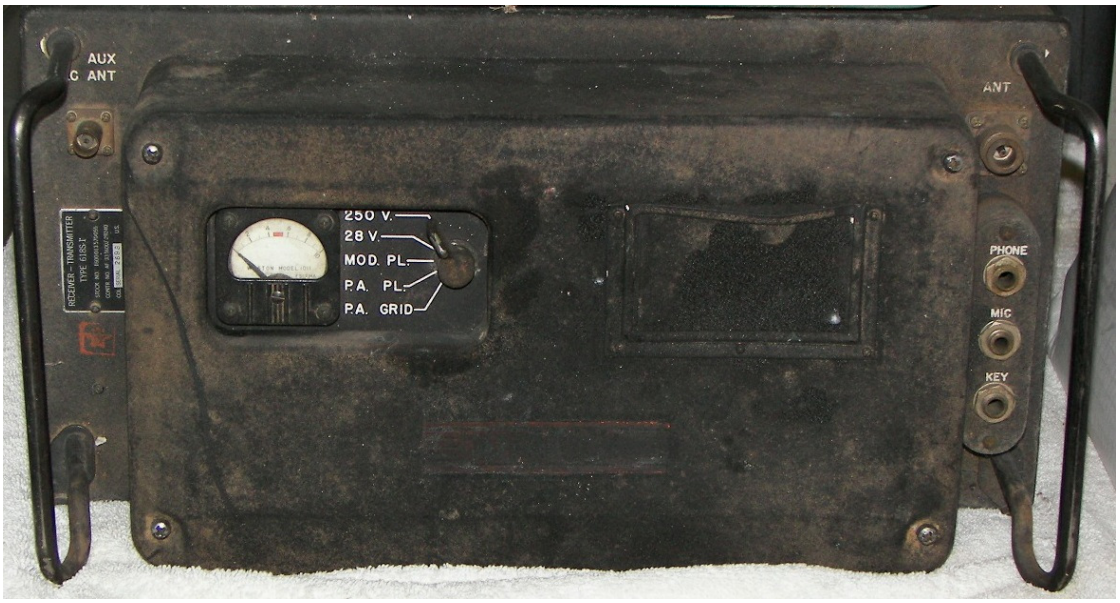
T.O. 12R2-4-6-2

COLLINS
618S-1
618S-1A
HF TRANCEIVER

AM / CW, 2 TO 25MHz, 4 Bands, 144 Channels



Also in this document:
Hookup and Channel Selection Notes
ARC-38 PTO Schematic for Continuous Coverage
BASIC Programs for Frequency and Crystal Calculations

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Part 2 of 3

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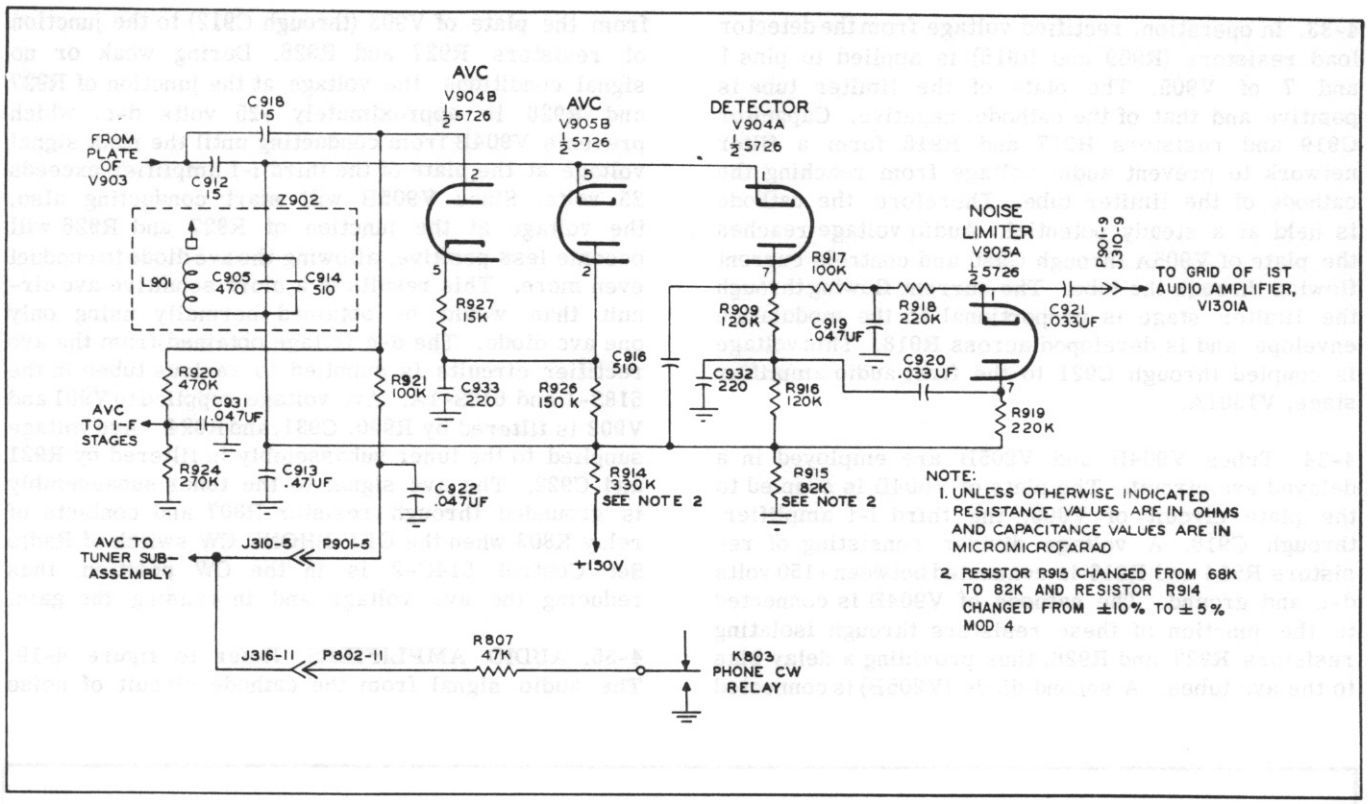

Figure 4-18. Detector, Noise Limiter, and Avc Stages, Simplified Schematic Diagram

diode V905 is connected with the first audio amplifier stage (V1301A) in the audio amplifier subassembly. Normal audio signals are coupled from the detector output to V1301A control grid. Sharp, high, amplitude noise impulses are limited in amplitude to a nominal 60% modulation characteristic.

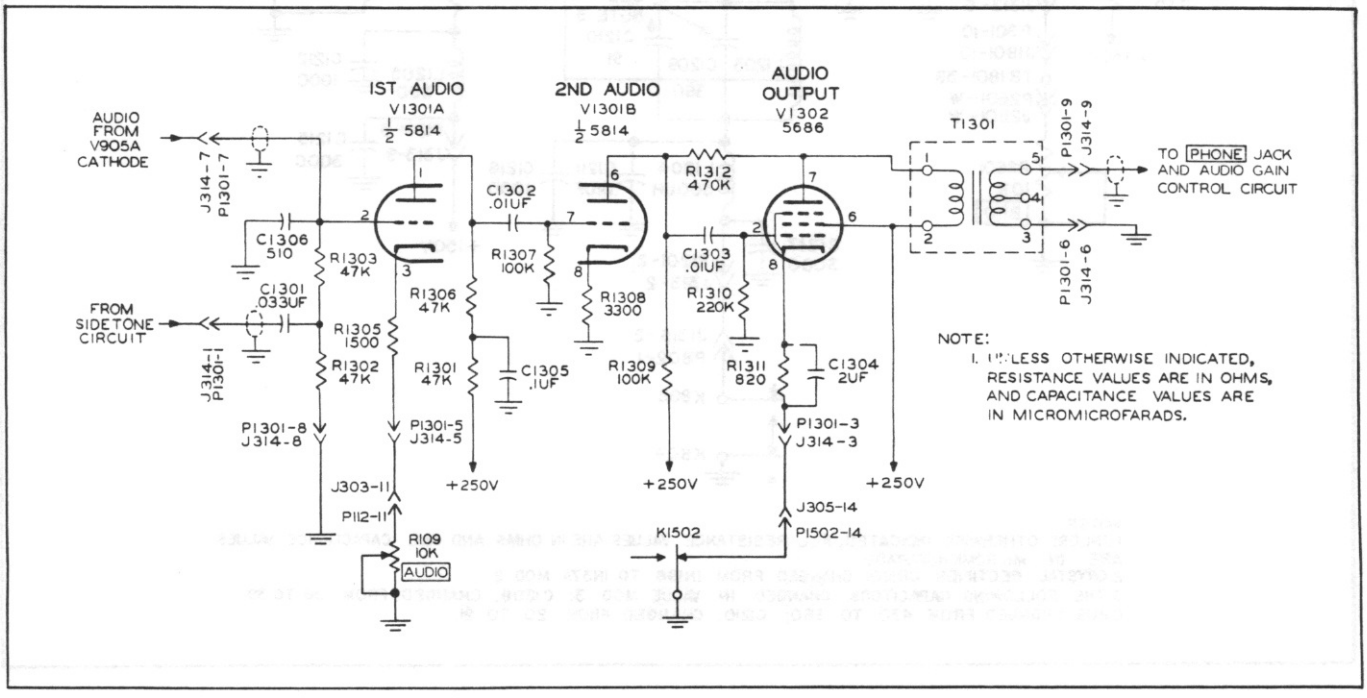

Figure 4-19. Receiver Audio Amplifiers, Simplified Schematic Diagram

4-33. In operation, rectified voltage from the detector load resistors (R909 and R916) is applied to pins 1 and 7 of V905. The plate of the limiter tube is positive and that of the cathode, negative. Capacitor C919 and resistors R917 and R918 form a filter network to prevent audio voltage from reaching the cathode of the limiter tube. Therefore, the cathode is held at a steady potential. Audio voltage reaches the plate of V905A through C920 and controls current flowing through the tube. The current flowing through the limiter stage is proportional to the modulation envelope, and is developed across R918. This voltage is coupled through C921 to the first audio amplifier stage, V1301A.

4-34. Tubes V904B and V905B are employed in a delayed avc circuit. The plate of V904B is coupled to the plate circuit of V903, the third i-f amplifier, through C918. A voltage divider consisting of resistors R914 and R915 is connected between +150 volts d-c and ground. The cathode of V904B is connected to the junction of these resistors through isolating resistors R927 and R926, thus providing a delay bias to the avc tubes. A second diode (V905B) is connected from the plate of V903 (through C912) to the junction of resistors R927 and R926. During weak or no signal conditions, the voltage at the junction of R927 and R926 is approximately +25 volts d-c, which prevents V904B from conducting until the peak signal voltage at the plate of the third i-f amplifier exceeds 25 volts. Since V905B will start conducting also, the voltage at the junction of R927 and R926 will become less positive, allowing the avc diode to conduct even more. This results in a more sensitive avc circuit than would be obtained normally using only one avc diode. The d-c voltage obtained from the avc rectifier circuits is supplied to various tubes in the 618S-1 and 618S-1A. Avc voltage supplied to V901 and V902 is filtered by R920, C931, and R924. Avc voltage supplied to the tuner subassembly is filtered by R921 and C922. The avc signal to the tuner subassembly is grounded through resistor R807 and contacts of relay K803 when the OFF PHONE CW switch of Radio Set Control 614C-2 is in the CW position, thus reducing the avc voltage and increasing the gain.

4-35. AUDIO AMPLIFIERS. Refer to figure 4-19. The audio signal from the cathode circuit of noise

