Section 3

ADJUSTMENT AND OPERATION

3.1. INITIAL ADJUSTMENT.

3.1.1. LOCATION OF CONTROLS. (Refer to figures 3-1 and 7-14.) - The 20V controls are all accessible from the front of the transmitter. With the doors closed, only the FILAMENT ON-OFF switch (left) and the PLATE ON-OFF switch (right) and the FILAMENT ON and PLATE ON pilot lamps are visible.

With the two access doors open, the POWER CHANGE switch, and the MULTIMETER switch on the left and the PA TUNING and PA LOADING controls on the right are accessible. These are the controls most used in normal operation.

For further adjustment on the transmitter, there are controls mounted behind small removable covers located on the control panels. Removing the upper left cover exposes the Modulator Bias adjustments. Removing the lower left cover exposes the Audio Balance control. Removing the upper right cover exposes the RF Driver plate tank can and the Audio Hum adjustments. Removing the lower right cover exposes the two crystal trimmer adjustments, the Crystal Selector switch and the Oscillator and Buffer plate circuit rf cans.

3.1.2. FUNCTION OF CONTROLS. -

(a) CIRCUIT BREAKERS AND SWITCHES. (Refer to figure 7-14 for location.) -

(1) FILAMENT ON-OFF Switch. - The FILAMENT ON-OFF switch, S-106, is a toggle type magnetically operated circuit breaker. When placed in the ON position, it energizes the filaments, the bias supply, the blower motor, the thermal time delay and the lumiline meter lights. The thermal time delay relay, K-101, has a delay period which is adjustable from 10 to 45 seconds. At the end of this period and provided all interlocks are closed, the plate contactor relay coil, K-102, is energized closing the plate contactor and bringing on the FILAMENT ON pilot lamp indicating a readiness for plate power.

(2) PLATE ON-OFF Switch. - The PLATE ON-OFF switch, S-107, is a toggle type magnetically operated circuit breaker similar to the FILAMENT ON-OFF switch. It energizes the high and low voltage transformer primaries provided, however, that the filaments have been on the required length of time and that the plate contactor, K-102, is closed. If desired, the FILAMENT ON-OFF switch and the PLATE ON-OFF switch may be thrown to the ON position at the same time. In this case the high and low voltage supplies will come on automatically at the end of the filament time delay and the PLATE ON pilot lamp will glow indicating that full operating condition has obtained.

(3) MULTIMETER Switch. - The MULTIMETER switch, S-102, is a two pole eight position switch which inserts the MULTIMETER, M-104, into the various circuits which are to be metered. Provisions are made to use the MULTIMETER for metering the cathode currents of the Oscillator, Buffer, RF Driver, 1st Audio and the Audio Driver stages, and the grid currents of the Buffer, RF Driver and Power Amplifier stages.

(4) POWER CHANGE switch, S-103, provides for a power change from 500 to 1000 watts. For full power operation at 1000 watts output, the POWER CHANGE switch shorts out the dropping resistance which is in series with the high voltage lead and allows the full high voltage to be applied to the Power Amplifier tube plates.

(5) Crystal Selector switch. - The Crystal Selector switch, S-101, is a screwdriver adjustment which selects the crystal to be inserted into the oscillator circuit. When the switch is turned to the left, the crystal on the left side of the chassis, Y-101 is placed in operation.

(b) ADJUSTMENT CONTROLS. (Refer to figure 3-1.) -

(1) Modulator Bias Control. - The Modulator Bias controls, R-162 and R-163, are screwdriver adjustments which adjust the amount of negative bias applied to the grids of the Modulator tubes. Turning the controls clockwise increases the amount of bias applied to the tubes. The left hand control is the bias adjustment for the front modulator tube and the right hand control is the bias adjustment for the rear modulator tube.

(2) Audio Balance Control. - The Audio Balance control, R-146, is a potentiometer in the cathode circuit of the Audio Driver stage. Its function is to decrease the distortion caused by unbalance in the audio section of the transmitter.

(3) Audio Hum Controls. - Audio Hum Control A, R-182, is used to adjust the drive to the power amplifier for minimum ac noise level.

Audio Hum Control B, R-120, is a potentiometer connected across the filaments of the Power Amplifier stage. It is a screwdriver adjustment which minimizes the hum caused by the ac filament voltage

and low voltage rectifier tubes, V-113 through V-116, making sure that they hang free and are not near or touching any metal parts of the transmitter.

