SECTION 5

MAINTENANCE

5.1. INSPECTION.

5.1.1. GENERAL. - This radio equipment has been constructed of materials considered to be the best obtainable for the purpose and has been carefully inspected and adjusted at the factory to reduce maintenance to a minimum. However, a certain amount of checking and servicing will be necessary to maintain efficient and dependable operation. The following section has been written to aid in checking the equipment.

5.1.2. ROUTINE INSPECTION. - Routine inspection schedules should be set up for periodic checks of this equipment. This inspection should include examination of the mechanical system for excessive wear or binding and of the electrical system for electrical defects and deterioration of components.

If the routine inspection of the equipment is carried out faithfully, the chances of improper operation of the equipment are greatly minimized. It is suggested that this inspection be made as frequently as possible and it should be sufficiently thorough to include all major electrical circuits of the equipment as well as the mechanical portion.

(a) CLEANING. - The greatest enemy to uninterrupted service in equipment of this type is corrosion and dirt. Corrosion, itself, is accelerated by the presence of dust and moisture on the component parts of the assembly. It is impossible to keep moisture out of the equipment in certain localities, but foreign particles and dust can be periodically removed by means of a soft brush and a dry, oil-free jet of air. Remove the dust as often as a perceptible quantity accululates in any part of the equipment. It is very important that rotating equipment, such as variable condensers and tap switches, be kept free from dust to prevent undue wear. Likewise, variable condenser plates should be kept free from dirt to avoid flashover.

One of the greatest sources of trouble in equipment located in a salt atmosphere is corrosion. Corrosion resulting from salt spray or salt laden atmosphere may cause failure of the equipment for no apparent reason. In general, it will be found that contacts such as tap switches, tube prongs, cable plug connectors, and relay contacts are most affected by corrosion. When it is necessary to operate the equipment in localities subject to such corrosive atmosphere, inspection of wiping contacts, cable plugs, relays, etc., should be made more frequently in order to keep the equipment in good condition.

(b) VACUUM TUBES. - Make a check of emission characteristics of all tubes. After the emission check, examine the prongs on all tubes to make sure that they are free from corrosion. See that all tubes are replaced correctly and fully in their sockets, and a good electrical contact

is made between the prong of the tube and the socket. Use caution in removing and replacing grid or plate caps on tubes so equipped. Before a tube is discarded, make certain that the tube is at fault and the trouble is not a loose or broken connection within the equipment. A complete set of tested tubes of the same type specified should be kept on hand at all times. If faulty operation of the transmitter is observed and tube failure suspected, each tube may be checked by replacing it with a tube known to be in good condition. Defective tubes causing an overload in power circuits may usually be located by inspection. It will be found that excessive heating or sputtering within the vacuum tubes is a good indication of a fault in the tube circuit.

If tubes have been in use for a period of time equal to or exceeding the manufacurer's tube life rating, it is suggested that they be replaced. A marked improvement in the performance of the equipment is usually noticeable after the weak tubes have been replaced.

(c) PRECAUTIONS FOR SATISFACTORY TUBE LIFE.

(1) Before any tube is removed from the equipment, make certain the primary power is disconnected from the equipment.

(2) Operate all tubes within ±5% of rated filament voltage.

(3) Do not exceed the rated plate current of any tube during normal operation of the equipment.

(d) TUBE REPLACEMENT PRECAUTIONS.

(1) All tubes are removed by pulling them straight away from the chassis.

(2) Remove plate cap connectors, from tubes so equipped, with great care to prevent breaking the seal around the plate cap.

(3) Before a tube is inserted, make certain that the type of tube is correct for the socket into which it is being placed.

N O T E

Changing master oscillator tubes (V001) may cause a slight change in master oscillator calibration.

(e) TUBE TABLE.

SYMBOL	TYPE	FUNCTION	RATED FIL. VOLTAGE
V001	6SJ7	Master oscillator	6.3
V101	6AK6	Buffer amplifier	6.3
V102	6AG7	Frequency multiplier	6.3
V103	7C5	Frequency multiplier	6.3

TUBE TABLE

SYMBOL	TYPE	FUNCTION	RATED FIL. VOLTAGE
V104	705	Frequency multiplier	6.3
V105	4D32	Power Amplifier	6.3
V201	6SL7	Audio Amplifier	6.3
V202	6SN7	Audio driver	6.3
V203	807	Modulator	6.3
V204	807	Modulator	6.3
V205	6SL7GT	Sidetone Oscillator	6.3
V301	5Z4	LV Rectifier	5.0
V302	5R4GY	HV Rectifier	5.0
V303	5R4GY	HV Rectifier	5.0
V304	VR75	Bias Regulator	---
V305	0A2	Screen Voltage Limiter	---
V306	0A2	Screen Voltage Limiter	---

(f) RELAYS. - All relays should be inspected at regular intervals. Check the contacts for proper alignment, pitting and corrosion. Use a burnishing tool to clean contacts - never use sandpaper or emery cloth.