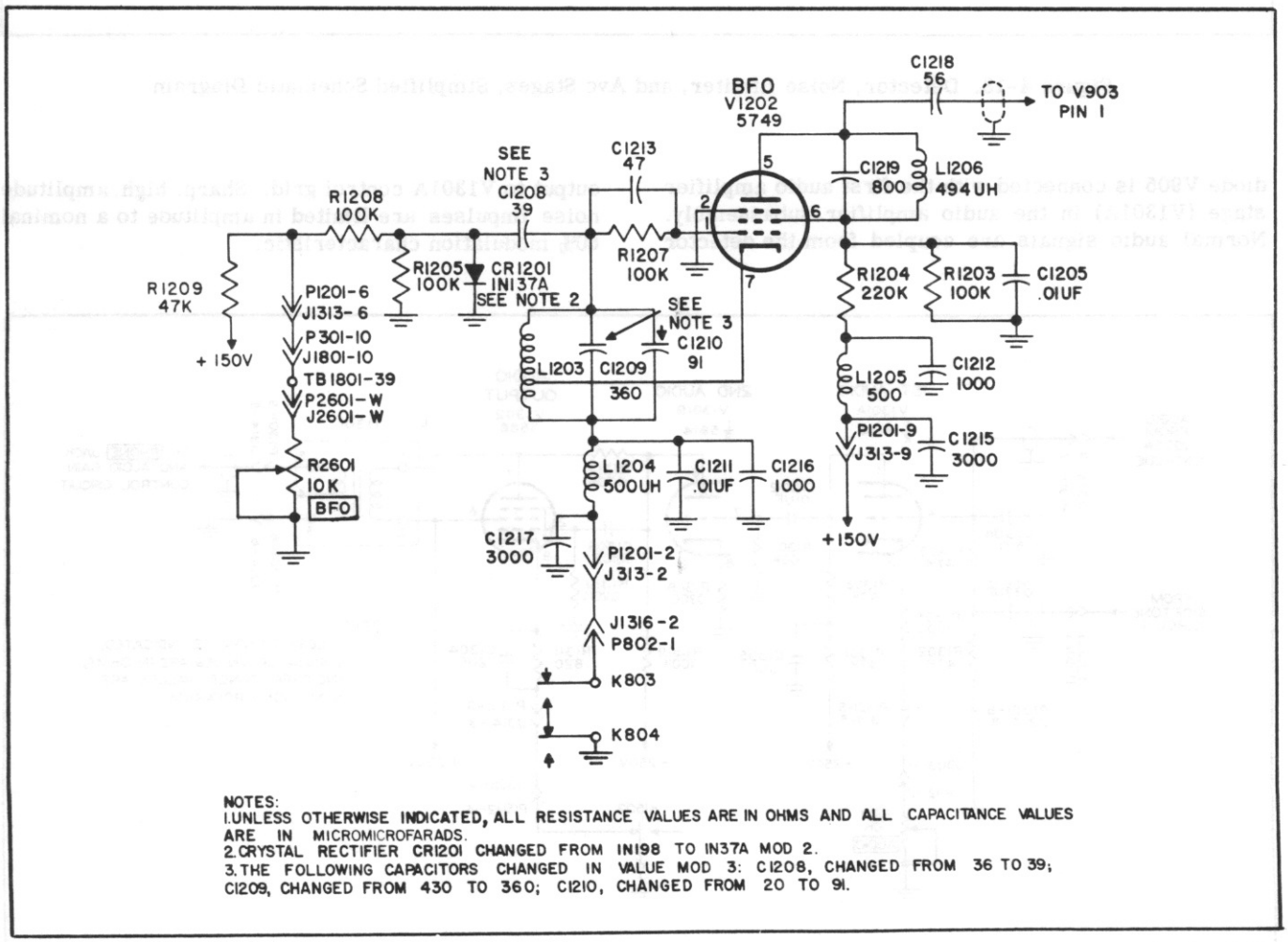

Figure 4-20. Beat-Frequency Oscillator, Simplified Schematic Diagram

limiter V905A is applied to the control grid of the first audio amplifier stage. The side-tone signal is coupled through capacitor C1301 and developed across grid resistor R1302. The audio side-tone signal or received signal, is amplified by V1301A and developed across the plate load resistor, R1306. A certain amount of control is obtainable over the amplification of V1301A. Resistor R109 is a screw driver adjustment, located on the front panel, and may be set during alignment procedures for the desired amount of audio gain. The audio signal is coupled through capacitor C1302 to the control grid of the second audio stage, V1301B. The plate circuit of V1301B is connected through resistor R1312 to the plate of the audio output stage, V1302. The resultant feedback voltage is of the opposite phase, and a slight amount of degeneration results. This degeneration helps to flatten the frequency response characteristics of the audio stages, and allows a more linear reproduction of the input signal. The cathode of V1302 is grounded through contacts of relay K1502. Relay K1502 is energized only during the centering cycle of the power amplifier subassembly, thus muting the audio output during this interval and preventing switching transients from being applied to the headset. The audio signal is amplified by V1302 and applied across the primary of transformer T1301. Approximately 500 milliwatts of audio power is available from V1302. The audio signal is coupled through T1301 and connected to the PHONE jack on the front panel of Radio Receiver-Transmitter 618S-1 and 618S-1A. The audio output signal also is connected to Radio Set Control 614C-2. Potentiometers within Radio Set Control 614C-2 allow control over the audio amplitude applied to the external interphone amplifiers while offering a constant impedance to transformer T1301, as will be explained in paragraph 4-68.

4-36. BEAT-FREQUENCY OSCILLATOR. Refer to figure 4-20. The beat-frequency oscillator stage, V1202, employs a type 5749 pentode tube in a series-fed, electron-coupled oscillator. The basic oscillator frequency is controlled by the parallel arrangement of inductor L1203, tuning capacitor C1209, and temperature-compensating capacitor C1210. The oscillator plate circuit consists of the screen grid of V1202, the parallel filter arrangement of C1205 and R1203, and the plate load resistor, R1204. Feedback to the grid is accomplished by the autotransformer-type connection of L1203 in the cathode circuit of V1202. The parallel arrangement of CR1201 and R1205 is in shunt with the oscillator tank circuit. Crystal rectifier CR1201 is connected through R1208, R1209, and L1205 to the 150-volt regulated line. The voltage across CR1201 is variable from zero to approximately 25 volts d-c by operation of the sliding arm of potentiometer R2601. Potentiometer Z2401C is operated through the BFO control on the front panel of Radio Set Control 614C-2. As the d-c voltage across CR1201 is varied, the impedance to ground also is varied, effectively changing the capacitive reactance of capacitor C1208, and altering the frequency of oscillation. In this manner, the pitch of the bfo signal is changed for monitoring of cw signals. Output from the bfo stage is taken across the plate tank circuit, consisting of C1219 and L1206, and coupled through capacitor C1218 to the control grid of the third fixed i-f stage, V903. The bfo stage is removed from the 618S-1 or 618S-1A circuits when the OFF PHONE CW switch of Radio Set Control 614C-2 is in the PHONE position, which de-energizes relay K803 and opens the cathode circuit of V1202. The bfo stage also is removed from the circuit during transmission by contacts of relay K804.

4-37. AGC AND AVC CIRCUITS. Refer to figure 4-21. A portion of the signal from the plate circuit of the tuner discriminator, V1001, is coupled through capacitor C1071 and developed across the tuned circuit consisting of inductor L1026 and capacitor C1116. Capacitor C1116 and inductor L1026, in conjunction with the distributed capacity, resonate at the lower and middle frequencies of the r-f crystal oscillator (V401) range, thereby increasing the agc voltage throughout these frequency ranges. This is desirable to compensate for a varying r-f crystal oscillator output. The signal from V1001 is rectified by CR1005 and filtered by the parallel combination of C1072, R1007, and R1006. Resistor R1006 is selected by factory experimentation for optimum agc voltage for each 618S-1 or 618S-1A component. Agc is supplied to variable i-f amplifier V1002 during both transmission and reception, thereby compensating for a varying output level from the r-f crystal oscillator stage.

4-38. Avc voltage from V904B is filtered by resistor R921 and capacitor C922 and applied through contacts of K1001 to the control grid circuit of the second r-f amplifier stage, V1009. The avc signal is grounded through resistor R807 and contacts of K803 when in the CW position, thus lowering the avc and increasing the gain when receiving cw signals. Relay K1001 is energized whenever the microphone push-to-talk button or the telegraph key is depressed, which removes the avc and grounds the grid circuit of V1009 during transmission. The avc voltage is further filtered by the low-pass filter arrangement of C1092, C1099, C1122, R1035, and R1052 for the receiver first and second mixer stages and the receiver first i-f amplifier stage. During transmission, V1005, V1006, and V1008 are removed from the circuit and not used.

4-39. FILAMENT CIRCUIT. Refer to figure 5-1. All tubes within Radio Receiver-Transmitter 618S-1 and 618S-1A are connected in a series-parallel arrangement to obtain the proper operating voltages for the filaments. Balancing resistors are employed, where necessary, as voltage dividers. Bypass capacitors are used on each tube filament where the possibility of r-f coupling exists to prevent spurious oscillations and coupling to the power source. Figure 5-1 illustrates the series-parallel layout of each tube filament, as well as the voltages at each pin. Reference is made to paragraphs 5-23 and 5-24 for further details of the filament circuit.

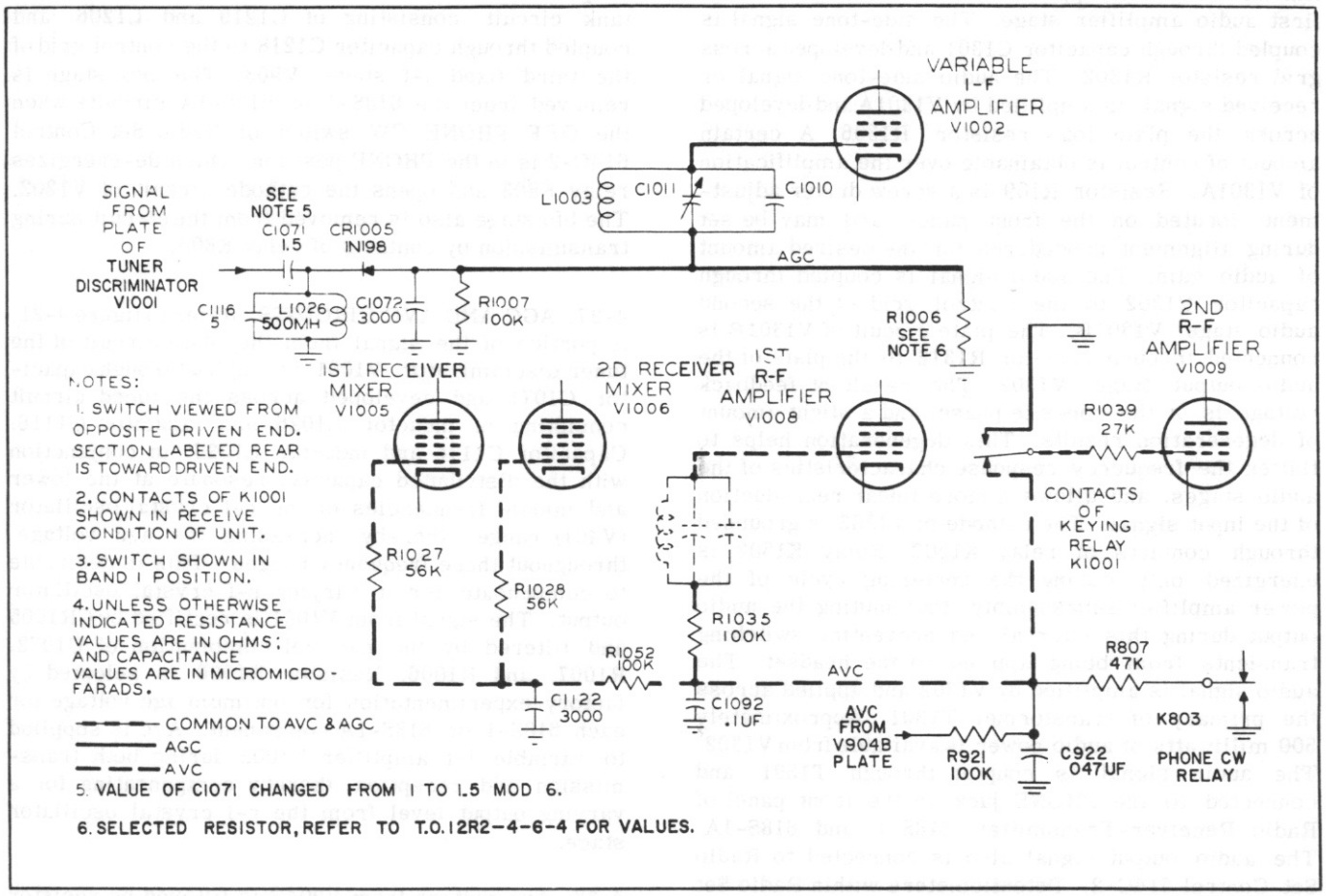

Figure 4-21. AGC and AVC Circuits, Simplified Schematic Diagram

4-40. POWER SUPPLY 416W-1. Refer to figure 7-16. Primary power for Dynamotor-Power Supply DY-118/ARC-38 is applied through terminal 23 of P1601, through contacts of thermal relay switch S1602, and through relays K1602 and K1603 to ground in Radio Set Control 614C-2. When the OFF PHONE CW switch is operated to the PHONE or CW positions, relays K1602 and K1603 are energized, which allows the selenium rectifier circuits of the DY-118/ARC-38 to operate.

4-41. Energizing of relay K1603 results in all the 400-cps voltages being applied to plug P1601 for distribution throughout the 618S-1 and 618S-1A systems. Transformer T1601 steps the 115 volts down to 6.3 volts and autotransformer L1606 steps the 115 volts down to 18 volts. Resistor R1606 and capacitor C1612 form a phase shift network for transformer T1601. The phase of the 6.3-volt, 400-cps power must be correct for proper operation of the 618S-1 and 618S-1A chopper coils, as will be described in paragraph 4-57.

4-42. After relay K1603 has been energized, a circuit exists through the surge current limiting resistor (R1601) to the 250-volt selenium rectifier supply. Parallel capacitors C1601A and C1601B form the charging capacitor for the voltage-doubling arrangement of CR1601 and CR1603. On the negative alternation of the 400-cps input, C1601A and C1601B conduct through CR1601, driving the left side of C1601A and C1601B negative. On the positive alternation, the discharge path for C1601A and C1601B is through R1601, through contacts of K1603, through the 115-volt, 400-cps power source, through capacitor C1602A, and through CR1603. The discharge current of C1601A and C1601B adds to the current of the 400-cps supply on the positive alternation, resulting in capacitor C1602A becoming charged to twice the peak value of the 115-volt positive alternation. On the following negative alternation, capacitor C1602A cannot fully discharge because of the long time constant formed by L1602, C1602B, and R1602, and remains at practically a constant d-c voltage. In this manner, with the discharge current of C1601A and C1601B adding to the source current to charge C1602A, and with C1602A remaining charged on the following alternation, the d-c voltage across C1602A is proportional to twice the peak of the input signal. Output from the 250-volt selenium rectifier supply is taken across bleeder resistor R1602 and applied to terminal 8 of P1601 for use within the 618S-1 and 618S-1A.

4-43. The 115-volt, 400-cps power also is applied through surge current limiting resistor R1603 after

K1603 has been energized. The 400-cps voltage is rectified by CR1602 and filtered by the low-pass filter arrangement of C1605A, R1604, C1606, and R1605, producing a negative voltage of 65 volts d-c. The output of this supply is applied to terminal 10 of P1601, and is used as a bias supply for the 618S-1 and 618S-1A power amplifier tubes. The rectified voltage from CR1602 also is applied through the low-pass filter arrangement of C1605B, R1609, R1608, and C1611, producing a negative 50-volt bias supply for the 618S-1 and 618S-1A modulator tubes. The modulator bias supply is made slightly variable by potentiometer R1608, and may be set during alignment procedures. After the bias supplies have been energized, a current path exists through R1607 and K1604 to ground, thereby energizing K1604.

