

**HIGH SEAS AND OVERSEAS RADIO  
WESTINGHOUSE LINEAR AMPLIFIER  
TYPE MS AND TYPE MS (MODIFIED)  
MECHANICAL ADJUSTMENTS AND LUBRICATION**

This section contains maintenance procedures for cleaning, testing, adjusting, and lubricating the mechanical items associated with the Westinghouse linear amplifier.

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**CHART 1  
CLEANING AND INSPECTING**

STEP	PROCEDURE
	<b><i>Warning: Hazardous voltages may be present even though the equipment is turned off. Use a grounding rod to discharge all exposed components before proceeding with the following procedures.</i></b>
1	Use a bristle brush and vacuum cleaner to remove heavy accumulations of dust.
2	Finish the cleaning with compressed air.
3	Remove dust accumulations from high-voltage equipment with a dust cloth.
4	While cleaning, inspect mechanical parts for excessive wear and electrical components for signs of overheating.

<b>CHART 1 (Cont)</b>	
<b>STEP</b>	<b>PROCEDURE</b>
5	<p>After cleaning, test the equipment and clear any troubles that appear.</p> <p><i>Note:</i> The dust filter at the intake of blower B201 should be replaced whenever accumulated dirt impedes the air flow through the radio frequency unit. The filter is removed by opening the rear access door of the servo panel and sliding out the filter pan. HI-E 40-type filters may be used to replace the screen mesh type.</p>
<p><b>CHART 2</b></p> <p><b>RELAY REQUIREMENTS AND ADJUSTMENTS</b></p>	
<p>This chart consists of two tables. Table A gives the relay requirements. The relays are listed by their designation, location, voltage and current ratings, and time delay (when applicable). Table B lists the relays with the adjustment tolerances.</p>	
<b>STEP</b>	<b>PROCEDURE</b>
1	<p>Refer to Table A and check relays for current and voltage. If the relay is both current and voltage rated, apply rated voltage and note the current required to hold and release the relay. If a relay fails to operate, check the armature for binding or for an open coil. If a relay fails to release, examine for armature binding and improper tension.</p>
2	<p>Refer to Table B for proper adjustment of all applicable relays.</p>
<p><b>CHART 3</b></p> <p><b>SWITCHES</b></p>	
<p>Failure of a circuit to function properly may be traced to dirty contacts on rotary switches. This chart outlines the procedures for cleaning and lubricating the switches. The cleaning procedure requires No. 320 aloxite cloth, or equivalent, and white cotton twill cloth. For lubricating, use petrolatum.</p>	

CHART 3 (Cont)	
STEP	PROCEDURE
	<b>Rotary Switches</b>
1	Remove dirt and corrosion with the twill cloth. Rub contacting surfaces of studs and contact rings, applying light pressure. When contacts are clean, apply the lubricant as described in Step 5. If the contacts are not cleaned using the twill cloth, follow the procedure in Steps 2, 3, 4, and 5.
2	Aloxite cloth is necessary to remove heavy tarnish or corrosion. Clean the surface of the contact ring by placing the aloxite cloth over a small piece of wood. Rub the contact ring lightly to obtain a bright clean surface.
3	Clean the contact studs by placing the aloxite cloth between the ring and the contact spring with the abrasive side of the cloth toward the spring. Withdraw the aloxite cloth with normal pressure exerted on the spring. Repeat this process several times.
4	Remove all loose particles from the contacts and the surroundings by wiping with a clean cloth.
5	With a clean cloth, apply a small amount of lubricant to the contact rings and studs. Keep the lubricant away from the other parts, especially the insulation. Wipe off the excess lubricant.
	<b>Interlock Switches</b>
6	Coat the contact portion of the switch blade with chalk. Position the blade vertically and close the door to a position where contact is just made.
7	Open the door and observe alignment as indicated by the chalk on the jaws of the switch.
8	If the blade is misaligned, loosen the mounting screws of the blade and adjust the position as required.
9	Check the contact follow by feel and adjust the mounting shims as required.
	<b>211C Switches</b>
10	The 211C switches are maintained and lubricated by methods specified in standard Bell System Practices. The lubrication must be done at least annually.