Inspect all door interlocks making certain that the male member is free by pressing on the contact blocks until the spring is completely compressed and then releasing the pressure. If the contact blocks do not spring out to their original position check the interlock carefully and adjust it until it operates properly.

Using an ohmmeter, check for continuity between terminals 2 and 3 on terminal board E-101. These terminals connect to the door interlocks, S-108 and S-109. The meter should indicate an open circuit when either one or both of the rear doors are open. Check for continuity between terminals 1 and 3 on terminal board E-101. These terminals connect to the blower interlock, S-110. The meter should indicate an open circuit. Now, lift the arm of the blower interlock and again check for continuity between terminals 1 and 3. The meter should now indicate a short circuit.

(b) Power Circuit Check. - Having checked the interlocks and connections as in paragraph 3.1.3.(a) above, proceed with the check of the Power circuit as follows:

(1) Close all of the cabinet doors tightly.

(2) Throw S-106, the FILAMENT ON-OFF switch, to the ON position. The lumiline meter lights, the filaments, the blower motor, and the bias supply should all come on instantly. Approximately 30 seconds later, the thermal time delay relay, K-101, should close energizing the plate contactor relay, K-102. The thermal time delay is adjustable from 10-45 seconds by means of R-171. In the event the delay period is longer or shorter than 30 seconds, adjust R-171. Turn R-171 to the left to shorten the time delay period and to the right to lengthen it. Any check of the period should be performed from a cold start since the relay will operate more quickly if it is still warm from a previous trial. The FILAMENT ON pilot lamp should come on as soon as the plate contactor relay is energized. When the plate contactor relay is energized, it readies the circuits for the application of plate power. The bias supply may be checked by opening one of the rear doors and checking the voltage from terminal 9 on E-101 to ground. It should be approximately 110 volts negative with respect to ground.

(3) Throw the PLATE ON-OFF switch, S-107, to the ON position. The PLATE ON pilot lamp should come on immediately.

(4) This completes the power circuit check. If any difficulty is encountered in obtaining the results specified in the procedures above, refer to Section 5, Corrective Maintenance.

(5) Throw the FILAMENT ON-OFF switch and the PLATE ON-OFF switch to the OFF position.

3.1.4. MERCURY VAPOR RECTIFIER TUBES. - To permit the proper conditioning of mercury vapor rectifier tubes, the filaments should be excited for a period of twenty minutes before the application of any plate power. This can be accomplished by allowing one of the cabinet doors to remain open with the filaments of the tubes excited, thus preventing the operation of the power control relay during the conditioning process. This aging procedure is required only in the case of new tubes or of old tubes which have been agitated or inverted and then replaced. This aging process is necessary in order to remove the mercury coating from the elements. If it is desired to have replacement rectifier tubes available for immediate use, they should be inserted in the equipment, aged, and carefully removed and stored in an upright position until needed. With short interruptions in service, not necessitating a change in rectifier tubes, the time delay relay will automatically provide an adequate time interval. If a cold rectifier tube is placed in the equipment, it is recommended that the filament power be on for at least 20 seconds before the application of plate power.

3.1.5. TUNING ADJUSTMENT. -

(a) Alignment of rf Section. -

(1) Remove the modulator tubes from the equipment, and recheck to see that the plate cap leads of the high voltage rectifier tubes, V-113 and V-114, are still hanging free. The low voltage rectifier tube plate caps should be replaced on their respective tubes, V-115 and V-116.

NOTE

OPERATION OF THIS EQUIPMENT INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. OPERATING PERSONNEL SHOULD AT ALL TIMES OBSERVE PROPER SAFETY PRECAUTIONS. DO NOT CHANGE TUBES OR MAKE ADJUSTMENTS INSIDE OF THE EQUIPMENT WITH THE HIGH VOLTAGE APPLIED. DO NOT DEPEND UPON THE DOOR INTERLOCKS FOR PROTECTION. ALWAYS SHUT DOWN EQUIPMENT WHEN MAKING ADJUSTMENTS.

(2) Rotate the Crystal Selector switch, S-101, to the desired position.

(3) Throw the FILAMENT ON-OFF and PLATE ON-OFF switches, S-106 and S-107, to their ON positions.

(4) Rotate the MULTIMETER switch, S-102, to the first four positions and check the MULTIMETER readings with those given in table 3-1. The full scale reading of the MULTIMETER is indicated for each position of the MULTIMETER switch.