4-44. Dynamotor D1601, in conjunction with the associated filter inductors and capacitors, supplies 250 volts d-c and 600 volts d-c to the 618S-1 and 618S-1A systems. Before primary power is available to run dynamotor D1601, relays K1601, K1602, K1603, and K1604 must be energized and sequence relay K801 of the 618S-1 or 618S-1A must be de-energized. Relays K1602 and K1603 are energized after switches S1601 and S1602 are closed and the OFF PHONE CW switch of the 614C-2 is in either the PHONE or CW positions. Relay K1604 is energized after the -50 volt bias supply is functioning, and bias is applied to the modulator tubes. Sequence relay K801 is de-energized following the channeling cycle of the 618S-1 and 618S-1A. After relays K1602, K1603, K1604 have been energized and sequence relay K801 has been de-energized, 27.5 volts d-c is available at the field winding of K1601. The opposite side of the field winding obtains ground through contacts of switch S2603A within Radio Set Control 614C-2 or through the microphone push-to-talk button, depending upon

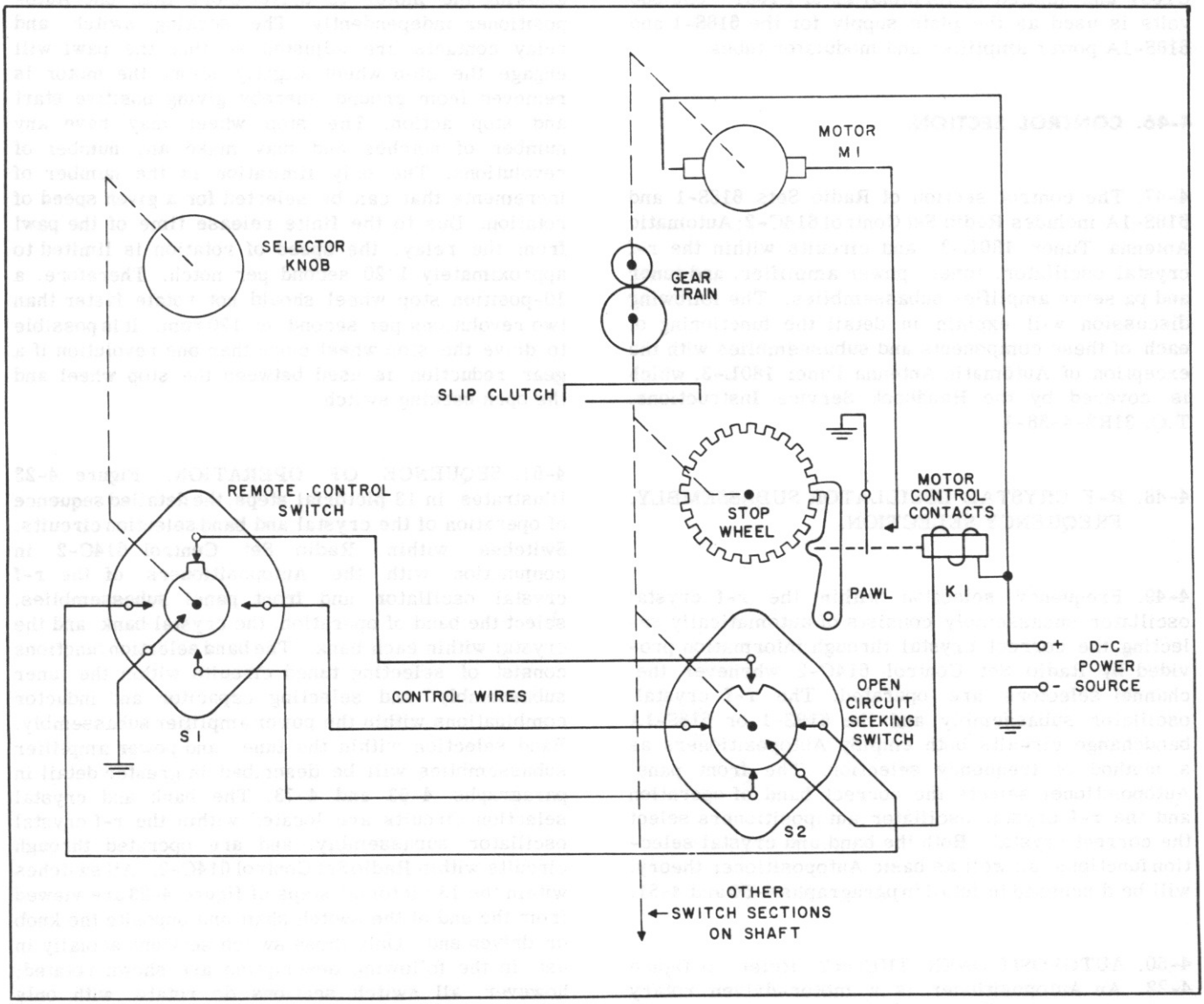

Figure 4-22. Typical Autopositioner System, Simplified Schematic Diagram

the mode of operation. When the 614C-2 OFF PHONE CW switch is in the PHONE position, ground is supplied for K1601 by operation of the microphone push-to-talk button, thus energizing K1601 and starting dynamotor D1601. When in the CW position, ground is supplied continuously through contacts of switch S2603A.

4-45. After relay K1601 has been energized, primary power is available through contacts of K1601 and through the input filter arrangement of C1604, L1603, and C1603 for the low-voltage field of dynamotor D1601. The 27.5 volts is stepped-up by D1601 to 250 volts and 600 volts d-c. The 250-volt output is filtered by L1604, L1601, and the parallel combination of C1608A and C1608B, and applied to terminal 20 of P1601. The 250 volts from D1601 is used as the plate supply for tubes within Automatic Antenna Tuner 180L-3 and Radio Receiver-Transmitter 618S-1 and 618S-1A. The 600-volt output is filtered by L1605 and C1607 and applied to terminal 22 of P1601. The 600 volts is used as the plate supply for the 618S-1 and 618S-1A power amplifier and modulator tubes.

4-46. CONTROL SECTION.

4-47. The control section of Radio Sets 618S-1 and 618S-1A includes Radio Set Control 614C-2; Automatic Antenna Tuner 180L-3; and circuits within the r-f crystal oscillator, tuner, power amplifier, and tuner and pa servo amplifier subassemblies. The following discussion will explain in detail the functioning of each of these components and subassemblies with the exception of Automatic Antenna Tuner 180L-3, which is covered by the Handbook Service Instructions, T.O. 31R2-4-38-1.

4-48. R-F CRYSTAL OSCILLATOR SUBASSEMBLY, FREQUENCY SELECTION.

4-49. Frequency selection within the r-f crystal oscillator subassembly consists of automatically selecting the correct crystal through information provided by Radio Set Control 614C-2 whenever the channel selectors are operated. The r-f crystal oscillator subassembly and the 618S-1 or 618S-1A bandchange circuits both employ Autopositioners as a method of frequency selection. The front panel Autopositioner selects the correct band of operation and the r-f crystal oscillator autopositioners select the correct crystal. Both the band and crystal selection functions, as well as basic Autopositioner theory, will be discussed in detail in paragraphs 4-50 and 4-51.

4-50. AUTOPOSITIONER THEORY. Refer to figure 4-22. An Autopositioner is a motor-driven rotary mechanism, providing for automatic selection of any of a given number of switch positions. The basic elements of the type of Autopositioner systems employed in Radio Set 618S-1 and 618S-1A are illustrated in figure 4-22. The remote control switch (S1) is ganged to a remotely operated selector knob. When the selector knob is rotated, as would be the case for selection of a new channel, switch S1 is operated to a different position. After S1 has been rotated, a ground circuit is provided for the autopositioner relay K1. Relay K1 is energized, lifting the pawl from the stop wheel and closing the ground circuit for motor M1. Motor M1 operates, driving the gear train, the stop wheel, and open seeking switch S2. When switch S2 has been rotated to a corresponding position with switch S1, the ground circuit for relay K1 is removed, and the pawl and motor ground contact are released. The motor runs to a stop, dissipating its kinetic energy in the slip clutch. The Autopositioner system now is relaxed, and will remain so until the selector knob is rotated again. The slip clutch performs the dual functions of dissipating the kinetic energy of the motor and allowing the motor to drive more than one Autopositioner independently. The seeking switch and relay contacts are adjusted so that the pawl will engage the stop wheel slightly before the motor is removed from ground, thereby giving positive start and stop action. The stop wheel may have any number of notches and may make any number of revolutions. The only limitation is the number of increments that can be selected for a given speed of rotation. Due to the finite release time of the pawl from the relay, the speed of rotation is limited to approximately 1/20 second per notch. Therefore, a 10-position stop wheel should not rotate faster than two revolutions per second, or 120 rpm. It is possible to drive the stop wheel more than one revolution if a gear reduction is used between the stop wheel and the open seeking switch.

4-51. SEQUENCE OF OPERATION. Figure 4-23 illustrates, in 13 pictorial steps, the detailed sequence of operation of the crystal and band selection circuits. Switches within Radio Set Control 614C-2, in conjunction with the Autopositioners of the r-f crystal oscillator and front panel subassemblies, select the band of operation, the crystal bank, and the crystal within each bank. The band selection functions consist of selecting tuned circuits within the tuner subassembly, and selecting capacitor and inductor combinations within the power amplifier subassembly. Band selection within the tuner and power amplifier subassemblies will be described in greater detail in paragraphs 4-63 and 4-73. The bank and crystal selection circuits are located within the r-f crystal oscillator subassembly, and are operated through circuits within Radio Set Control 614C-2. All switches within the 13 pictorial steps of figure 4-23 are viewed from the end of the switch shaft and opposite the knob or driven end. Only those switch sections actually in use in the following description are shown rotated; however, all switch sections do rotate, with only those illustrated actually connected to the circuit.

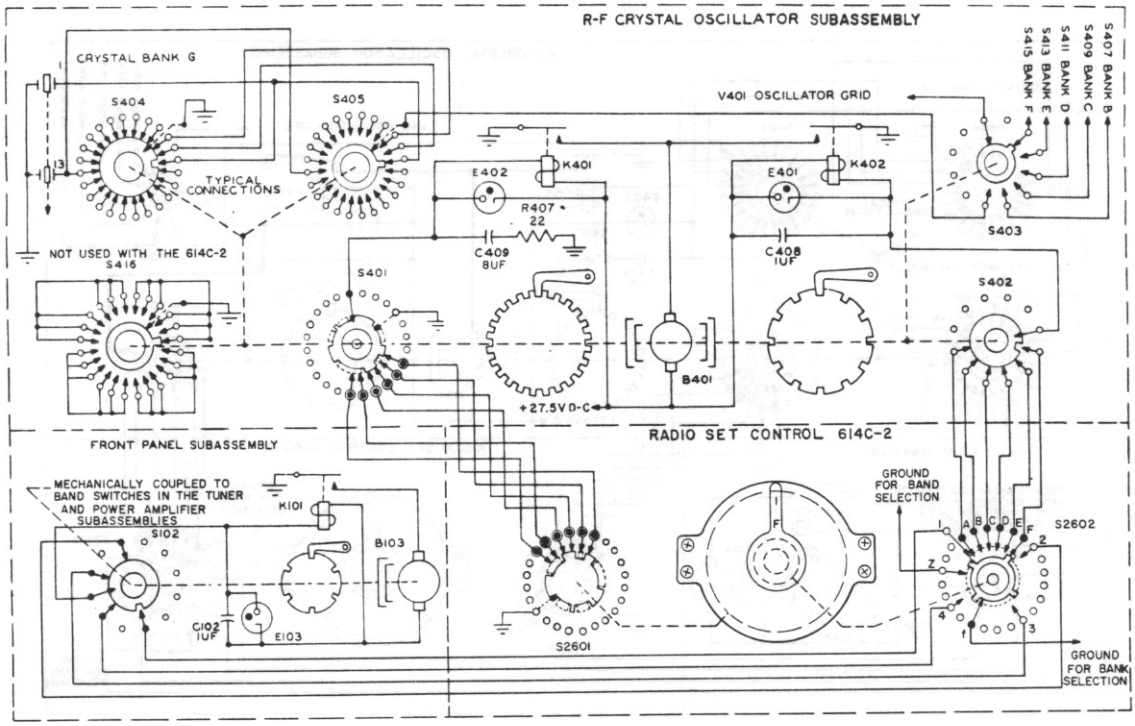

Figure 4-23. Autopositioner Sequence of Operation (Step 1 of 13 steps)

a. It is desired to select a frequency corresponding to the G-13 crystal position.

b. The Autopositioner systems are at rest in the previously selected position, F1. Note that the crystal shorting switch for bank F, S414, is not shown and the crystal selector switch for bank F, S415, is indicated.

c. Voltage (27.5 volts d-c) is available to the control system. A ground must be supplied before system will operate.

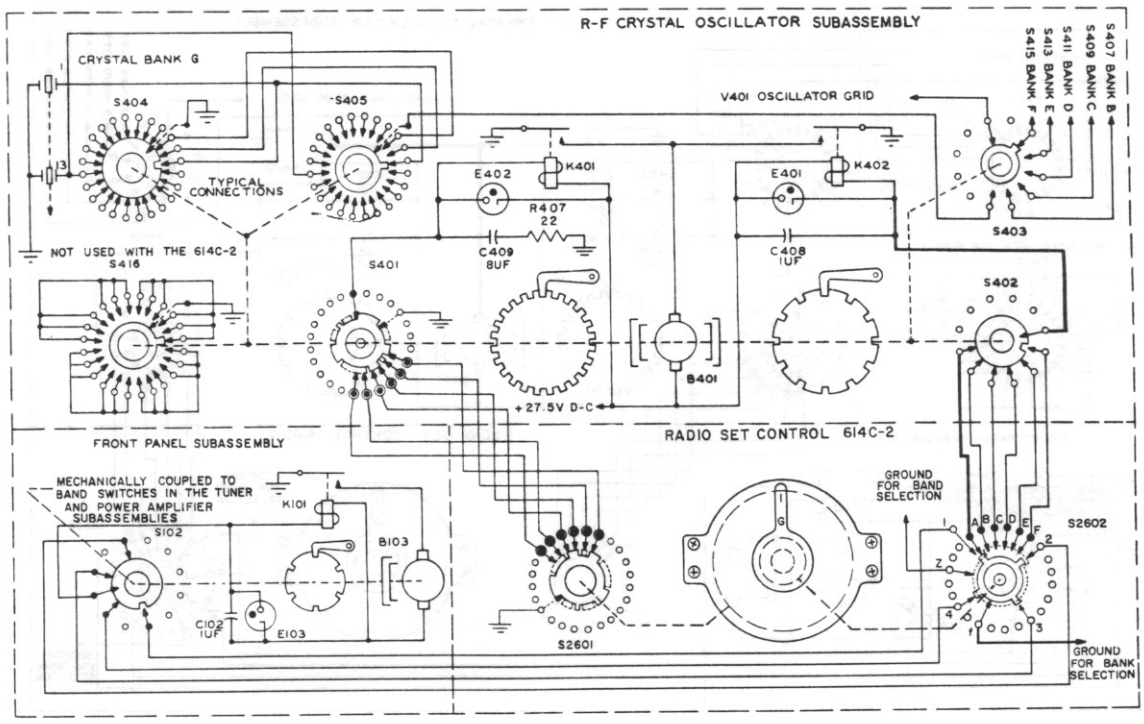

Figure 4-23. Autopositioner Sequence of Operation (Step 2 of 13 steps)

d. Bank-band selector S2602 is rotated to the G position by operation of the middle 614C-2 knob.

e. The field of relay K402 is grounded through contacts of S402 and the front section (solid lines) of S2602, energizing K402.