## CHART 4

## LUBRICATION

STEP	PROCEDURE
1	<p><b>Servo Motors</b></p> <p>The motors (B3 through B9) of the servo assemblies have oilite bearings and do not require lubrication. If a motor bearing becomes tight, apply a light oil at each of the bearings and rotate the motor in both directions until it runs freely. Servo motor B10 should be oiled with premium grade SAE 20 or 30 every two to six months depending upon the frequency of use.</p>
2	<p><b>Blower Motors</b></p> <p>Blower motor B101 in the rectifier unit of unmodified units has sealed bearings and <i>requires no lubrication</i>.</p>
3	<p>Blower motors B1 and B2 in the amplifier unit should be filled one-third to one-half full of Andok C grease (Humble Oil Co.) when installed and approximately every six months thereafter.</p>
4	<p>Fill through the pressure fitting until grease is forced out through the drain plug.</p> <p>Blower motor B201 in the control unit is equipped with ball bearings which are packed at the factory. For moderate use (continuous full-load operation at normal temperatures), the motor should be greased approximately every three years using a high-grade ball bearing grease. The manufacturer recommends a standard sodium base grease of No. 2 or No. 3 consistency. Do not use silicone grease or greases with solid additives (graphite, talc, etc). Carefully wipe off the exterior of containers and fittings before transferring grease. The housing is provided with two plugged holes at the top and bottom and pressure-type seals.</p>
5	<p>Remove both plugs for lubrication and scrape out any hardened grease that may have accumulated. A little oil added while the motor is running will help to soften old grease. Any standard fitting may be inserted into the top hole.</p>
6	<p>Add grease to flush out the old grease. Run motor a few minutes to allow the excess grease to drain through the bottom hole; then replace plugs.</p>
	<p><i>Note:</i> Some MS amplifiers are supplied with blower motors B201 with sealed bearings. Bearings in these motors should be replaced on a trouble basis.</p>
7	<p><b>Tuning Capacitors</b></p> <p>Turn the tuning dial of the capacitor to be oiled to the maximum position (minimum capacitance).</p>
8	<p>If necessary, rotate the end housing until the oil hole is at the top.</p>

<b>CHART 4 (Cont)</b>	
<b>STEP</b>	<b>PROCEDURE</b>
9	<p>Apply one or two drops of SAE 30 oil through the oil hole to the threads of the operating screw.</p> <p><i>Note:</i> An oil hole should be drilled in any end housing which does not have one.</p>
<p><b>CHART 5</b></p> <p><b>SERVO ASSEMBLIES</b></p>	
<p><b>Input and Output Drive Assemblies (Fig. 1):</b></p> <p>Input and output servo assemblies are identical except for the coupling shafts. A servo assembly consists of a servo motor, servo motor limit switches, a followup potentiometer, a variable capacitor, a front panel servo position indicator, and the coupling linkage between the servo motor and the variable capacitor. In case of excessive wear of any of the gears which are pinned to shaft MP1 of the input or output drive, it is necessary to replace shaft MP1 and all components on the shaft.</p> <p>Input and output drive servo motors (B3 through B9) and limit switches (S11 through S24) may be replaced without disassembling other portions of the servo drive assembly. When replacing a servo motor or limit switch, remove the electrical connections and the mounting hardware from the faulty component.</p>	
<b>STEP</b>	<b>PROCEDURE</b>
1	Disconnect coupling from tuning capacitor and remove electrical connections from motor terminal strip and connections to followup potentiometer and limit switch on mounting plate. Remove tuning knob.
2	Loosen setscrews and drive pin MP14 from bushing MP15 and remove bushing from shaft MP1.
3	Remove stop washers MP16 and limit switch assembly.
4	Loosen stopnuts which secure main mounting plate to standoff and remove main mounting plate from chassis.
	<i>Note:</i> Omit Steps 5 and 6 if the potentiometer or gear MP9 is not to be replaced.
5	Remove pin securing gear MP8 to potentiometer shaft.
6	Remove potentiometer mounting plate from main mounting plate. Remove potentiometer from mounting plate.