5.2. TROUBLE SHOOTING.

5.2.1. GENERAL. - The most general cause of improper operation of radio equipment is tube failure. Refer to paragraph 5.1.2., (b) in this section for comments concerning vacuum tube replacement. Defective tubes causing an overload in power circuits may usually be located by inspection. High voltage arcs may be caused by bent condenser plates, corrosion or dust. Corrosion resulting from operating the equipment in a salt laden atmosphere may cause failure of the equipment for no apparent reason.

In general, trouble encountered in radio apparatus may be isolated by means of various tests and measurements, and the section of the transmitter determined in which the trouble is located. If this is done, the components in the associated circuit may be checked and the trouble located. Refer to the tables of meter readings and resistance measurements.

No one but an authorized and competent service man equipped with proper test facilities should be permitted to service this equipment.

5.2.2. FUSES.

(a) GENERAL. - This equipment is supplied with fuses of the correct rating in each position. Fuse failures should be replaced with spares only after the circuit in question has been carefully examined to make certain that no permanent fault exists. Always replace a fuse with the rating specified in the following table:

FUSE TABLE

SYMBOL	LOCATION	TYPE	RATING
F301	LV Power supply primary	Cartridge (3AG)	3 amp.
F302	HV Power supply primary	Cartridge (3AG)	5 amp.

5.3. ALIGNMENT.

5.3.1. GENERAL. - Should, for any reason, the exciter stages get out of alignment, it is recommended that the unit be realigned at once. Improper operation might result in damage to valuable equipment.

5.3.2. HIGH FREQUENCY OSCILLATOR. - Should trouble develop in the high frequency master oscillator, the unit should be returned to the factory for servicing. However, the unit can be serviced and realigned by persons understanding such techniques providing accurate test equipment is at hand. A crystal controlled frequency standard with outputs at 1700 and 2000 kc with an accuracy of better than .015 percent, must be used for setting the band edges.

(a) PROCEDURE.

(1) Apply power to the transmitter and let the MO warm up for about 30 min. then check the oscillator frequency on a receiver. Operate the transmitter with the emission control in the CAL position and the key closed.

(2) Couple a receiver to the output of the oscillator.

(3) Set the vernier index to exact center of the dial window.

(4) Tune receiver to output of 1700 kc freq. standard.

(5) Rotate MO to vicinity of 3400 kc on the exciter dial and zero beat with the signal from the standard. Write dial reading down for use as a reference.

(6) Rotate the MO dial toward 4 mc exactly 12 turns.

(7) Tune the receiver to the 2000 kc output of the standard.

(8) The MO should zero beat with the 2000 kc output of the standard at exactly 12 turns of the MO dial.

(9) If such is the case but the dial reading is incorrect, loosen the set screws in the oscillator coupler and turn the dial to the correct reading (4000 kc) after which tighten the set screws again. If the MO does not zero beat with the standard at 4 mc, proceed as follows:

(10) Read the kc difference (the difference of where the signal appeared from where it should have appeared after 12 turns) and multiply it by 5. Add this figure to the actual beat note dial setting if the beat note was less than 12 turns or subtract it if the beat note occurred at more than 12 turns. Now set the dial to this new frequency, remove the trimmer plug from the top of the oscillator, and turn the adjustment until zero beat is again reached. It will be found that the high and low ends are very nearly 12 turns apart. Repeat the above procedure until such is the case; remember that a new reference point will occur at the low end of the dial each time.

Examples of above operations:

#1

Beat note at low end of dial	= 3402 kc
Reading at which beat note should appear after 12 turns of dial	= 4002 kc
Actual dial reading	= 4003 kc
Difference frequency (4003 - 4002)	= 1 kc
Multiplied by 5	= 5 kc
Subtracted from 4003 (since beat note occurred at more than 12 turns)	= 3998 kc

After setting dial to 3998 kc and zero beating the MO to the standard with the trimmer adjustment, the low end beat note should appear at 3398 kc.

#2

Beat note on low end of dial	= 3498 kc
Reading at which dial should appear after 12 turns	= 3998 kc
Actual dial reading	= 3996 kc
Difference frequency (3998 - 3996)	= 2 kc
Multiplied by 5	= 10 kc
Added to 3996 (since beat note occurred at less than 12 turns of the dial)	= 4006 kc

After setting the dial at 4006 and zero beating the MO to the standard with the trimmer adjustment, the low end beat note should appear at 3406 kc.

(11) After the oscillator has been adjusted to cover the range 3400 to 4000 kc in exactly 12 turns, the coupler set screws can be loosened and the dial set on frequency.