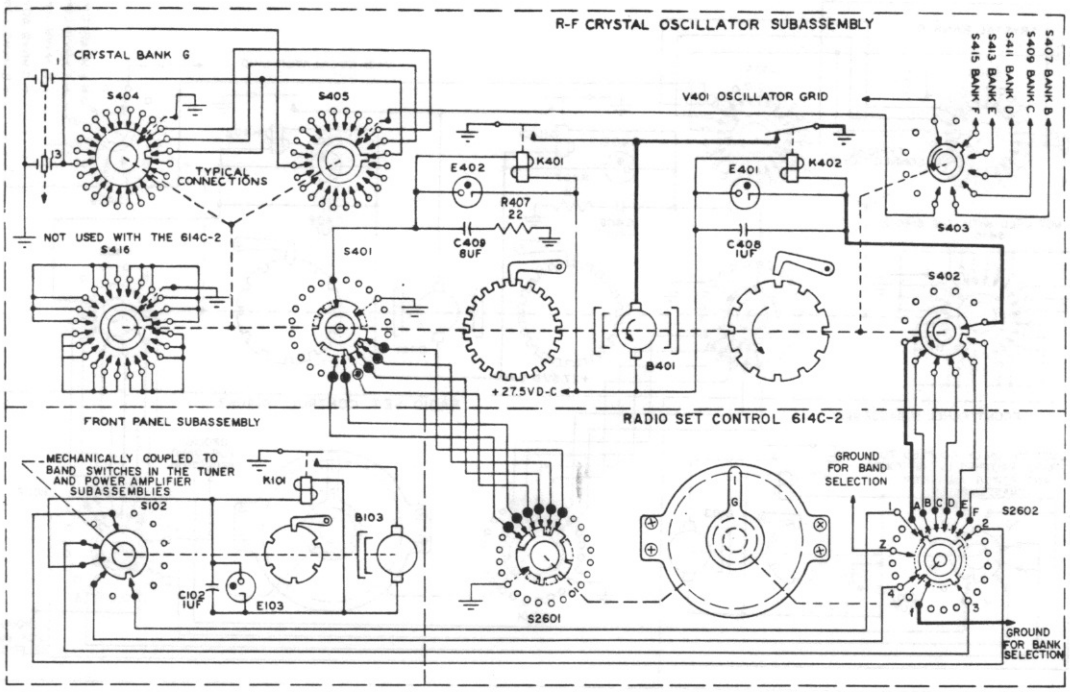

Figure 4-23. Autopositioner Sequence of Operation (Step 3 of 13 steps)

f. Contacts of relay K402 energize motor B401 and lift the pawl from the bank selector stop wheel.

g. Motor B401 rotates, driving switches S401 and S402 and the bank selector stop wheel.

h. Clutch on the crystal selector autopositioner side of B401 slips.

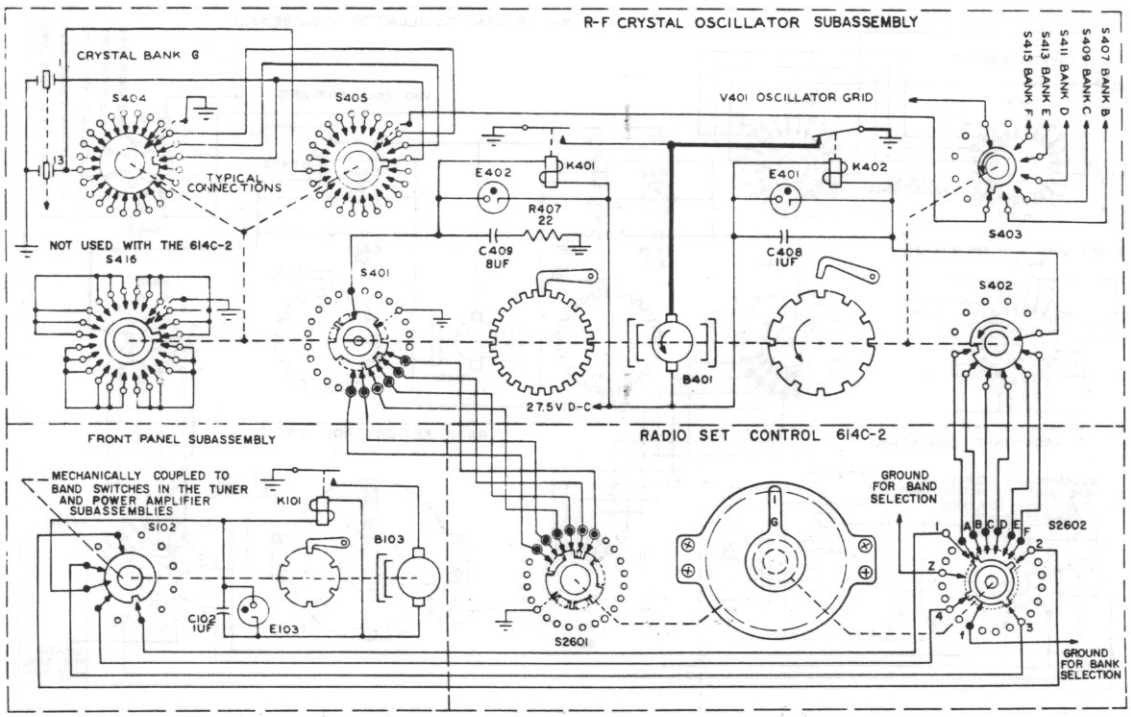

Figure 4-23. Autopositioner Sequence of Operation (Step 4 of 13 steps)

i. Switch S402 finds an open circuit position, which corresponds to the bank G position.

j. The field of relay K402 is opened from the ground circuit.

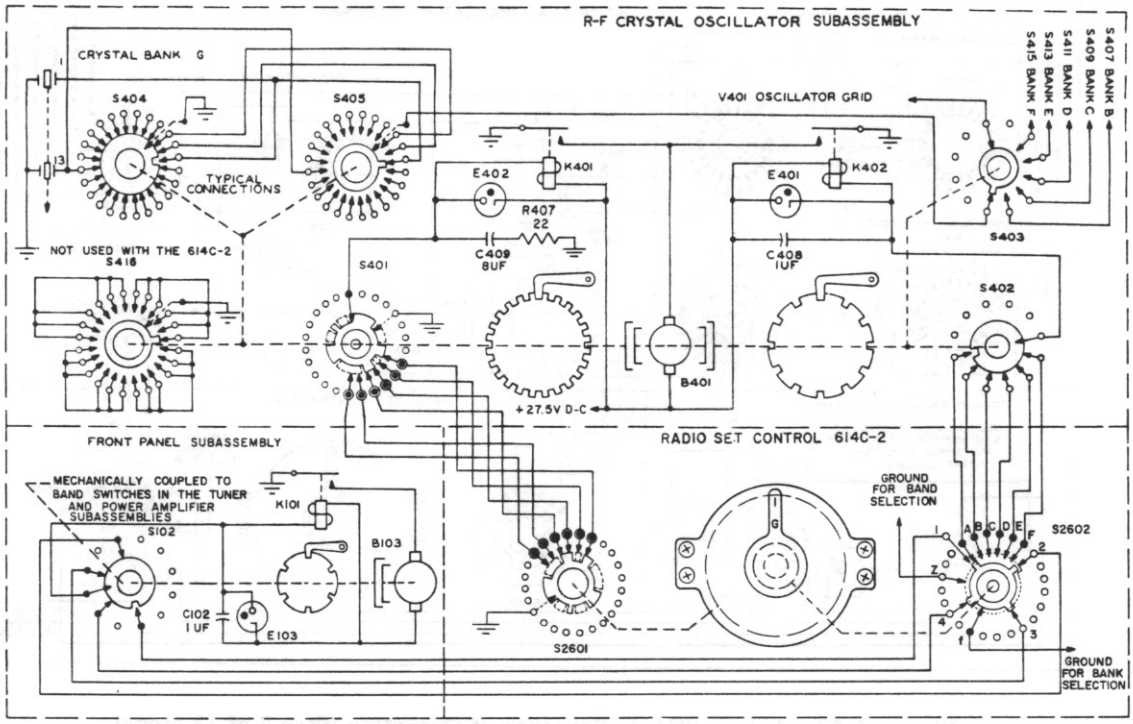

Figure 4-23. Autopositioner Sequence of Operation (Step 5 of 13 steps)

k. Relay K402 releases the pawl of the bank selector stop wheel and removes the 27.5-volt d-c from motor B401.

l. The kinetic energy of motor B401 is dissipated in the slip clutch and the bank selector autopositioner system comes to rest in the G position.

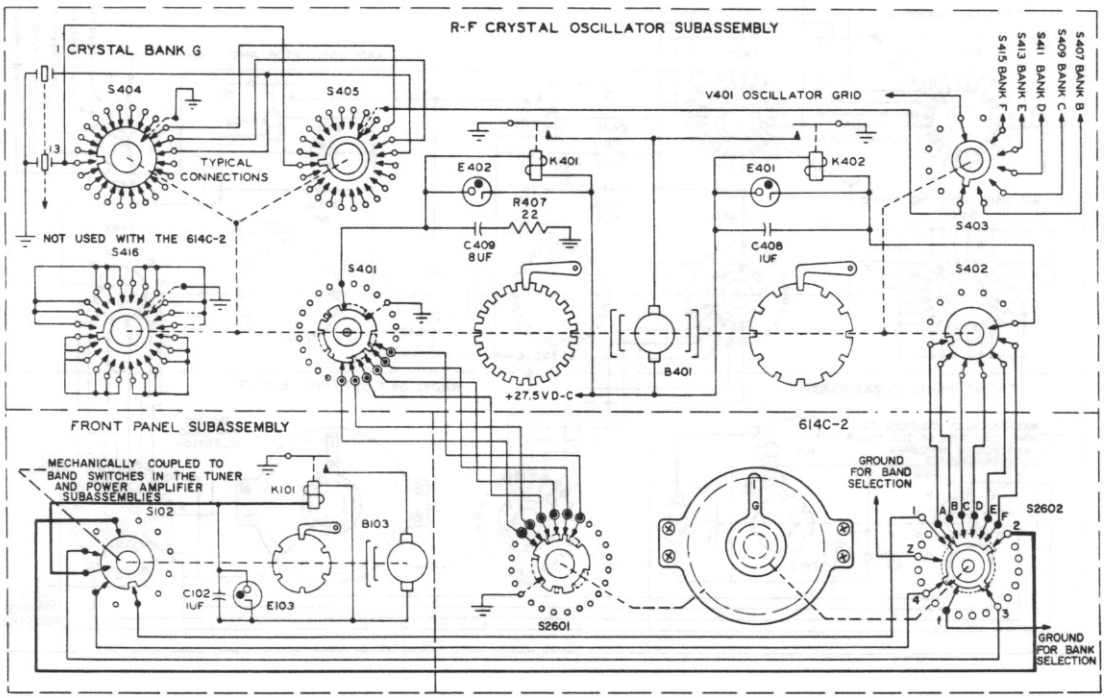

Figure 4-23. Autopositioner Sequence of Operation (Step 6 of 13 steps)

m. Rotation of the middle 614C-2 knob to the G position (step No. 2d) also results in the field of relay K101 being grounded through contacts of S102 and S2602.

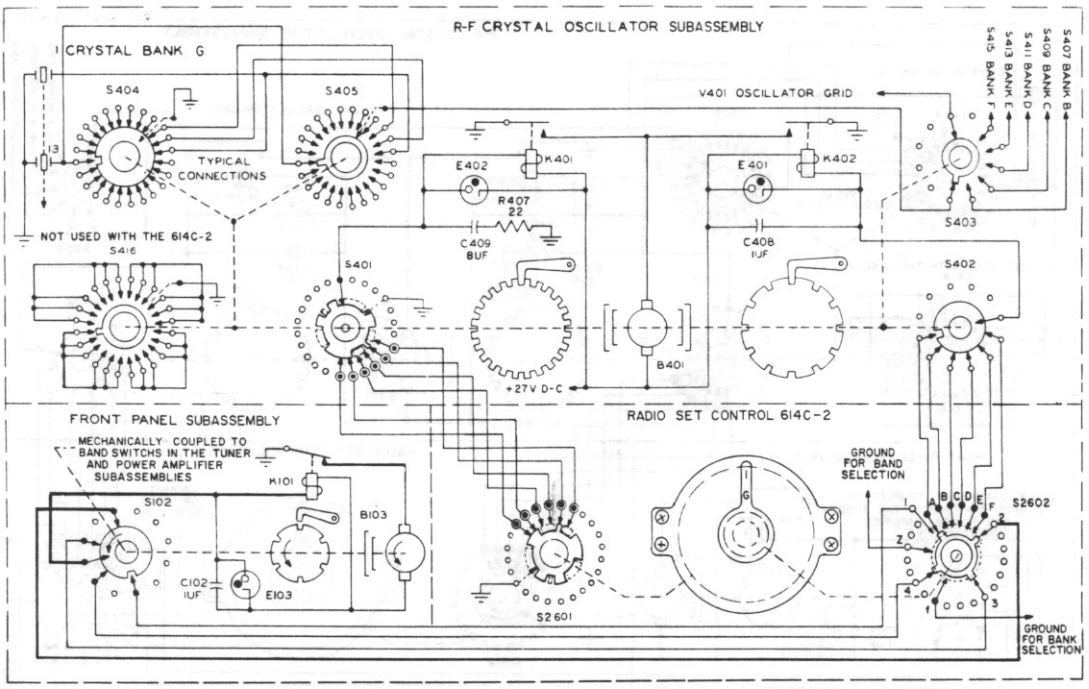

Figure 4-23. Autopositioner Sequence of Operation (Step 7 of 13 steps)

n. Contacts of relay K101 energizes motor B103 and lifts the pawl from the band selector stop wheel.

o. Motor B103 rotates, driving switch S102, the band selector stop wheel, and the bank selector switches of the 618S-1 or 618S-1A tuner and power subassemblies.