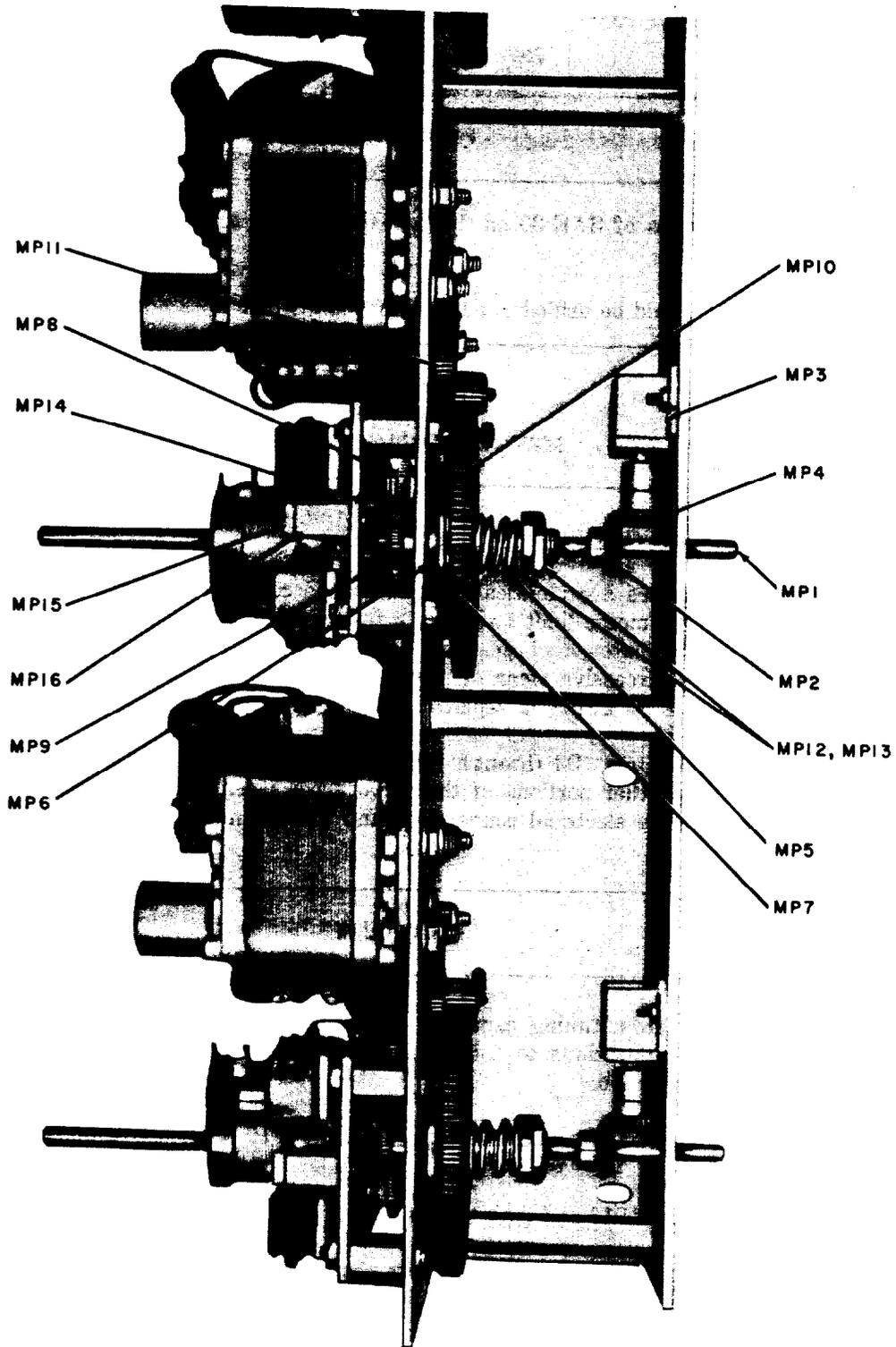


Fig. 1—Input and Output Drive Assemblies

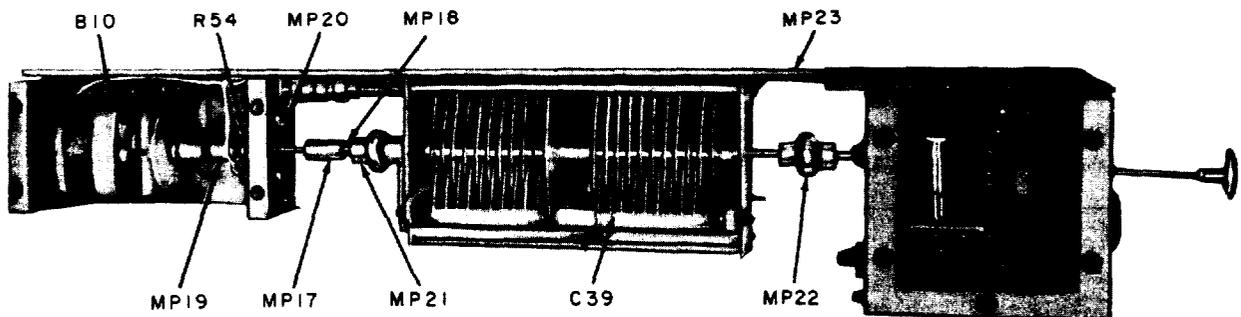
CHART 5 (Cont)

STEP	PROCEDURE
7	Loosen setscrews and drive pin from spur gear MP9 and remove spur gear from shaft MP1.
8	Loosen two nuts MP12 and slide nuts, spring MP5, and spring washer MP13 forward on shaft MP1.
9	Drive pin from clutch MP6, loosen setscrews on miter gear MP2, and remove shaft from assembly.  <i>Note:</i> If shaft MP1 or any part pinned to spur gear MP8, clutch MP6, or bushing MP15 requires replacement, replace shaft MP1 and all pinned parts.
10	Discard worn or damaged parts. Apply light coat of petrolatum to all bearing surfaces of replacement gears.
11	Place clutch disc MP7 and spur gear MP10 in position on clutch MP6.
12	Hold clutch MP6 in position so that spur gear MP10 meshes with spur gear MP11 when gear MP10 and clutch disc MP7 rest firmly against the plate MP6.
13	Insert shaft MP1 through opening in front of drive assembly, through gear MP2, through spring washer MP13, through clutch MP6, and through opening in rear plate of drive assembly.
14	Position shaft MP1 so that MP1 protrudes 3/4 inch from front plate assembly. Position miter gear MP2 to mesh with miter gear MP4.
15	Check that clutch MP6 is in position described in Step 13. Tighten setscrew in clutch MP6. Drill 3/32-inch hole and pin clutch MP6 to shaft MP1.
16	Place spring washer MP13 in position on shaft MP1.
17	Place spur gear MP9 on shaft MP1 so that spring washer MP13 is pressed firmly against rear plate drive assembly.
18	If potentiometer and potentiometer mounting plate were removed (Steps 5 and 6), replace on main mounting plate.
19	Place main mounting plate in position on standoffs and tighten stop nuts which secure main mounting plate to standoffs. Check that spur gear MP8 on potentiometer meshes with spur gear MP9 on shaft MP1. Tighten setscrew on spur gear MP8.
20	Place stopwashers MP16 and bushing MP15 on shaft MP1.
21	Tighten setscrews of bushing MP15.

CHART 5 (Cont)