NOTE

The above method of adjustment is that which is used at the factory. This is a short cut method and proves very reliable. Actually, the object is to get the 1700 kc and the 2000 kc outputs of the oscillator exactly 12 turns apart and it can be attained by using the slower method of moving the trimmer capacitor in one direction or the other and checking the results until the desired answer is obtained. Be sure to replace the trimmer cover plug after alignment.

NOTE

Somewhat greater accuracy can be obtained if the oscillator end points are set using harmonic operation i.e. listen in the 14 or 28 mc region for the harmonics of the 1700 and 2000 kc signals and set the corresponding harmonic of the MO to zero beat with these. Do this only after obtaining a very close adjustment as outlined above.

5.3.3. MULTIPLIER STAGES. - Should the grid drive to the final fall below 5 ma on the meter due to change of tubes or aging of components, the transmitter r-f circuits should be realigned. Proceed as outlined below only after the master oscillator has been checked and recalibrated as outlined in paragraph 5.3.2.

A small fiber screwdriver and a 1/4" open end wrench are required for these adjustments.

(a) PROCEDURE.

(1) Remove the transmitter from the cabinet and tip it up on end. (RF section up).

(2) Remove the fuse from the HV primary. (This allows the low voltage supply to be turned on while the HV supply remains turned off.)

(3) Turn the LV and HV power switches ON.

(4) Place the CW-CAL-PH switch in the PH position.

(5) Place the METER selector switch in the GRID position.

(6) Adjust for maximum grid current using the adjustments and conditions listed below in order from top to bottom of the list. (Refer to figure 5-1 for adjustment identification.)

ORDER OF ADJUSTMENT	BAND SW SET AT	TUNING SET AT	ADJUSTMENT
1	10M	28,800	3 Slugs marked "28.8"
2	40M	7,300	C150
3	40M	7,200	1 Slug marked "7.2"
4	15M	21,600	3 Trimmers marked "21.6"
5	20M	14,250	3 Trimmers marked "14.4"
6	80M	3,750 kc	1 Trimmer marked "3.6"

NOTE

In item 4 under ADJUSTMENT, the mistracking of the third multiplier plate circuit will result in low grid current when the main tuning dial is set much outside the limits of the amateur 20 meter band (14 to 14.4 mc). Proper grid current can be obtained at any frequency on the range 12.8 - 16 mc by adjustment of trimmer C137 (marked 14.4) on the third multiplier.

NOTE

If extensive multiplier alignment has been necessary, it is likely that the two spurious signal traps will need tuning. Do not touch the spurious signal tuning condensers unless this is so, since these adjustments are

very critical. The spurious signal trap tuning condenser for the 80 meter band, C149 is located on the side of the multiplier unit next to C150, see figure 5-4. These traps are tuned as follows: With the transmitter aligned as indicated in the above paragraphs, tune the transmitter for 3.5 mc output and listen with a receiver to the 1.75 mc output. Watching the receiver "S" meter, tune C147 for minimum signal. Then tune the transmitter up on 7.15 mc and listen on 3.575 mc with the receiver. Adjust C149 for minimum signal. Both of these adjustments will be very sharp and care should be taken that they are not disturbed in the least after the adjustments have been made. Replace the multiplier bottom cover.

5.3.4. MODULATOR BIAS ADJUSTMENT. - The modulator bias can be adjusted by turning the screwdriver slot equipped potentiometer R305. For best distortion characteristics, the static, or resting, modulator plate current should be 55 ma with the 600 - 700 v switch in the 700 v position. Potentiometer R305 is located within the top of the cabinet near the filter capacitors, therefore, the interlock switch will have to be held closed while making this adjustment. Take great care to avoid touching any components carrying high voltage!

The proper bias for the modulator grids is approximately minus 25 volts.

5.4. LUBRICATION. - The following parts should be lubricated annually or whenever the need arises by brushing a thin film of the indicated lubricant on the points of mechanical contact. Don't over-lubricate.

(a) PA Bandswitch Contacts: MOBILE PD535A (Socony Vacuum Oil Co.)

(b) Panel Bushings: MOBILE PD535A (Socony Vacuum Oil Co.)

5.5. OSCILLATOR TUBE REMOVAL. - Replacing an oscillator tube requires the breaking of the seal around the shield and it will then become necessary to reseal the shield. If it becomes necessary to replace an oscillator tube, use a glyptal cement or a generous of Duco cement to reseal the shield.

5.6. DESICCANT CAPSULE. - A silica-gel tube is mounted on the top of the oscillator shield. The silica-gel absorbs moisture from within the oscillator and aids in retaining the oscillator calibration. Moisture causes the color of the silica-gel to change from blue to pink. The silica-gel tube is screwed into a hole in the shield. The plastic tube should be replaced by a new tube of silica-gel when all of the material within the tube has changed from blue to pink. New tubes of silica-gel may be ordered from the Collins Radio Company.