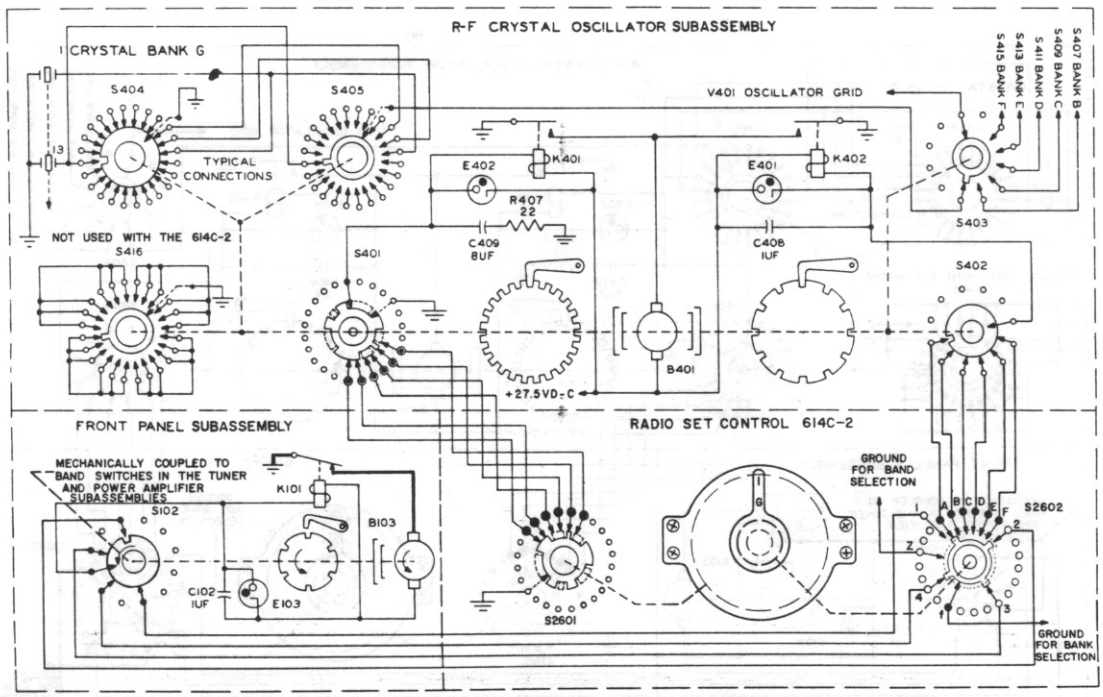

Figure 4-23. Autopositioner Sequence of Operation (Step 8 of 13 steps)

p. Switch S102 finds an open circuit position, which corresponds to the new band position (in this case, band 2).

q. The field of relay K101 is opened from the ground circuit.

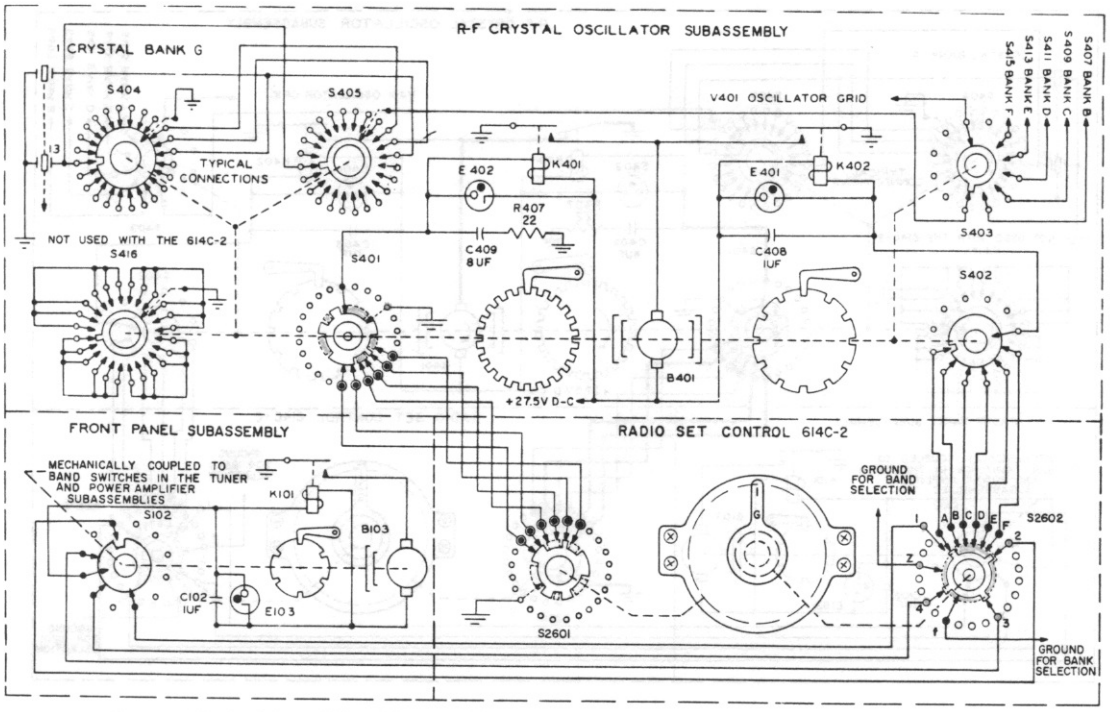

Figure 4-23. Autopositioner Sequence of Operation (Step 9 of 13 steps)

r. Relay K101 releases the pawl of the band selector stop wheel and removes the 27.5-volt d-c from motor B103.

s. The kinetic energy of motor B103 is dissipated in the slip clutch and the band selector autopositioner system comes to rest in the proper position.

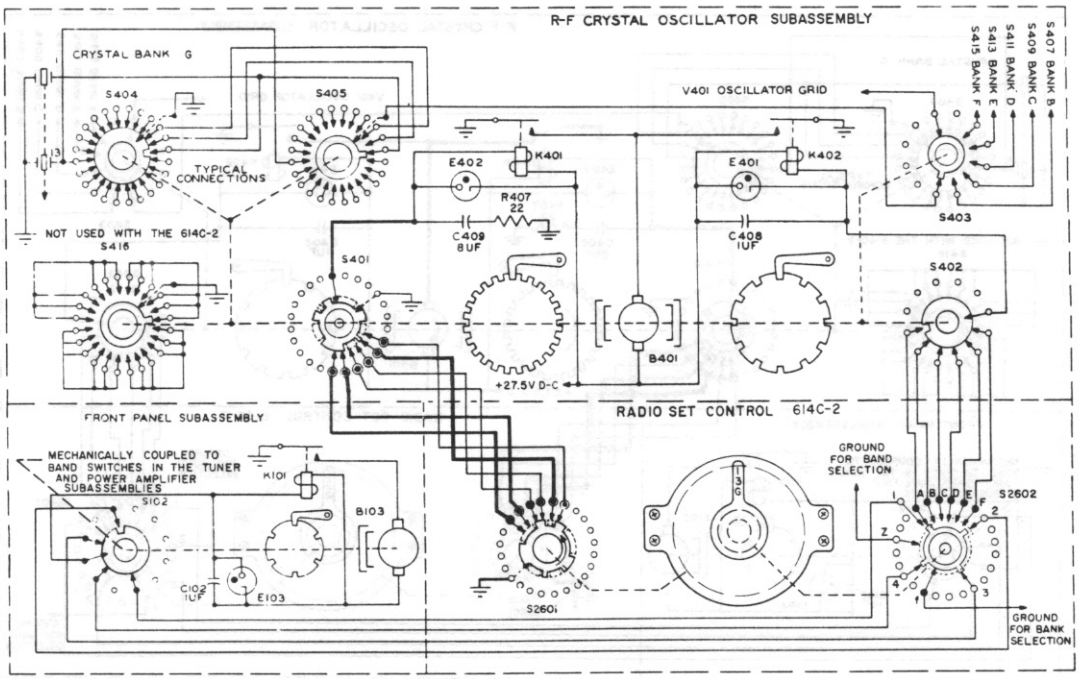

Figure 4-23. Autopositioner Sequence of Operation (Step 10 of 13 steps)

t. Crystal selector S2601 is rotated to the 13 position by operation of the large 614C-2 knob.

u. The field of relay K401 is grounded through contacts of S401 and S2601, energizing K401.

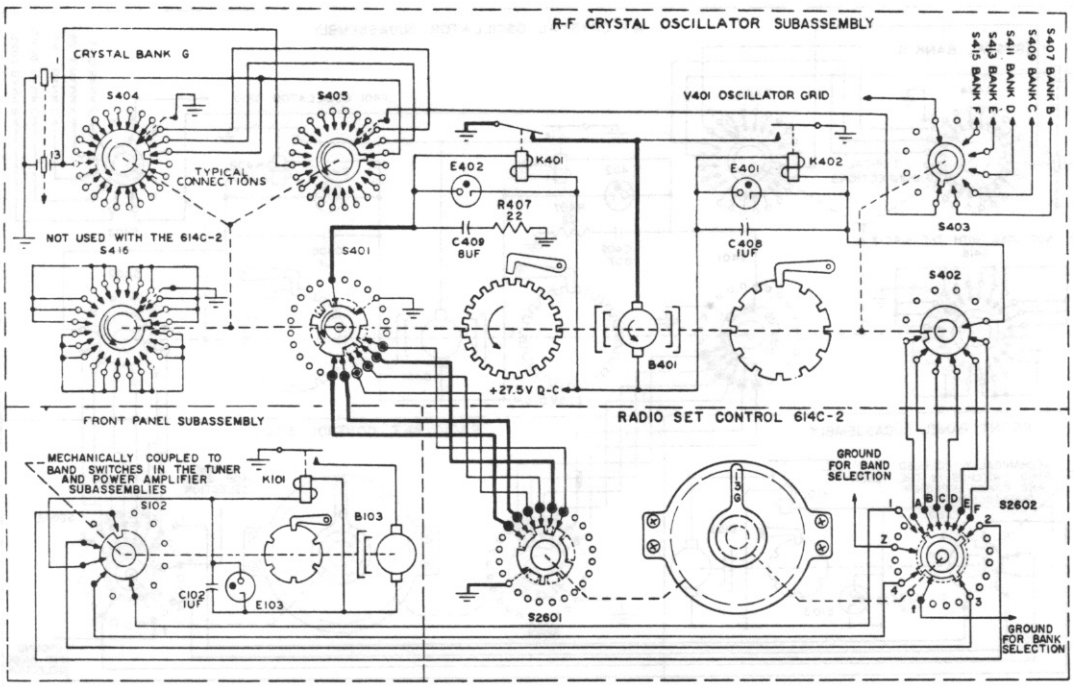

Figure 4-23. Autopositioner Sequence of Operation (Step 11 of 13 steps)

v. Contacts of relay K401 energizes motor B401 and lifts the pawl from the crystal selector stop wheel.

w. Motor B401 rotates, driving switches S401, S404, and S405, and the crystal selector stop wheel.

x. Clutch on the bank selector autopositioner side of B401 slips.

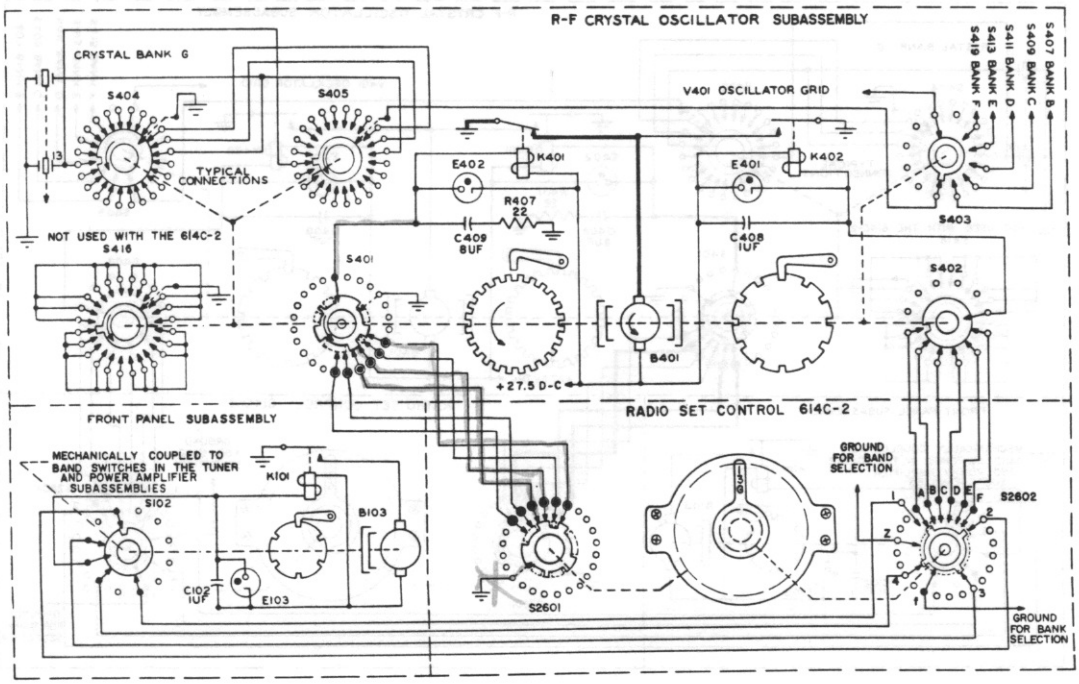

Figure 4-23. Autopositioner Sequence of Operation (Step 12 of 13 steps)

y. Switch S401 finds an open circuit position, which corresponds to the crystal 13 position.

z. The field of relay K401 is opened from the ground circuit.

