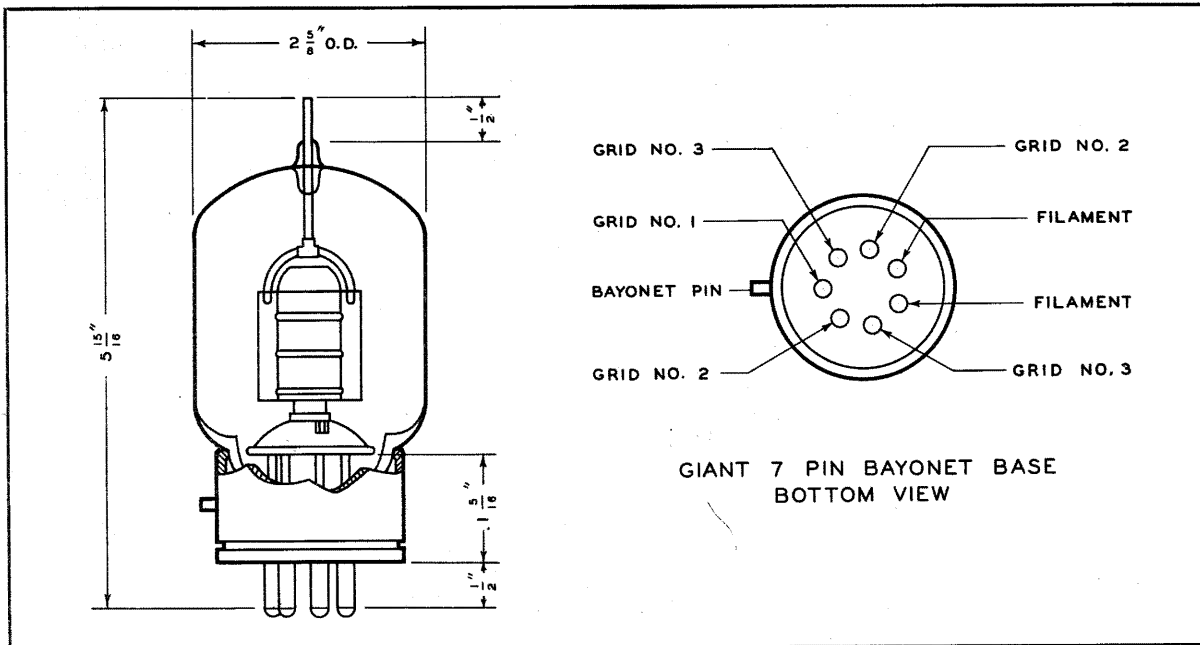


Figure 5-2. Tube JAN-4E27—Outline Dimensions and Bottom View of Socket

e. Turn the range switch on the wattmeter to the "ON" position. Listen for the blower motors in the wattmeter.

CAUTION

If no motors are heard do not operate as damage to the wattmeter will result.

f. Turn on the transmitting equipment and amplifier and tune as if an antenna were connected instead of the wattmeter. (Refer to sec. II, par. 6b.)

g. Using the calibration charts supplied with the wattmeter, read the power indicated on the 0-1 milliammeter on the wattmeter.

b. The output coupling is adjusted for maximum power output at 130 megacycles by moving coupling loop L106 with respect to L105. To move coupling loop L106, loosen screws holding it to frame and slide the whole assembly in the screw slots. The output of the driving transmitter must not be varied. The amplifier plate tuning must be adjusted constantly to counteract the detuning affect caused by moving L106. Optimum power output for a given frequency is approximately 180 watts at about 1 to 2 megacycles bandwith, but the final setting of L106 should provide the best overall coupling for broad-band operation.

Note

The amplifier will oscillate with no load in the grid circuit. It will not oscillate, however, during normal operation. A satisfactory dummy load for the grid circuit is a 50-ohm resistor.

9. COMPLETE OVERHAUL OF EQUIPMENT.

a. Check all fuses and pilot lamps.

b. Test all tubes in another equipment known to be good. Low cathode current indicates the end of the useful life of a tube. (See figs. 5-2 and 5-3.)