STEP	PROCEDURE
22	Reconnect potentiometer and limit switch assembly leads.
23	With miter gear MP2 and spur gear MP9 loose on shaft MP1, set counter MP3 to indicate 010.
	<b>Caution: Perform alignment Steps 25 through 33 carefully to avoid damage to followup potentiometers and tuning capacitors. Direction of rotation is from the front, facing counter.</b>
24	While holding counter at 010 to prevent an indication change, rotate shaft MP1 counterclockwise until switch plate contacts mechanical stop and rotate potentiometer fully clockwise. Rotate potentiometer clockwise one-half turn and, while maintaining the counter MP3 at 010, tighten setscrews on miter gear MP2 and spur gear MP9.
25	Drill 3/32-inch hole and pin spur gears MP8 and MP9 to drive shaft MP1 and potentiometer shaft, respectively. Drill 3/32-inch hole and pin MP15 to shaft MP1.
26	Rotate shaft MP1 clockwise and check that the switch plate reaches its mechanical stop before the followup potentiometer reaches its mechanical stop.
27	Adjust clutch by tightening nut MP12. The clutch should hold at 60 ounce-inches of torque and start slipping at 80 ounce-inches of torque.
28	Replace tuning knob. Reconnect coupling to tuning capacitor, but do not tighten coupler setscrews.
29	Perform Steps 31, 32, or 33 as required during reassembly of an output or input drive assembly section.
30	Set INPUT A or INPUT B tuning capacitor C1 or C2 (or OUTPUT D or OUTPUT E tuning capacitor C23 or C24) as follows: Turn stub of capacitor counterclockwise until end housing becomes free, and turn stub clockwise until housing tightens. Turn clockwise one full turn, and then hold in this position and rotate spur gear MP10 counterclockwise until counter MP3 indicates 010. Tighten remaining setscrews in capacitor drive shaft and gears.
31	Set OUTPUT C or OUTPUT F tuning capacitor C22 or C25 as follows: Turn stub of tuning capacitor counterclockwise until end housing becomes free and then turn stub clockwise until housing tightens. Turn clockwise three full turns, and then hold in this position and rotate spur gear MP10 counterclockwise until counter MP3 indicates 010. Tighten remaining setscrews in capacitor drive shaft end gears.
32	Set OUTPUT G tuning capacitor C26 as follows: Turn stub of capacitor counterclockwise until end housing becomes free and then turn clockwise until housing tightens. Turn clockwise eight full turns, and hold in this position and rotate spur gear MP10 counterclockwise until counter MP3 indicates 010. Tighten remaining setscrews in capacitor drive shaft and gears.

CHART 5 (Cont)	
STEP	PROCEDURE
33	Replace electrical connections to drive motor terminal strip.
34	Mark setscrews in coupling link with blue enamel (Benolite 670 or equivalent).
<p><b>Balance Drive Assembly (Fig. 2):</b></p> <p>The balance drive assembly contains the balance potentiometer, servo motor, variable air capacitors, associated shafts and couplings, a dial assembly, and balance indicator circuit. To guard against shaft slippage resulting in a misalignment of parts, all couplings including the gear on the main shaft are pinned. When replacing any shafts, drill pin holes directly through the center of the shaft.</p> <p>To separate the assembly for parts replacement and to adjust the clutch mechanism during reassembly, refer to Figure 2 and proceed as follows:</p>	



**Fig. 2—Balance Drive Assembly**

## CHART 5 (Cont)

STEP	PROCEDURE
1	Loosen setscrews securing coupling MP17 to shaft MP18 and shaft of potentiometer R54.
2	Remove cover from motor housing. Loosen setscrews securing clutch coupling MP19 to shaft of servo motor B10.
3	Remove cover plate MP20 with potentiometer R54 attached and coupling MP17.
4	Remove hardware securing servo motor B10 to mounting block and remove motor.
5	Remove external electrical connections to capacitor C39.
6	Loosen setscrews securing flexible couplings MP21 and MP22 to shaft of capacitor C39, and remove flexible coupling MP21.
7	Remove hardware securing capacitor C39 to mounting plate MP23, and remove capacitor C39.
8	<b><i>Replace parts in reverse order of removal.</i></b> To recouple potentiometer R54 and capacitor C39, set capacitor C39 at half mesh so that clockwise rotation of capacitor shaft (as viewed from dial end) causes C39 to unmesh. Set potentiometer R54 so that arm is at electrical center (zero resistance between arm C and permanent center-tap terminal T). Tighten setscrews on couplings MP17 and MP21. Adjust torque of clutch MP19 so that when servo motor B10 is energized, capacitor C39 rotates without any clutch slippage. Check that clutch slips when capacitor C39 is rotated by hand from slotted shaft of BALANCE control.