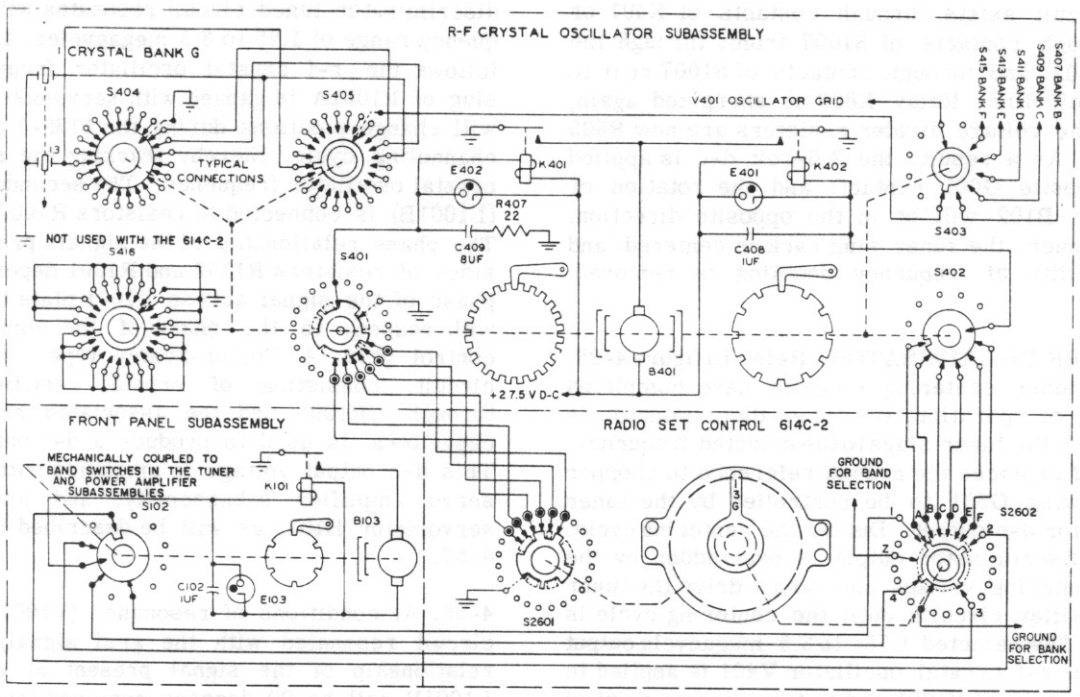

Figure 4-23. Autopositioner Sequence of Operation (Step 13 of 13 steps)

aa. Relay K401 releases the pawl of the crystal selector stop wheel and removed the 27.5-volt d-c from motor B401.

bb. The kinetic energy of motor B401 is dissipated in the slip clutch and the crystal selector autopositioner system comes to rest in the 13 position.

4-52. TUNER SUBASSEMBLY, FREQUENCY SELECTION.

4-53. TUNER TABLE CENTERING CIRCUIT. The 1.75- to 3.5-megacycle signal from the r-f crystal oscillator stage, V401, is applied to the control grid of tuner discriminator V1001. The tuner discriminator, in conjunction with the tuner servo amplifiers (V601 and V602) and servomotor B102, performs the function of setting the tuner slugs to the correct operating position. With certain tuner slug positions, it might be possible to resonate the tuned circuits to the second harmonic of the master oscillator frequency. To prevent this from happening, the tuner table centering circuit, illustrated in figure 4-24, is used to assure the return of the tuner slugs to the center position before setting up. Switch wafers S1007 front and rear are illustrated in figure 4-24 in an open circuit condition. This is the position corresponding to the center position of the tuner slugs. When at rest at a certain frequency, switch wafers S1007 front and rear will be in a different position than illustrated; however, an open circuit for the 27.5-volt line will still exist until relay K401 or K402 is energized. Relay K401 is energized whenever a new crystal is selected and relay K402 is energized whenever a new bank or band is selected, as described in paragraph 4-51 and figure 4-23. Assume that the tuner slug rack is at rest in such a position that S1007 front and rear are rotated one position clockwise and a new channel has been selected. A ground circuit now exists through contacts of K401 or K402 through contacts of S1007 rear, through the field of relay K802, and through contacts of S1007 front to the 27.5-volt d-c line. Relay K802 is energized and provides its own holding ground. Contacts of relay K802 connect to contacts of chopper G601 within the tuner servo amplifier subassembly. With S1007 front and rear rotated one position clockwise, one of the G601 contacts is connected between the voltage divider arrangement of R804 and R803, resulting in a d-c voltage of approximately 2.6 volts being applied between the G601 contact and ground. The other G601 contact is connected across the parallel arrangement of R806 and R805 to ground, and no voltage is present at this contact. Conditions now are correct for the tuner servomechanism to operate, and servomotor B102 rotates the tuner slug rack and switch S1007 front and rear. Operation of the tuner servomechanism and circuitry will be described in detail in paragraph 4-57. Switch S1007 front and rear will rotate until the wafers again are at an open circuit position, at which time the tuner slugs will be centered and relay K802 is de-energized. If, before the channel is changed, the tuner slug rack is at rest in such a position that the opposite direction of rotation of servomotor B102 is required to center the slugs, switch S1007 front and rear will be rotated in the opposite direction. This may be illustrated by assuming S1007 front and rear are rotated one position counterclockwise in figure 4-24. In this case, as soon as relays K401 or K402 are energized, a

ground circuit exists through contacts of K401 or K402, through contacts of S1007 front, through the field of K802, and through contacts of S1007 rear to the 27.5-volt line. Relay K802 is energized again; however, the voltage divider resistors are now R805 and R806. As a result, the 2.6-volt d-c is applied to the opposite G601 contact, and the rotation of servomotor B102 will be in the opposite direction. In this manner, the tuner slug rack is centered, and the possibility of frequency doubling is removed.

4-54. TUNER DISCRIMINATOR. Refer to figure 4-25. After the tuner centering circuits have completed their cycle of operation, the tuner discriminator is free to drive the tuner slugs to the selected frequency. Relay K802 replaces the ground reference to chopper G601, allowing G601 to be controlled by the tuner discriminator d-c output. During the centering cycle, the tuner discriminator output is overridden by the 2.6-volt centering voltage and cannot drive the tuner servo amplifier circuits until the centering cycle is complete. The selected 1.75- to 3.5-megacycle output signal from r-f crystal oscillator V401 is applied to the control grid of V1001 and to the common point of resistors R1001 and R1002. The 1.75- to 3.5-megacycle signal is amplified and developed across the tuned circuit consisting of the primary of T1001 and capacitors C1002, C1001, and C1124. The tuner discriminator tuned circuit resonates within the frequency range of 1.75 to 3.5 megacycles, and therefore follows the r-f crystal oscillator frequency. The slug of L1001A is ganged with servomotor B102, and will change positions during the 618S-1 and 618S-1A channeling cycle, thereby tracking the selected r-f crystal oscillator frequency. The secondary of T1001 (L1001B) is connected to resistors R1002 and R1001. The phase relationship of the signals present at both sides of resistors R1002 and R1001 depends upon the phase of the signal across V1001 plate tuned circuit with respect to the phase of the signal at V1001 control grid. A Foster-Seeley type discriminator circuit, consisting of crystal rectifiers CR1001 through CR1004 and the associated resistors and capacitors, is used to produce a d-c output voltage. This d-c output voltage is amplified within the tuner servo amplifier subassembly, and used to drive servomotor B102, as will be described in paragraph 4-57.

4-55. At conditions of resonance (V1001 plate tuned circuit resonated with the grid signal), the phase relationship of the signal present at each side of L1001B will be 90 degrees removed from the signal at the junction point of R1001. (The voltage across R1001 is equal to the voltage across R1002 and is of the opposite phase.) The output of the tuner discriminator circuit, through the parallel arrangement of

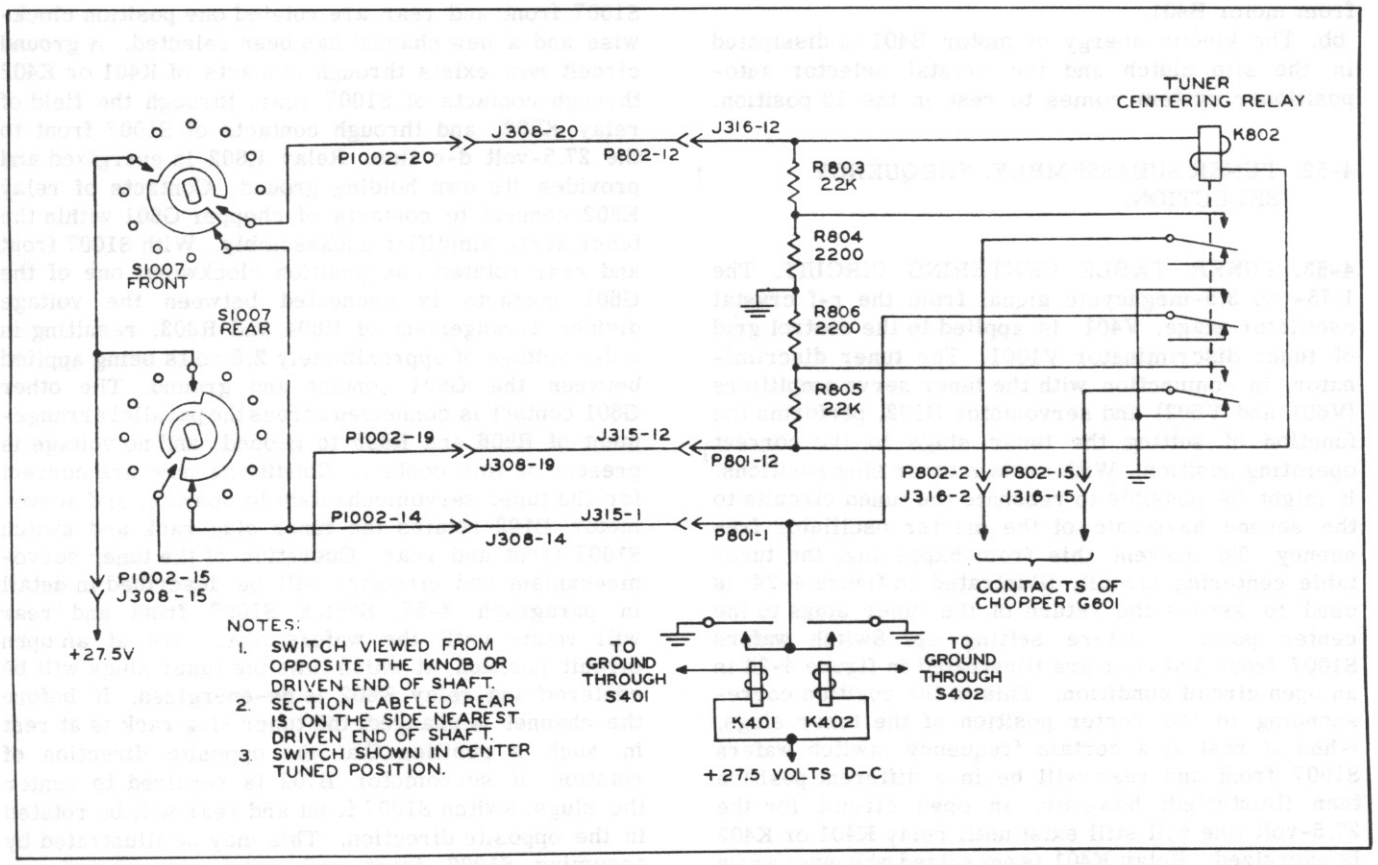

Figure 4-24. Tuner Table Centering Circuit, Simplified Schematic Diagram

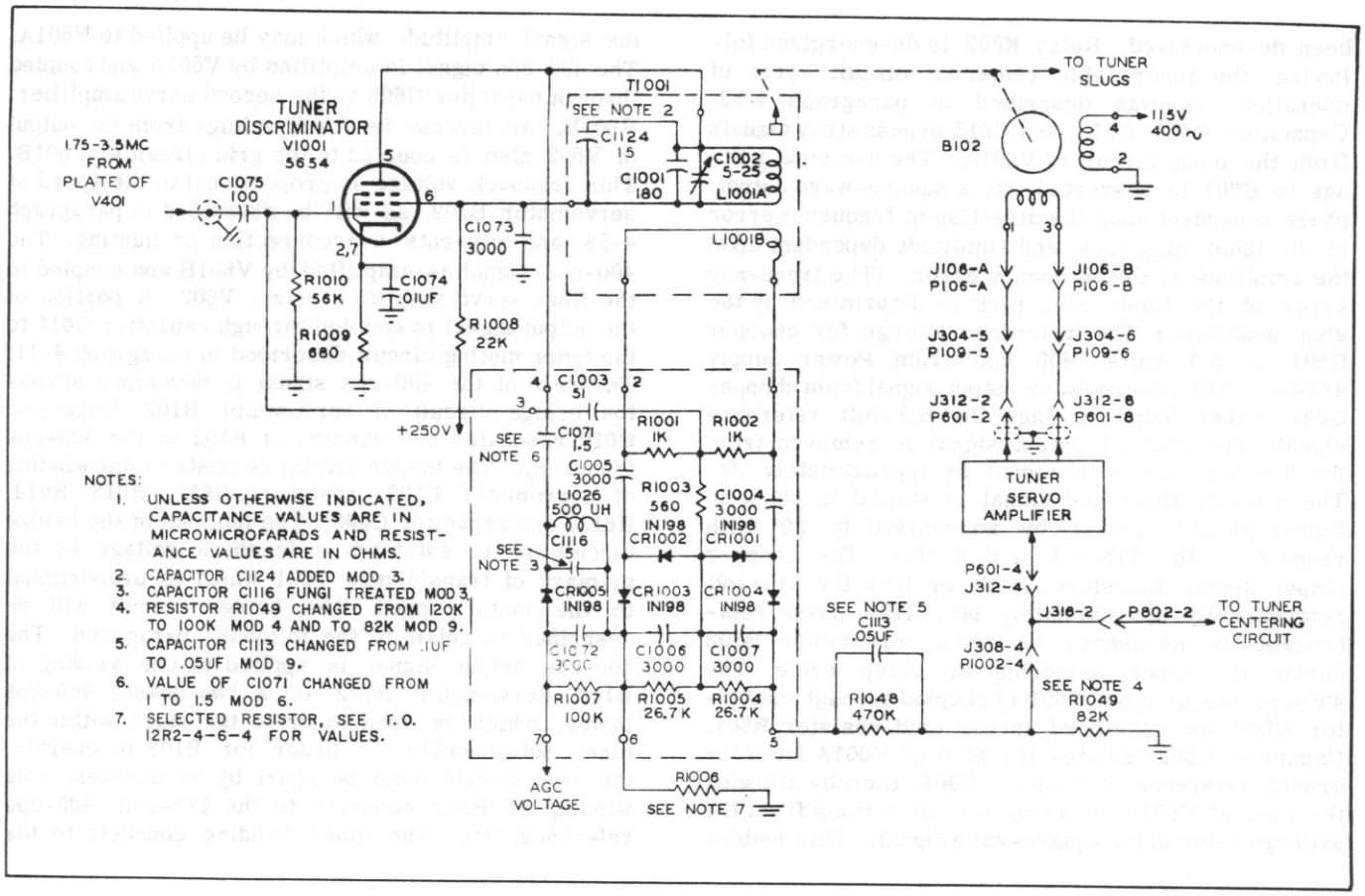

Figure 4-25. Tuner Discriminator and Servomotor B102, Simplified Schematic Diagram