NOTE

The seal around the oscillator tube shield and the silica-gel tube is more easily broken if the parts are warm. This can be done safely with a light bulb or infra-red lamp placed close to the oscillator.

TYPICAL TEST VOLTAGES

DC Voltages to Ground measured with Volt-ohmyst. Conditions: Phone - No Mod. Readings taken at LF end of each band.

Tube	Pin	R.F.					
		3.5	7.0	14.0	21.0	27.2	28.0
V101	6AK6						
G1	1	-17.0	-16.5	-1.0	-0.9	-1.0	-0.9
K	2, 7	1.0	1.0	2.9	2.85	2.85	2.9
P	5	235	230	230	225	225	225
G2	6	155	150	65	65	65	65
V102	6AG7						
K	1,3,5	2.6	2.6	3.9	3.2	3.4	3.2
G1	4	-18.	-18.	-36	-36	-38	-36
G2	6	220	215	205	205	205	210
P	8	230	230	220	220	225	225

Tube	Pin	R.F.					
		3.5	7.0	14.0	21.0	27.2	28.0
V103	7C5						
P	2	235	235	215	210	215	215
G2	3						
G1	6	-24.	-23.	-56.	-21.	-69.	-51.
K	7	25.	25.	27.	27.	26.	26.
V104	7C5						
P	2	225	220	215	215	215	215
G2	3						
G1	6	-115	-110	-170	-175	-150	-150
K	7	-59	-56	-52	-52	-51	-50
V105	RK-4D32						
G2	2	285	300	300	300	295	295
K	4, 5	0	0	0	0	0	0
G1	6	-120	-100	-93	-105	-105	-102
P	Cap	690	680	690	690	690	690

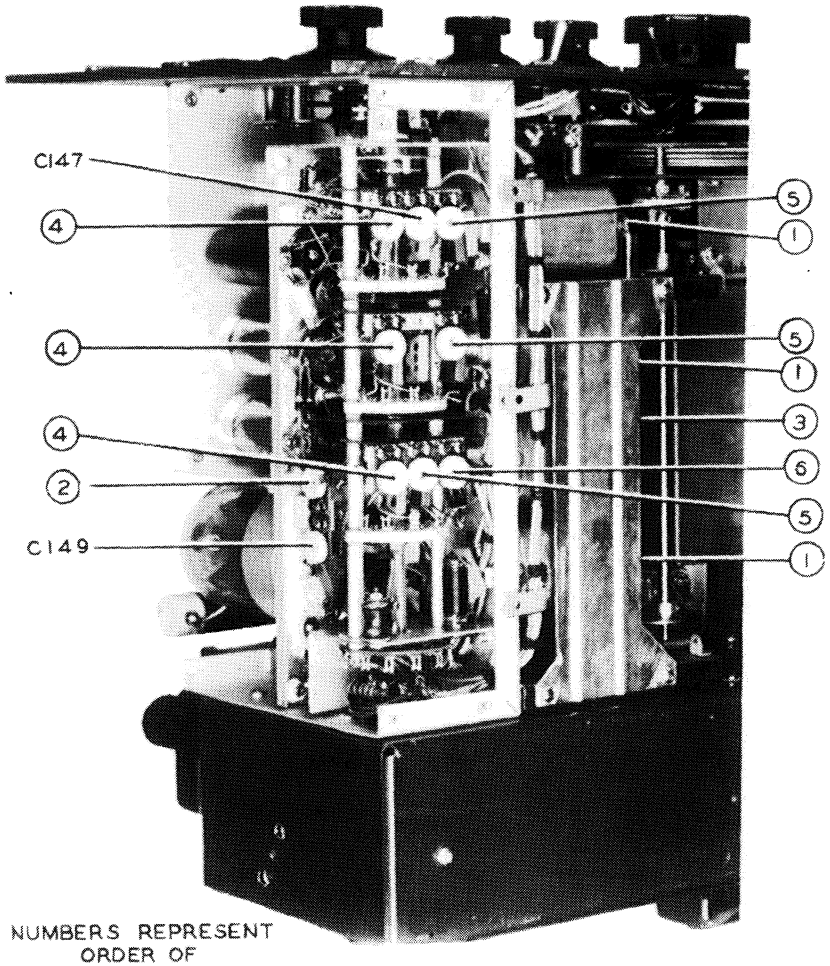
DC Voltages to Ground in Audio System (Volt-ohmyst)