(5) Rotate the MULTIMETER switch to the position designated 807 GRID, 25 MA. The 807 RF Driver grid current will have to be adjusted for a peak reading by adjusting the Buffer plate tank trimmer capacitors, C-114 and C-115. The Buffer plate circuit is mounted in the left hand rf can located behind the lower right insert cover.

NOTE

TO OBTAIN MAXIMUM FREQUENCY COVERAGE PER CAN IN THE AM BROADCAST BAND, THE TRIMMING CAPACITORS ARE IN PARALLEL. SET ONE CAPACITOR IN A POSITION THAT GIVES A GOOD TUNING RANGE WITH THE OTHER CAPACITOR. SEAL THE FIRST CAPACITOR OPENING WITH SCOTCH TAPE.

TABLE 3-1. TYPICAL METER READINGS

Switch	Switch Position	Meter	Meter Reading
MULTIMETER SWITCH	1ST AUDIO CATH. 25 MA.	MULTIMETER	4 ma.
MULTIMETER SWITCH	2ND AUDIO CATH. 25 MA.	MULTIMETER	14 ma.
MULTIMETER SWITCH	OSC. CATH. 25 MA.	MULTIMETER	4 ma.
MULTIMETER SWITCH	1ST BUFF. GRID. 2.5 MA.	MULTIMETER	0.1 ma.
MULTIMETER SWITCH	1ST BUFF. CATH. 25 MA.	MULTIMETER	6.5 ma.
MULTIMETER SWITCH	807 GRID 25 MA.	MULTIMETER	1 ma.
MULTIMETER SWITCH	807 CATH. 250 MA.	MULTIMETER	55 ma.
MULTIMETER SWITCH	P.A. GRID 25 MA.	MULTIMETER	20 ma.
POWER CHANGE	LOW (550 w)	MOD. PLATE CURRENT	
		static	120 ma.
		100% mod.*	320 ma.
POWER CHANGE	LOW (550 w)	P.A. PLATE VOLTAGE	2200 volts
POWER CHANGE	LOW (550 w)	P.A. PLATE CURRENT	330 ma.
POWER CHANGE	LOW (550 w)	R.F. LINE CURRENT	
		70 ohm antenna	2.8 amps
		50 ohm antenna	3.3 amps
POWER CHANGE	HIGH (1100 w)	MOD. PLATE CURRENT	
		static	120 ma.
		100% mod.*	450 ma.
POWER CHANGE	HIGH (1100 w)	P.A. PLATE VOLTAGE	3100 volts
POWER CHANGE	HIGH (1100 w)	P.A. PLATE CURRENT	500 ma.
POWER CHANGE	HIGH (1100 w)	R.F. LINE CURRENT	
		70 ohm antenna	3.95
		50 ohm antenna	4.7

* With 1000 cycle sine wave.

(6) Turn the MULTIMETER switch to the position designated 1st BUFFER CATHODE, 25 MA, and check the reading with those given in Table 3-1.

(7) Turn the MULTIMETER switch to the position designated PA GRID, 25 MA. Adjust the two Driver plate trimmer capacitors, C-125 and C-126, in the same manner as described above, to obtain maximum Power Amplifier grid current as indicated on the MULTIMETER.

(8) Throw the PLATE ON-OFF switch, S-107, to OFF and replace the plate caps on the high voltage rectifier tubes, V-113 and V-114.

(9) Replace the Modulator tubes and turn the two bias adjustment controls, R-162 and R-163, to their maximum clockwise position. This should be maximum negative bias as indicated by a decrease in Modulator Plate current.

(10) Adjust the clip on the modulation monitoring coil, L-110, located in the rf compartment, to a position near the ground end of the coil.

(b) Power Amplifier Plate Tuning and Loading.

(1) Turn the POWER CHANGE switch, S-103, to the LOW position.

(2) Set PA LOADING at minimum by turning the PA LOADING control, C-147, to 100 on the dial.

(3) Throw FILAMENT ON-OFF and PLATE ON-OFF switches to their ON positions.

(4) As soon as the PLATE ON pilot lamp comes on, adjust the PA TUNING control, C-146, for minimum Power Amplifier plate current as indicated on PA PLATE CURRENT meter, M-102.

(5) Turn the MULTIMETER switch to the position designated PA GRID, 25 MA, and retune the 807 RF Driver plate tank for maximum Power Amplifier grid current as indicated on the MULTIMETER.

(6) Adjust the Modulator Bias Adjustment controls in the following manner. Visually observe the color of the modulator tubes and adjust the two controls, R-162 and R-163, until the two tubes appear to have the same color, making certain that after the final adjustments, the total plate current remains at 120 ma.