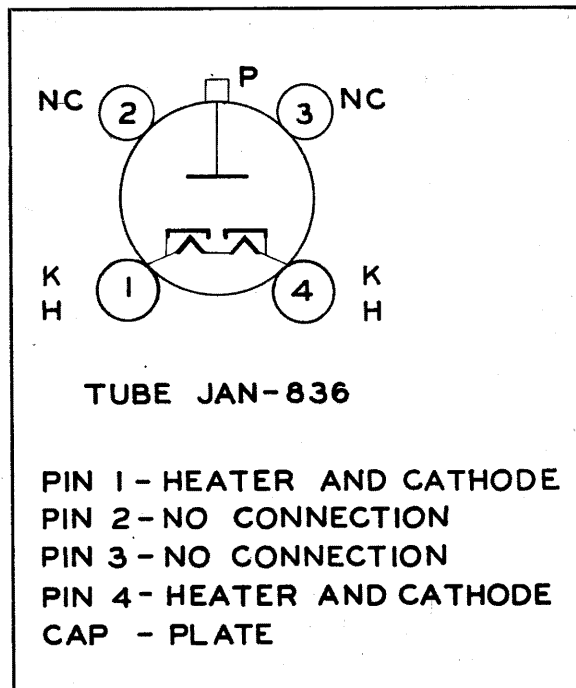


Figure 5-3. Tube JAN-836—Socket Connections

- c. Check the rolo coils as directed in paragraphs 5 and 6, this section.
- d. Check the transformers for cracked or broken insulators.
- e. Measure the resistance at the tube sockets, and compare with the values given in paragraph 3, this section. (See figs. 5-2 and 5-3.)

- f. Measure the voltage at the tube sockets, and compare with the values given in paragraph 3, this section. (See figs. 5-2 and 5-3.)
- g. Tune for spot-frequency or broad-band operation as instructed in section II, paragraph 6b or 6c.
- b. Check the output power with Radio Frequency Wattmeter TS-118/AP, if available as directed in paragraph 8, this section.

SECTION VI SUPPLEMENTARY DATA

I. TUBE COMPLEMENT.

Quantity	Type Designation	Function
2	JAN-4E27	Amplifier
2	JAN-836	Rectifier

2. SPECIFICATIONS.

- Frequency range 85-150 megacycles
- Bandwidth..... 3 to 4.5 megs. or 2 to 2.5 megs.
- R-F power outputs.....100-180 watts
- R-F driving power.....5-10 watts
- A-C power input... 650 watts at either 80 or 115 volts
400-2600 cycles per second
- Power factor0.80
- D-C power input..... 28 watts at 24 volts

3. RADIO FREQUENCY WATTMETER TS-118/AP.

- a. Radio Frequency Wattmeter TS-118/AP is an untuned wattmeter of the thermocouple type used for checking the output of a radio frequency amplifier. The wattmeter provides a load for a transmitter equivalent to the load supplied by the antenna and a 50-ohm transmission line.
- b. The wattmeter has 3 power ranges: 0 to 35 watts, 30 to 200 watts, and 175 to 400 watts.
- c. The meter does not radiate interfering energy beyond 30 feet.
- d. Refer to the handbook of maintenance instructions for the wattmeter for details of constructions and theory of operation.

4. AMPLIFIER ALIGNMENT UNIT TS-92/AP.

- a. Amplifier Alignment Unit TS-92/AP consists of an untuned r-f pickup probe antenna, a crystal detector, a selective amplifier tunable from 1/2 to 7 megacycles, a demodulator, and an output meter. (Refer to the handbook of maintenance instructions for details of theory and constructions.)
- b. A-C power required for the bandwidth indicator is 50 watts at 110 volts, 60 to 2600 cycles-per-second. The frequency range is 20 to 250 megacycles.

5. TUBE RATINGS (MAXIMUM ALLOWABLE PER TUBE).

a. JAN-4E27

- D. C. plate voltage.....2000 volts
- D. C. plate current.....150 ma.
- D. C. suppressor voltage.....80 volts
- D. C. suppressor current......8 ma.
- D. C. screen voltage.....500 volts
- D. C. control grid voltage.....500 volts
- D. C. control grid current......25 ma.
- Plate dissipation.....75 watts
- Filament voltage.....5.0 volts
- Filament current.....7.5 amps.
- Plate-grid0.04 mmfd.
- Input capacity.....13.8 mmfd.
- Output capacity.....6.7 mmfd.