4D32 Plate Current = 220 MA E_p = 700 V Key Down

Audio Amplifier V201, 6SL7GT				Driver V202, 6SN7GT			Modulator V203, & 4, 807			Sidetone Osc. V205, 6SL7GT		
		PH	CW		PH	CW		PH	CW		PH	CW
Pin 1	G	-0.6	-0.8	G	0	0				G	-.5	-3.0
2	P	88.	-0.9	P	235	235	G2	235	0	P	-.8	25
3	K	0	0	K	7.4	7.4	G1	-25	-25	K	0	0
4	G	0	0	G	0	0	K	0	0	G	-.3	-0.5
5	P	100	100	P	235	235	---	---	---	P	-.8	24
6	K	0.8	0.8	K	7.4	7.4	P	720	740	K	0	---
7												
8												

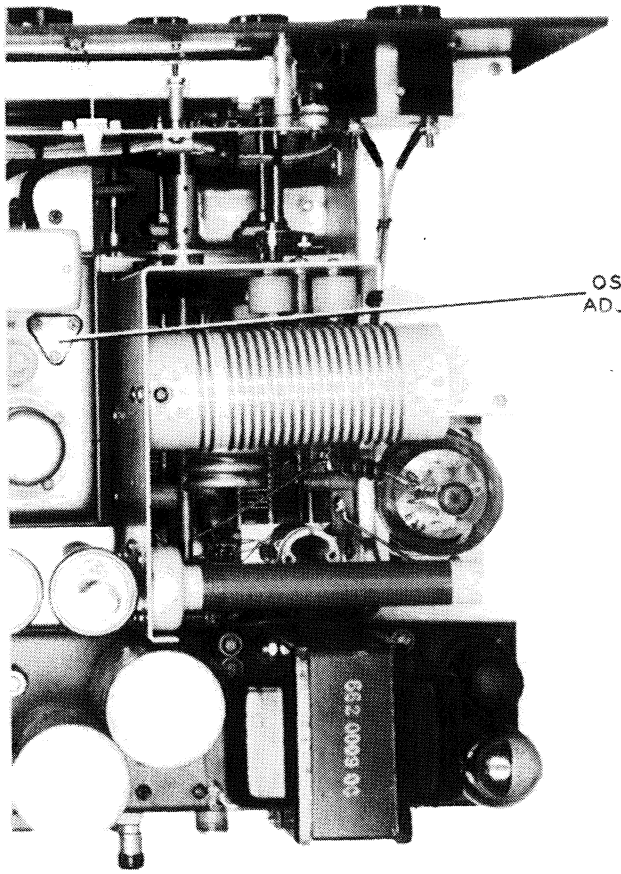
Key up - key down conditions of V105 (4D32)
CW operation
f = 7 mc

	Key up	Key down
Plate E	820	740
Plate I	0	220
Screen E	300	300



NUMBERS REPRESENT ORDER OF ADJUSTMENT (SEE TEXT)