**TABLE A****RELAY REQUIREMENTS**

<u>RELAY</u>	<u>CABINET LOCATION</u>	<u>COIL RATING</u>			<u>CONTACT RATING</u>		<u>ADDITIONAL DATA</u>
		<u>VOLTS</u>	<u>CURRENT, WATTS, VA, OR OHMS</u>	<u>POLES</u>	<u>CURRENT</u>	<u>VOLTS</u>	
S1, S3, S4	Control	40-52 Vdc	1000 OHMS	NO DPST	6 A ac	115 Vac	
S2	Control	115 Vac		NO DPST	6 A ac	115 Vac	
S6, S7	Control	48 Vdc	112 mA 2500 OHMS				Self-holding
S8	Control	48 Vdc					MAX of 30-sec delay. Adjust for 15-sec delay.
S9 to S18	Control		245 mA 700 OHMS				
S19 to S28	Control		1 mA 8450 OHMS				
K101	Rectifier	110 Vac	6 W 35 VA	4 NO	25 A ac	208 to 220 Vac	
K102	Rectifier	115 Vac	2.75 VA (Motor)	2 NO	5 A ac	125 Vac-Vdc	Time delay adjustable to 1.5 minutes.
K103	Rectifier	115 Vac	5 W 10 VA	DPDT	12 A ac	115 Vac	
K104	Rectifier	110 Vac	40 W 200 VA	3 NO 1 NO aux	150 A ac open 5 A ac	600 Vac 250 Vac	
K105	Rectifier	115 Vac $\pm 50\%$	2 W	DPDT	0.3 A ac	120 Vac	5-sec delay not adjustable.
K106	Rectifier	115 Vac 90 Vac MIN 125 Vac MAX	24 VA	SPDT	10 to 15 (15 A dc cold non-inductive load)	25 kV	

TABLE ARELAY REQUIREMENTS (Cont)

<u>RELAY</u>	<u>CABINET LOCATION</u>	<u>COIL RATING</u>		<u>POLES</u>	<u>CONTACT RATING</u>		<u>ADDITIONAL DATA</u>
		<u>VOLTS</u>	<u>CURRENT, WATTS, VA, OR OHMS</u>		<u>CURRENT</u>	<u>VOLTS</u>	
K107	Rectifier		0.5 to 2 AMP	1 NO 1 NC	5 A ac	115 Vac	Adjust to operate at 7.5 AMP when shunted by 0.4 OHMS.
K108	Rectifier	115 Vac 92 Vac MIN	0.045 AMP	DPDT	15 A ac	110 Vac	
K109, K109A	Rectifier (Heater for K109)		1 AMP 40°C	1 NC	0.4 to 65 A ac	250 Vac	
K110	Rectifier	115 Vac 90 Vac MIN 125 Vac MAX	24 VA	1 SPDT 2 NO	10 to 15 A ac cold non- inductive load, 20 A ac non- inductive load	25 kV 115 Vac aux CONT	
K111	Rectifier	110 Vac	6 W	5 NO 1 NC	10 A ac	600 Vac	
K112	Rectifier	115 Vac					
K1 thru K4, HR1 thru HR4	RF		6 AMP at 40°C	1 NC	0.4 to 65 A ac	250 Vac	Hand reset position.
K5, K6	RF		0.25 to 1 AMP				Adjust to trip at 2.0 AMP when shunted by 2.5 OHMS.
K7, K8	RF	115 Vac 92 Vac MIN	0.045 AMP	DPDT	15 A ac	110 Vac	