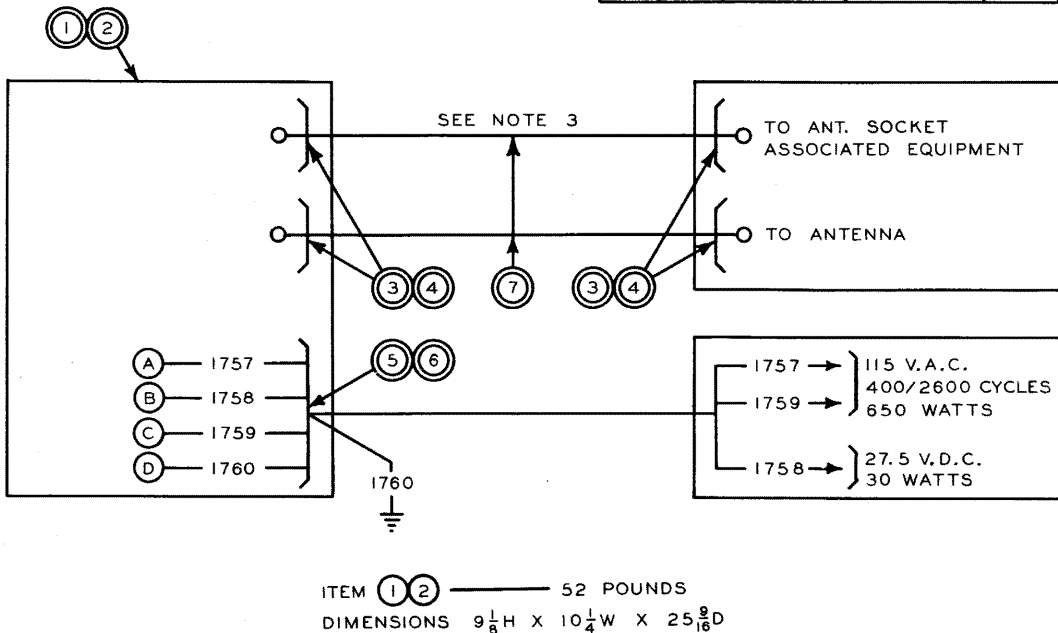
b. JAN-836

- Heater voltage..2.5 volts (heating time 40 seconds)
- Heater current.....5.0 amps.
- Peak inverse voltage.....5000
- Peak plate current.....1.0 amp.
- Average plate current.....250 ma.

ITEM	EQUIPMENT	NO. REQ'D	NOMENCLATURE
* 1	RADIO FREQUENCY AMPLIFIER	1	SEE NOTE 2
* 2	MOUNTING	1	MT-171/U
* 3	RADIO FREQUENCY PLUG	4	UG-21/U
* 4	RADIO FREQUENCY ADAPTER	AS REQ'D	UG-27/U
* 5	PLUG	1	AN3108-22-4S
* 6	ADAPTER	1	AN3057-12
* 7	RADIO FREQUENCY CABLE	AS REQ'D	RG-8/U