BOTTOM



TOP

FIGURE 5-1 ALIGNMENT ADJUSTMENTS

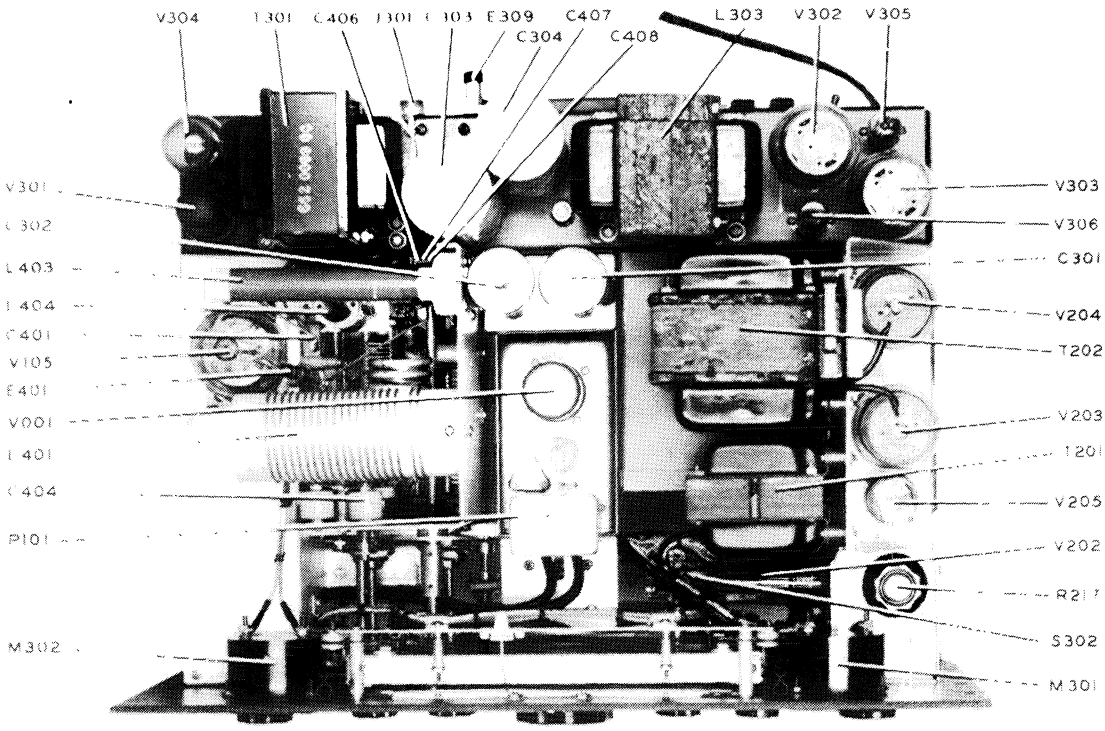


FIGURE 5 2 32V 2 PARTS ARRANGEMENT - TOP VIEW

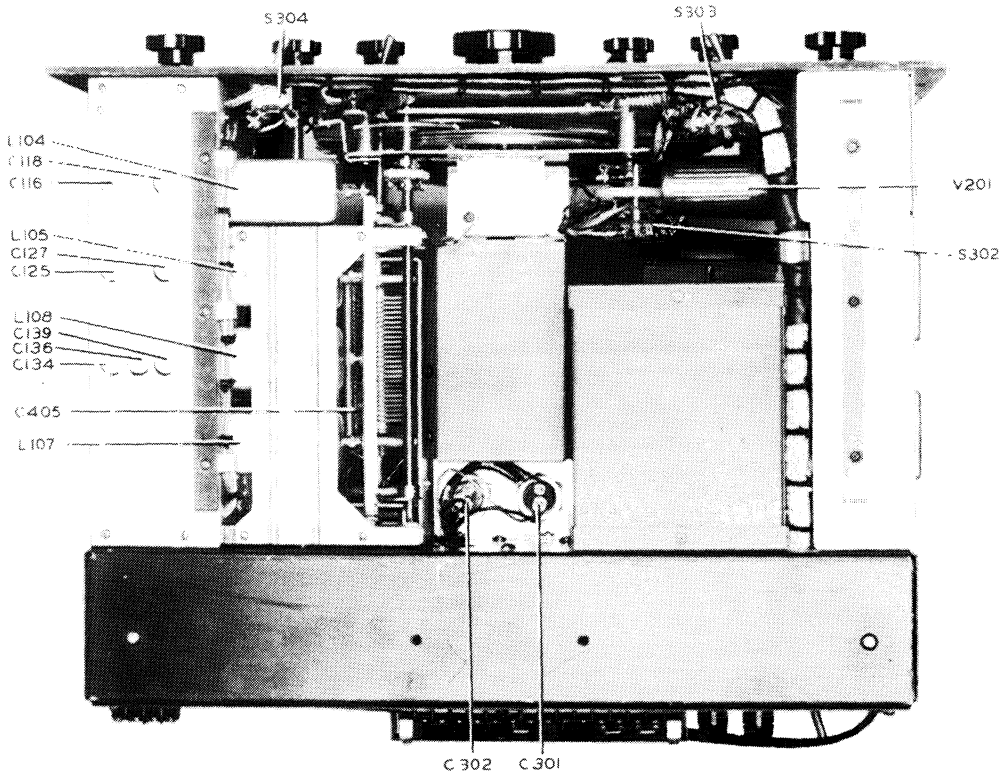