TABLE A

## RELAY REQUIREMENTS (Cont)

RELAY	CABINET LOCATION	COIL RATING		POLES	CONTACT RATING		ADDITIONAL DATA
		VOLTS	CURRENT, WATTS, VA, OR OHMS		CURRENT	VOLTS	
K9	RF	115 Vac 92 Vac MIN	0.1 AMP 145 OHMS	DPDT	15 A ac	110 Vac	
K10	RF	100 Vdc	10 W OPR 0.7 AMP	SPDT	10 A ac rms at 30 MHz	10 kV peak	Current handling increases as frequency decreases.
K11 thru K14	RF	115 Vdc		1 NO	20 A ac	10 kV peak	Contact ratings are given for 25 MHz.
K15, HR15	RF		6 AMP 50°C	1 NC	0.4 to 65 A ac	250 Vac	Auto reset position.
K16	RF	115 Vdc	30 VA	1 NC 2 NC	15 A RF	3 kV	Relay provides 4 lbs push.
K17	RF	115 Vdc			6 A RF	10 kV	
K18 thru K24	RF	6.3 Vac	4000 OHMS OPR 8.1 mA hold 6.3 mA RLS 3.6 mA	SPST	5 A ac	500 Vac	The product of current (sample MAX) and voltage at closing (500 volts MAX) should not exceed 250 VA for any single contact.
K25	RF	115 Vac	6 W 35 VA	4 NO	12 A ac	115 Vac	
K201 HR201	Control (Heater for K201)	230 Vac	3.74 AMP 40°C	1 NC	0.4 to 65A ac	250 Vac	Hand reset position.
K301	Control	115 Vac 92 Vac MIN	0.045 AMP	DPDT	15 A ac	110 Vac	

**TABLE B**  
**SUPPLEMENT TO RELAY REQUIREMENTS**

<u>RELAY</u>	<u>MOUNTING</u>	<u>ADJUSTMENT</u>
<b><u>Radio Frequency Unit</u></b>		
K1, K2, K3, K4, K5	Not critical	Factory adjustment only.
K6	Vertical	Adjust stationary contacts so that they just touch moving contacts when the latter are 5/32" above the de-energized position.
K7, K8, K9, K26, K27	Not critical	Factory adjustment only.
K10	Not critical	No adjustment. Make sure that the switch shaft is secured by the locking setscrew before removing or connecting the actuator.
K11, K12, K13, K14	Not critical	No adjustment.
K16	Vertical with contacts at the top.	No adjustment.
K17	Not critical	No adjustment.
K18, K19, K20, K21, K22, K23, K24	Vertical with base down	No adjustment.
K25	Vertical	Adjust armature for $0.87 \pm 0.015$ " overtravel when coil is energized. Contact gap with coil de-energized should be $0.147 \pm 0.015$ ".
<b><u>Rectifier Unit</u></b>		
K101	Vertical	Adjust for a minimum contact gap of 0.281". Contacts to be within $\pm 0.007$ " of a true plane. Overtravel should be $0.105 \pm 0.0625$ as taken from top edge of the saddle.
K102	Long dimension horizontal. Gear shafts vertical and motor at top.	Set backstop so that the contact arm is 1/2 scale division from the contact closed position.
K103	Vertical with contacts at the top.	When the make contacts are closed, the moving contact fingers should be deflected slightly over 1/32" measured at the upper edge of the moulded armature block. Adjustment is made by carefully bending the contact bracket.

**TABLE B****SUPPLEMENT TO RELAY REQUIREMENTS (Cont)**

<u>RELAY</u>	<u>MOUNTING</u>	<u>ADJUSTMENT</u>
	<u>Rectifier Unit (Cont)</u>	
K104	Vertical with contacts at the top.	Gap between contactors when fully open would be $17/32'' \pm 1/32''$ . Main contact overtravel along top edge of saddle with contactor fully closed should be $15/64'' \pm 1/16''$ . When bottom contactors are just touching, the gap between the top contacts should be $1/32''$ .
K105	Vertical with contacts at the top.	Contact pressure 12 to 14 grams.
K106, K110	Not critical	Adjust for an overtravel of $1/32''$ .
K107	See relay K5 of the Radio Frequency Unit.	
K108	Not critical	Factory adjustment only.
K109	See relay K1 of the Radio Frequency Unit.	
K111	See relay K25 of the Radio Frequency Unit.	
K112	See relay K5 of the Radio Frequency Unit.	
	<u>Control Unit</u>	
K201	See relay K1 of the Radio Frequency Unit.	
K301	Not critical	Factory adjustment only.
	<u>Servo Panel</u>	
D2	Special requirements	See BSP for 211C type selector.