C1113 and R1048, therefore is zero. If the slug of L1001 is not adjusted to the correct position for resonance with the grid signal, the balance condition will no longer exist. Assume the slug of L1001A is off resonance in a direction causing the voltage across R1001 to be larger than the voltage across R1002 because of the vector addition of the grid and plate signals. In this case, the charge path for C1005 is through CR1002, R1003, and R1001. On the following alternation of L1001B, C1005 will discharge through R1001, R1003, R1005, and CR1003. A voltage doubling action occurs, with the net C1005 current adding to the net L1001B current. The discriminator output voltage is no longer zero, but is a particular amplitude d-c, polarity dependent upon the direction off resonance and amplitude dependent upon the amount off resonance. If the slug of L1001A is off resonance causing the voltage across R1002 to be larger than the voltage across R1001, capacitor C1004 becomes the dominant capacitor. In this case, C1004 charges through CR1001, R1003, and R1002. The discharge path is through R1002, R1003, R1004, and CR1004, the current adding to the net L1001B current. The output d-c voltage is of the opposite polarity, amplitude dependent upon the distance off resonance. At resonance, there will be no net current, either from capacitors C1004 and C1005 or from L1001B. Therefore, as soon as the slug of L1001A is correctly set up, the tuner discriminator output will be zero, and servomotor B102 no longer will operate. The d-c output is applied through the parallel combination of R1048 and C1113 and developed across R1049. The time constant formed by R1048 and C1113 will prevent overcorrection or hunting while not destroying the sensitivity of the frequency correction circuits.

4-56. A part of the signal from the plate of V1001 is coupled through capacitor C1071 and developed across a tuned circuit consisting of L1026 and C1116. This tuned circuit, in conjunction with the distributed capacity, is resonant at the lower and midrange of the r-f crystal oscillator frequency spectrum, and tends to increase the voltage across CR1005 for these frequencies. The signal is rectified by CR1005 and filtered by the parallel combination of capacitor C1007 and resistors R1006 and R1007. The resultant voltage is a negative d-c, amplitude dependent upon the input signal to V1001. This negative d-c voltage is used to provide agc to variable i-f amplifier V1002, and compensates for a varying r-f crystal oscillator output.

4-57. TUNER SERVO AMPLIFIER SUBASSEMBLY AND SERVOMOTOR. Refer to figure 4-26. The d-c output from the tuner discriminator circuit is applied to the lower contact of chopper G601. The top contact of G601 is grounded after relay K802 has

been de-energized. Relay K802 is de-energized following the tuner table centering circuit cycle of operation, as was described in paragraph 4-53. Capacitors C601, C612, and C613 bypass stray signals from the input circuit of V601A. The d-c input voltage to G601 is converted into a square-wave output, phase dependent upon the direction of frequency error in the tuner slug rack, and amplitude dependent upon the amplitude of the frequency error. (The frequency error of the tuner slug rack is determined by the slug positions.) The reference voltage for chopper G601 is 6.3 volts, 400 cps from Power Supply 416W-1. The square-wave output signal from chopper G601 either leads or lags the 6.3-volt reference signal. The chopper output signal is removed from the 6.3-volt reference signal by approximately 70°. The 6.3-volt reference signal is shifted in phase in Power Supply 416W-1 by approximately 20° with respect to the 115-volt a-c source. The chopper output signal, therefore, leads or lags the 115-volt reference by approximately 90°. This phase relationship is necessary to drive servomotor B102 during the tuner centering or setup cycle. The 400-cps signal from G601 is coupled through capacitor C602 and developed across grid resistor R601. Capacitor C602 isolates the grid of V601A from the ground reference of chopper G601, thereby allowing the grid of V601A to swing both directions from the average value of the square-wave signal. This doubles the signal amplitude which may be applied to V601A. The 400-cps signal is amplified by V601A and coupled through capacitor C605 to the second servo amplifier, V601B. An inverse feedback voltage from the output of V602 also is coupled to the grid circuit of V601B. This feedback voltage is proportional to the speed of servomotor B102, as will be described in paragraph 4-58, and prevents overcorrection or hunting. The 400-cps signal is amplified by V601B and coupled to the final servo amplifier stage, V602. A portion of the output signal is coupled through capacitor C611 to the tuner muting circuit described in paragraph 4-11. The rest of the 400-cps signal is developed across the bridge circuit of servomotor B102. Capacitor C610 resonates one winding of B102 to the 400-cps frequency. The bridge circuit consists of one winding of servomotor B102, resistors R611, R613, R614, R612, and capacitor C609. The function of the bridge circuit is to establish a feedback voltage to the primary of transformer T601 which is proportional to the motor speed. The bridge circuit will be described in detail in the following paragraph. The 400-cps output signal is applied to one winding of B102. Servomotor B102 is a two-phase, 400-cps motor, which is used to drive the slugs within the tuner subassembly. In order for B102 to operate, the two signals must be apart by 90 degrees. One winding of B102 connects to the 115-volt, 400-cps reference line. The other winding connects to the

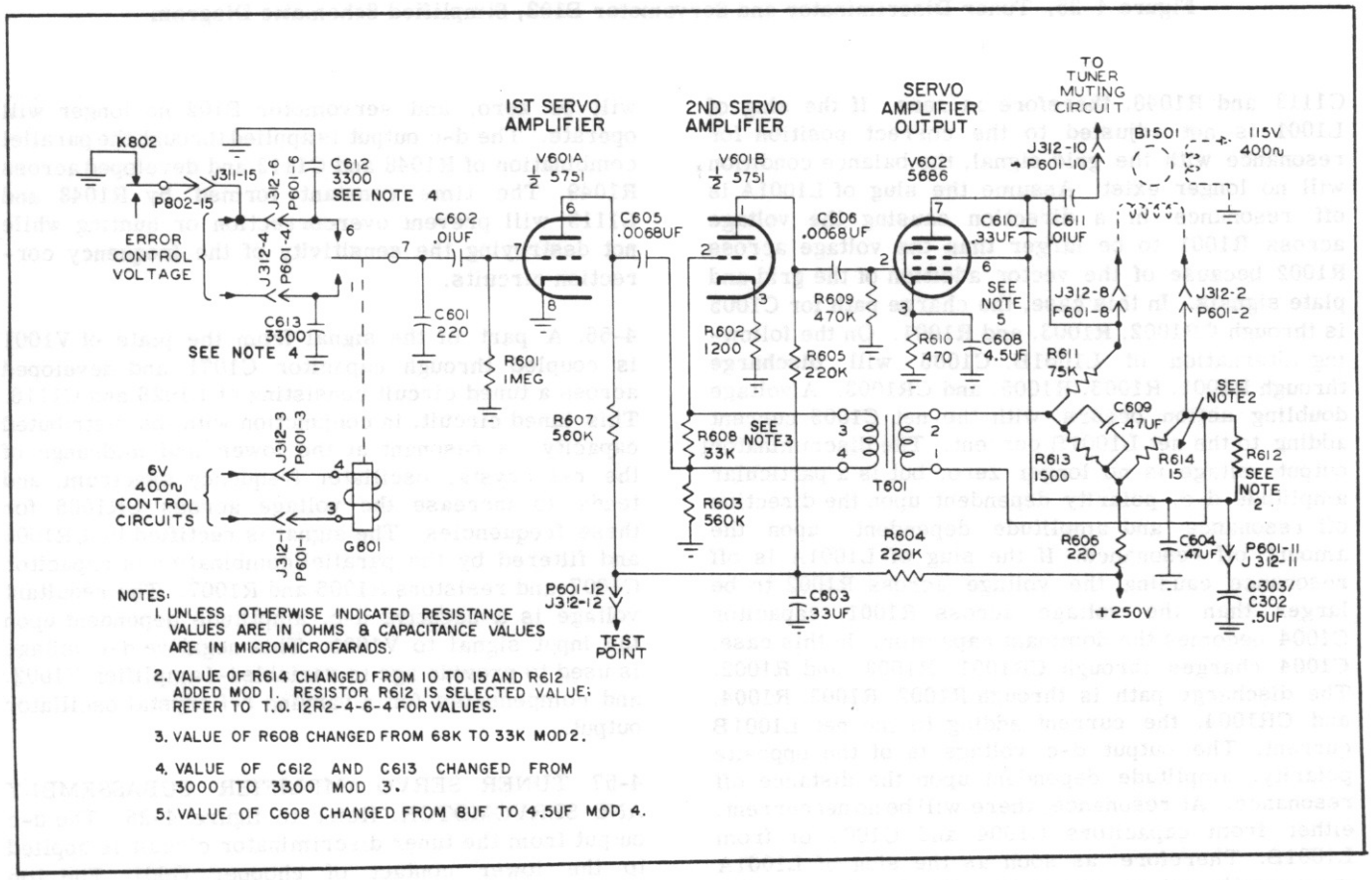

Figure 4-26. Tuner Servo Amplifier Subassembly and Servomotor B102, Simplified Schematic Diagram

servo amplifier output signal. The phase of the servo amplifier output signal with respect to the phase of the 115-volt reference voltage will be either leading or lagging 90 degrees. When the d-c input to chopper G601 is negative, B102 will rotate in one direction; when positive, B102 will rotate in the opposite direction. The polarity of the d-c input voltage is dependent upon the direction of frequency error, and therefore, B102 will drive the tuner slugs either up or down, depending upon the direction necessary to set up the tuned circuits. After the slugs have been driven to the setup position, the d-c voltage to chopper G601 is removed, and B102 stops. The servo amplifier circuits employed for the power amplifier subassembly are identical to those described in this paragraph. The origin of the d-c input voltage from the power amplifier subassembly will be described in detail in paragraphs 4-60 and 4-61. Otherwise, the operation is identical, and the output of V602 will drive servomotor B1501 to set up the power amplifier frequency. The mechanical operation of servomotors B102 and B1501 will be described in detail (figure 4-27) in paragraphs 4-59 through 4-61.

4-58. Reference is made to figure 4-27 for a functional diagram of the rate bridge circuits employed in the tuner servo amplifier subassembly. In this diagram, g represents the counter emf of servomotor B102; R_3 and L_3 represent the plate winding of B102; R_4 represents the parallel combination of R614 and R612; R_2 and C_2 represent the parallel combination of R613 and C609, respectively; the power source represents the 400-cps output signal from V602; and V represents the signal applied to the primary of transformer T601. The circuit illustrated in figure 4-27 is electrically equivalent to the circuitry at the plate of V602. When the bridge circuit is balanced, zero voltage from the power source will be present between terminals V. It can be proved mathematically that two independent conditions for balance exist. These are: $R_1 R_4 = R_2 R_3$ and $R_1 R_4 C_2 = L_3$. Notice that the two equations have no frequency terms. Theoretically, the bridge is ideally balanced at all frequencies. With the bridge balanced, no voltage will be present from the power source; however, since g is in one leg only, a voltage proportional to the speed of motor B102 will be present between terminals V. The voltage between terminals V is applied to the primary of T601, and is used to limit the gain of V601B and V602.

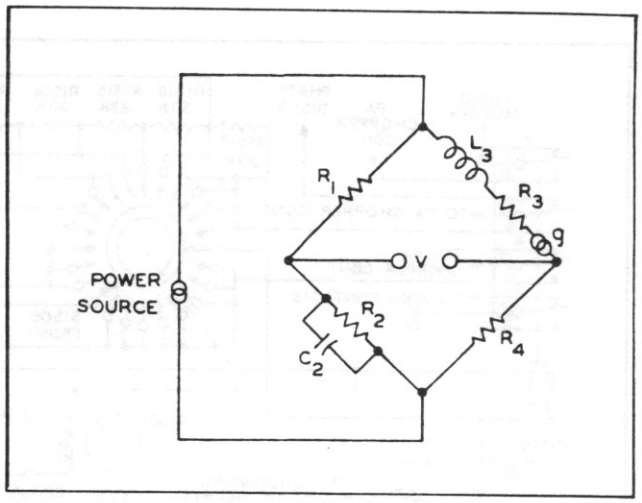

Figure 4-27. Rate Bridge, Functional Diagram

4-59. POWER AMPLIFIER SUBASSEMBLY, FREQUENCY SELECTION.

4-60. BAND CENTERING CIRCUITS. Reference is made to the simplified schematic diagram, figure 4-7. Rough tuning of the power amplifier subassembly consists of selecting the proper network values of inductance and capacitance for the band selected. Switches S1501 through S1504 perform these functions. Switches S1501 through S1504 and S1506 are operated by the band selector autopositioner motor, B103. Switches S1506 and S1505 and the associated circuits perform the function of placing the roller of main tuning inductor L1502 to the center position of the band selected. Figure 4-28 illustrates the approximate tuning ranges for each band. The rear section of switch S1505 serves as a protective stop mechanism. If, for any reason, servomotor B1501 continues to rotate until the shorting roller of L1502 approaches either extreme end of travel, one of two sets of contacts of S1505 rear are shorted and the power amplifier band centering circuits recycle. Reference is made to figure 4-29 for the sequence of operation of the power amplifier band centering circuits.