FIGURE 5 3 32V 2 PARTS ARRANGEMENT-BOTTOM VIEW

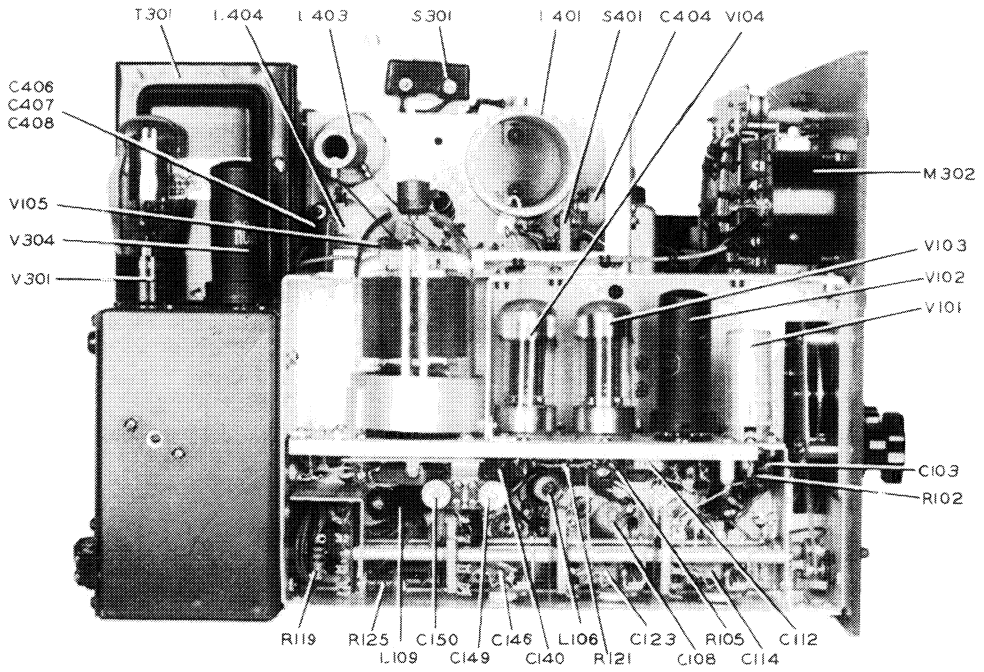


FIGURE 5-4 32V-2 PARTS ARRANGEMENT-LEFT SIDE OPEN

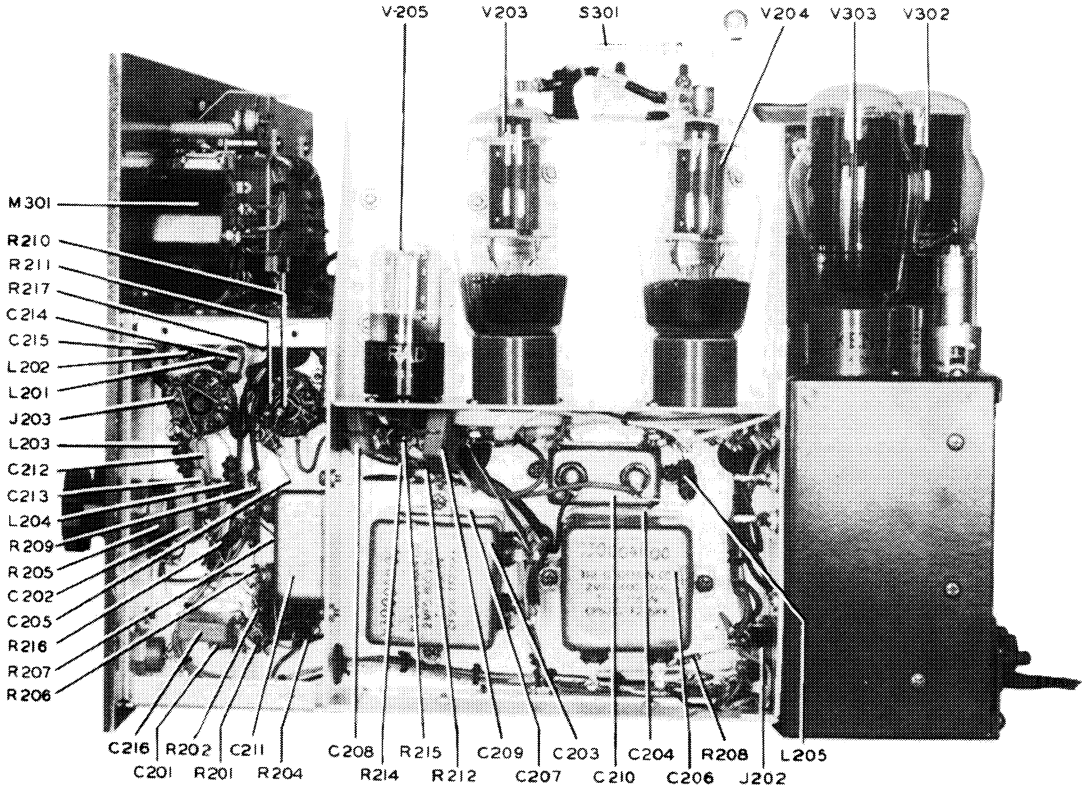


FIGURE 5-5 32V-2 PARTS ARRANGEMENT - RIGHT SIDE OPEN