(7) Turn the POWER CHANGE switch, S-103, to the HIGH position.

(8) Immediately make certain the the Power Amplifier is tuned to resonance. If not, adjust the PA TUNING control to obtain minimum plate current as indicated on PA PLATE CURRENT meter, M-102.

(9) Retune the 807 RF Driver plate tank circuit, if necessary. (See step (5) above.)

(10) Increase the loading by reducing the capacity of the PA LOADING capacitor, C-147, while simultaneously retuning the Power Amplifier plate circuit to resonance by means of the PA TUNING control. The type of output network employed in the 20V detunes the plate circuit as the loading is changed thereby causing the plate current to soar. The best procedure in loading is to adjust the two controls simultaneously as mentioned above. However, it may also be accomplished by first increasing the loading slightly, then retuning the plate circuit to resonance, and repeating this procedure until the RF Line current, as indicated on M-101, is slightly less than the amount necessary to obtain the desired power output, when the Power Amplifier plate circuit is in resonance.

(11) Detune the Power Amplifier plate circuit very slightly to the side of resonance which yields an increase in the RF LINE CURRENT meter reading. The Power Amplifier plate current will also increase slightly; however, the increase in power to the rf line will be greater than the increase in Power Amplifier input power, thus yielding a higher plate efficiency.

(12) Adjust the PA LOADING and PA TUNING controls to the point where the desired amount of RF Line Current is obtained with the highest operating efficiency. This will always result with the Power Amplifier plate circuit slightly detuned.

(c) Audio Adjustments. - There are only five adjustments which need to be made in regard to audio frequencies. These include the two Modulator Bias Adjustments, the Cathode Balance control in the Audio Driver stage, and the audio hum adjustments. The following adjustments are to be made with the transmitter operating as in paragraph 3.1.5.(b)(12) above.

NOTE

BEFORE PROCEEDING WITH STEP (1) BELOW, IT WILL BE NECESSARY TO READJUST THE MODULATION MONITORING TAP ON L-110 TO OBTAIN THE DESIRED OUTPUT TO THE MODULATION MONITORING EQUIPMENT.

(1) Distortion. - Inject a 1000 cycle signal of sufficient amplitude to modulate the rf carrier 95%. Adjust the Cathode Balance control, R-146, and the two Modulator Bias adjustment controls R-162 and R-163, to obtain minimum distortion as indicated on a distortion analyzer, without exceeding the 120 ma static plate current of the two modulator tubes.

(2) Hum and Noise. - Inject a 1000 cycle audio signal of sufficient amplitude to modulate the rf carrier 100%. Calibrate the noise meter and remove the modulation, and read the noise level. Adjust Audio Hum Control A, located to the right of the 807 plate tank, for minimum noise. Adjust Audio Control B, located to the left of the 807 plate tank, to further reduce the amplitude of the noise level.

3.2. ROUTINE OPERATION.

3.2.1. GENERAL. - The steps outlined in this section may be used as a guide to routine operation of the equipment, subsequent to completion of the initial adjustments. It is suggested that the operator refer to the adjustment section of this instruction book, paragraph 3.1.(a) through 3.1.(b) for a more detailed explanation in regard to the adjustment of the transmitter circuits. Control knobs and meter locations are shown in figure 7-14. It is assumed in the following procedures that the main station power switch is in the ON position.

3.2.2. STARTING THE EQUIPMENT.

(a) Check first to see that all doors are closed, and then throw the FILAMENT ON-OFF switch to the ON position.

(b) Check to see that the POWER CHANGE switch is in the proper position for the desired power output.

(c) Check to see that the desired crystal is in the circuit. The left hand crystal is selected when the switch is thrown to the left. The right hand crystal is selected when the switch is thrown to the right.

(d) Throw the PLATE ON-OFF switch to the ON position.

(e) Check the Power Amplifier plate current, the RF Line current, the Modulator cathode current, and the currents at all positions of the MULTIMETER switch. Check the PA plate voltage. Refer to Table 3-1 for typical meter readings.

(f) Make all necessary monitoring observations.

3.2.3. POWER CHANGE. - The power output of the 20V may be changed from 1000 watts to 500 watts by merely turning the POWER CHANGE switch to the LOW position. Minor corrections in power output are made by means of the PA TUNING and PA LOADING controls. It is not necessary to shut the plate power off during the change.