* INDICATES GOVERNMENT FURNISHED EQUIPMENT

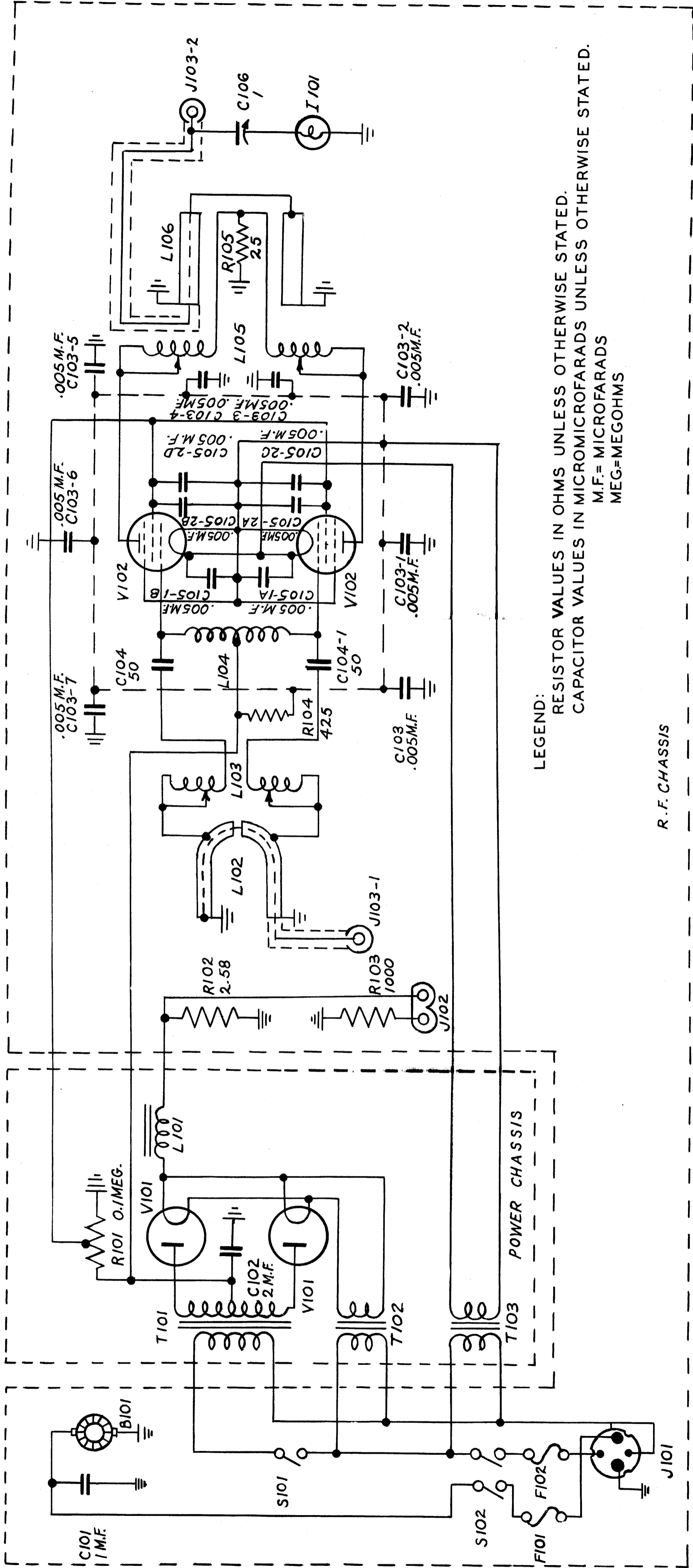
WIRE TABLE				
ALL WIRES TO BE PER SPEC. AN-J-C-48 UNLESS OTHERWISE SPECIFIED. WIRE SIZES MARKED + TO BE INDIVIDUALLY SHIELDED PER SPEC. 95-27273. ALLOWABLE VOLTAGE DROP TO BE IN ACCORDANCE WITH SPEC. 95-32310 UNLESS OTHERWISE SPECIFIED.				
REF. NOTE	WIRE NO.	MAXIMUM VOLTAGE IN WIRE	MAXIMUM ALLOWABLE RESISTANCE IN WIRE	WIRE SIZE
4	1757	115 A.C.	.08	AN-20
	1758	28 D.C.	.09	AN-20
4	1759	115 A.C.	.08	AN-20
	1760	0	.02	AN-20



NOTES-1:

- ALL TERMINAL STRIPS REQUIRED IN THE INSTALLATION OF THE WIRING SHALL BE MADE OF SUITABLE INSULATING MATERIAL AND WITH TERMINAL SPACING TO PROVIDE PROTECTION AGAINST VOLTAGE BREAKDOWN.
- 2: WIRING FOR RADIO FREQUENCY AMPLIFIER AM-14/APT AND RADIO FREQUENCY AMPLIFIER AM-18/APT IS INTERCHANGEABLE.
- 3: THIS CABLE BETWEEN UNITS SHALL NOT BE LONGER THAN 2 FEET.
- 4: WIRES 1757 AND 1759 SHALL BE SHIELDED WHEN ROUTED CLOSE TO AND PARALLEL WITH SKIN OF PLANE FOR DISTANCE GREATER THAN 3 FEET.

Figure 8-3. Radio Frequency Amplifier AM-14/APT—Cabling Diagram



LEGEND:
 RESISTOR VALUES IN OHMS UNLESS OTHERWISE STATED.
 CAPACITOR VALUES IN MICROMICROFARADS UNLESS OTHERWISE STATED.
 M.F.= MICROFARADS
 MEG.=MEGOHMS

R. F. CHASSIS

Figure 8-5. Radio Frequency Amplifier AM-14/APT—Schematic Diagram