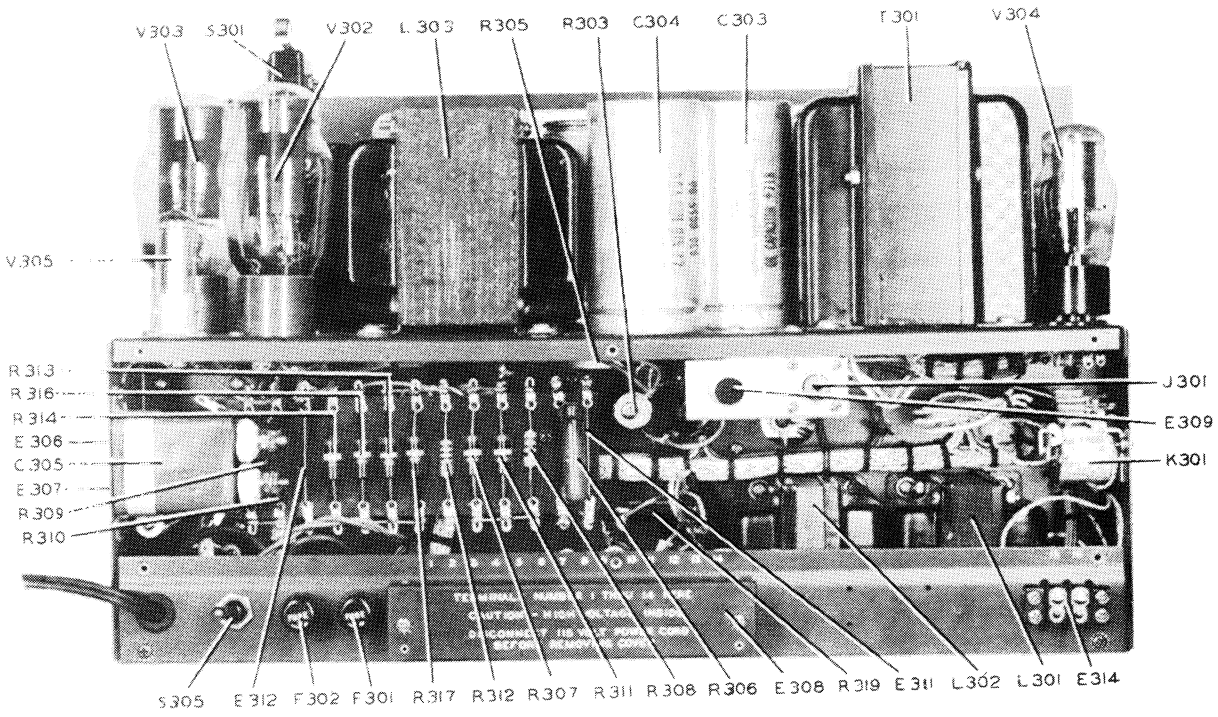


FIGURE 5 6 32V-2 PARTS ARRANGEMENT-REAR OPEN

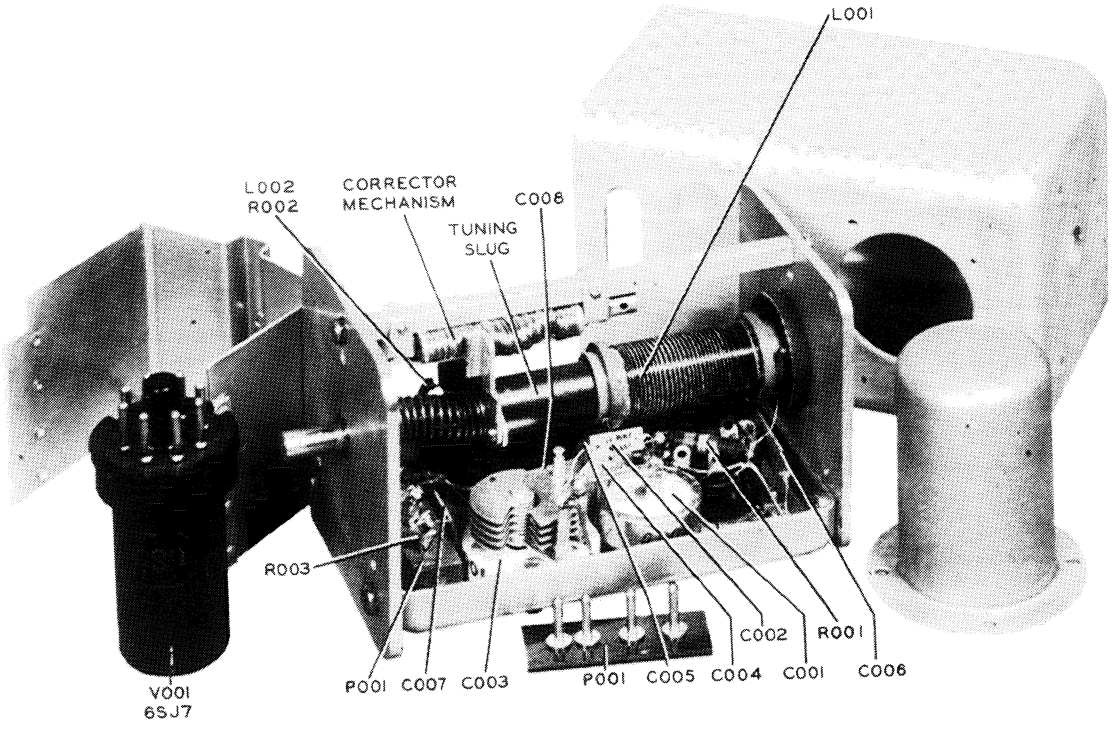


FIGURE 5-7 PARTS ARRANGEMENT 70E-8-OPEN