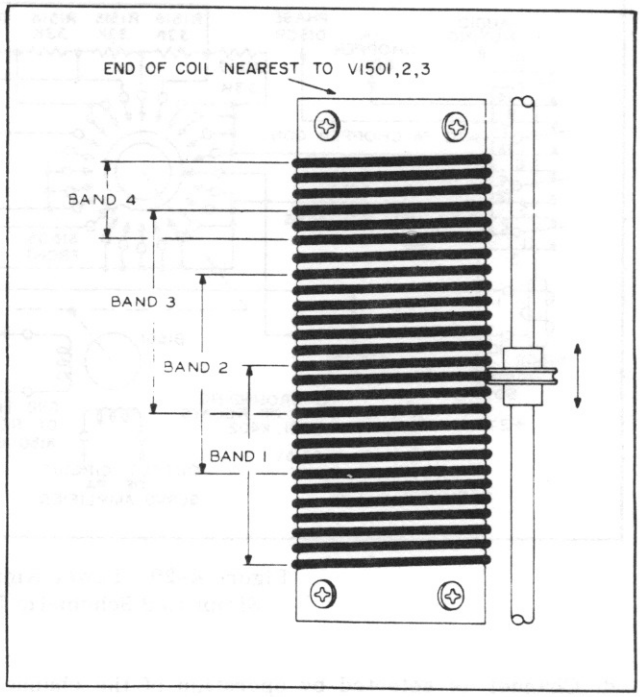

Figure 4-28. Inductor L1502, Approximate Tuning Ranges, Functional Diagram

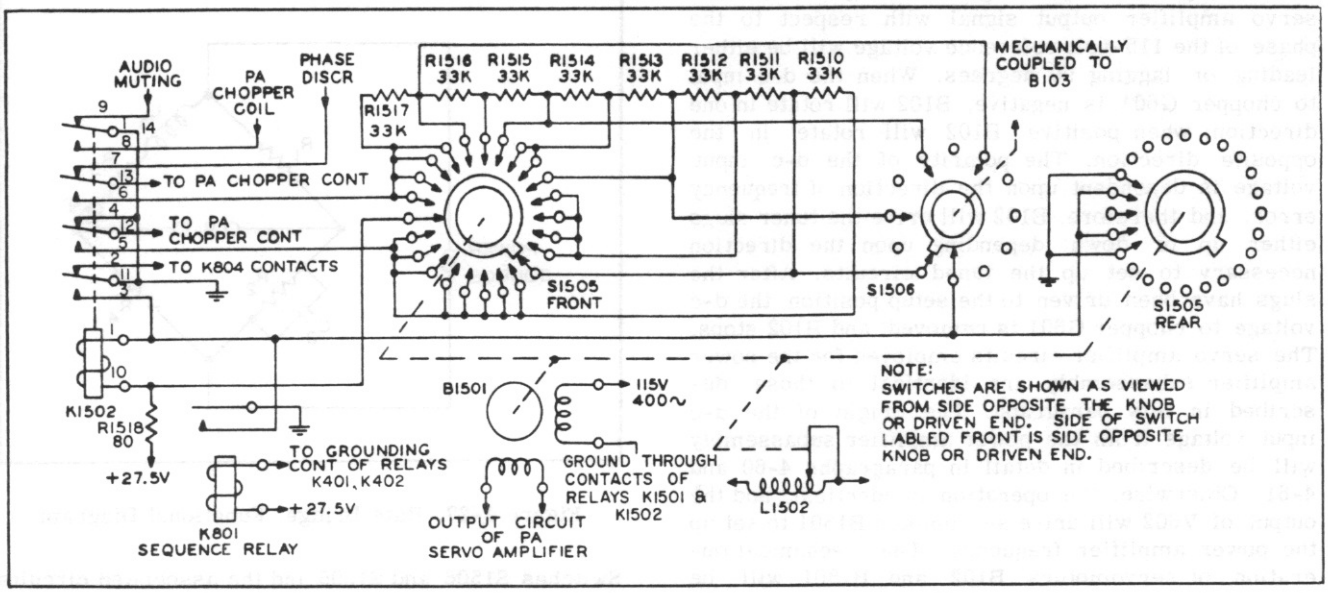

Figure 4-29. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 1 of 4 steps)

a. A frequency in band 3 is to be selected.

b. Centering circuits are at rest with switches in a position corresponding to the previously selected band; band 1 in this example.

c. Voltage is available through R1518 to energize band centering mechanism. A ground circuit must be supplied before sequence relay K801 can be energized.

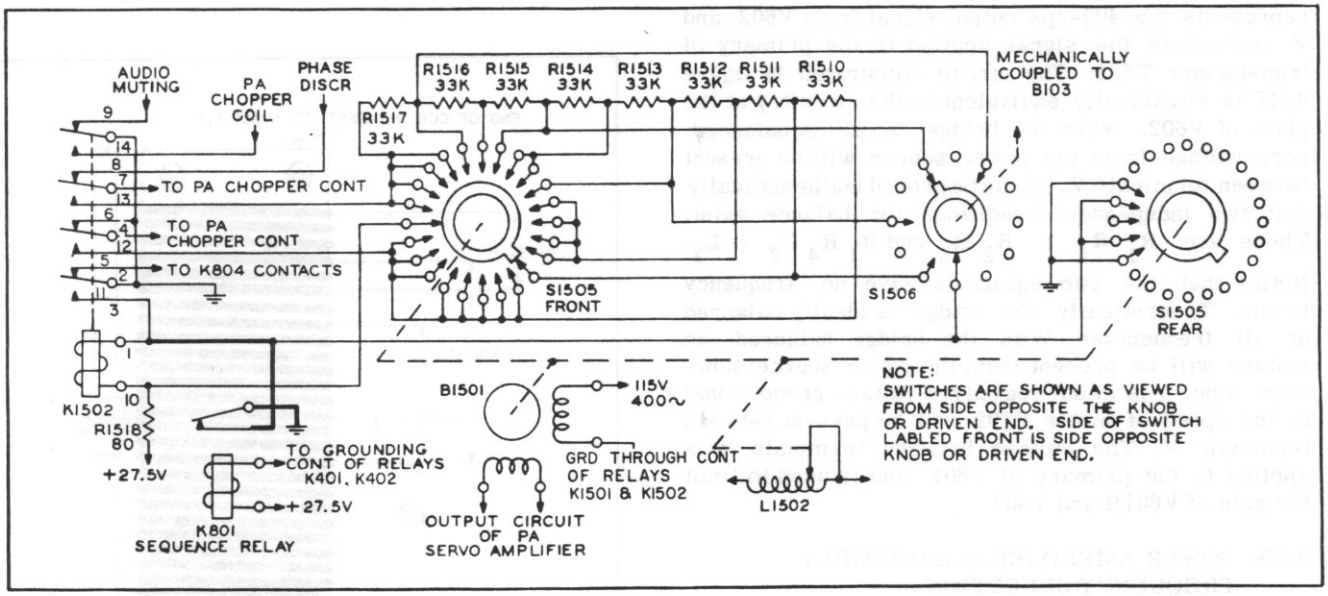

Figure 4-29. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 2 of 4 steps)

d. Channel is selected by operation of the channel selectors of Radio Set Control 614C-2. This operates relay K401 and/or relay K402, which in turn grounds and energizes sequence relay K801.

e. Contacts on sequence relay K801 close to supply a ground to relay K1502.

f. Switch S1506 is rotated to the band 3 position by operation of the bandchange autopositioner and motor B103 on the front panel of the 618S-1 or 618S-1A.

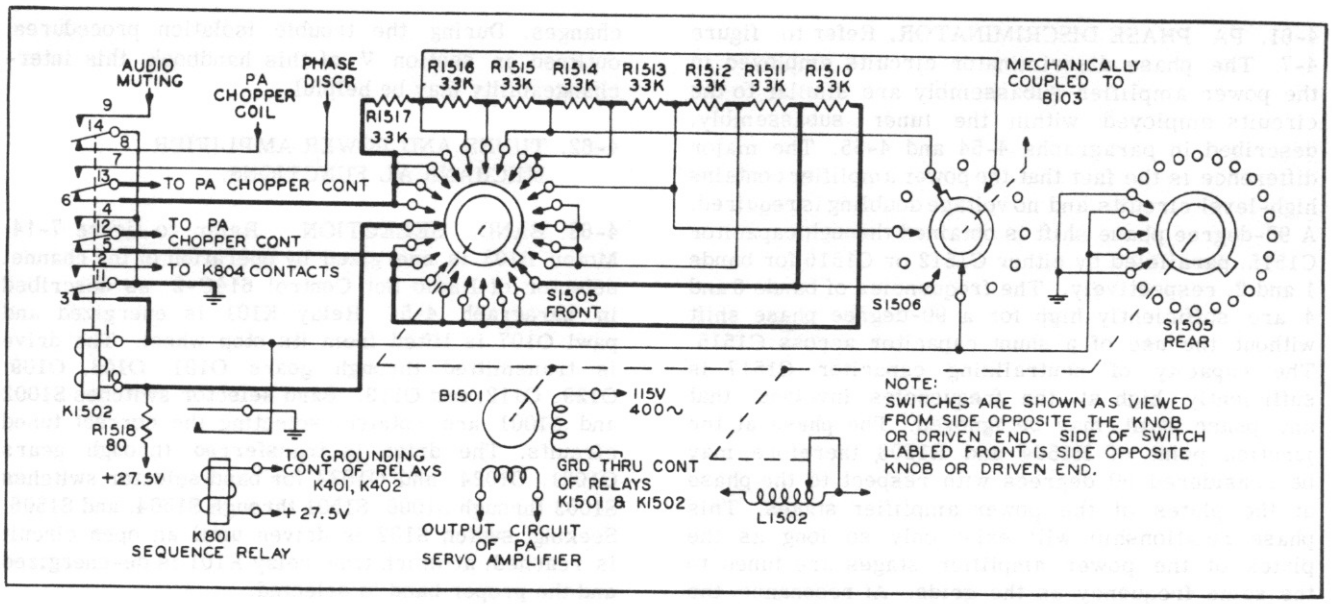

Figure 4-29. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 3 of 4 steps)

g. Relay K1502 operates, supplying its own ground. The ground supplied by relay K801 is removed when the correct frequency is selected in the r-f crystal oscillator subassembly.

h. One side of pa chopper G601 is grounded by contacts of K1502.

i. An unbalanced voltage is fed to contacts of pa chopper G601 through the action of S1505 front and resistors R1510 through R1517.

j. Contacts of K1502 remove ground from the cathode of audio output stage V1302, muting the audio output, and open the 618S-1 or 618S-1A keying circuits through contacts of relay K804 to prevent spurious radiation.

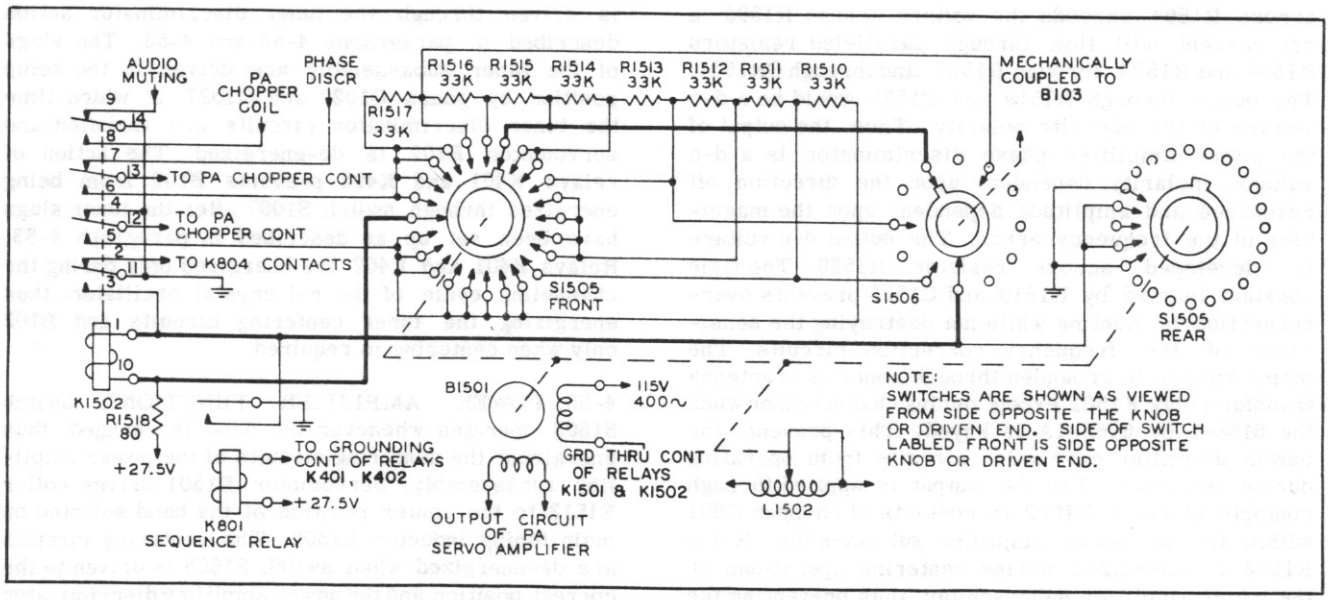

Figure 4-29. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Step 4 of 4 steps)

k. The unbalanced d-c voltage fed to G601 contacts causes the power amplifier servomechanism to function.

l. Operation of the power amplifier servomechanism includes rotation of servomotor B1501.

m. Rotation of B1501 drives S1505 front and rear to the band 3 position. The correct inductor and capacitor combinations are selected and the roller of L1502 is centered within the range of band 3.

n. Relay K1502 is shorted and de-energized.

4-61. PA PHASE DISCRIMINATOR. Refer to figure 4-7. The phase discriminator circuits employed in the power amplifier subassembly are similar to the circuits employed within the tuner subassembly, described in paragraphs 4-54 and 4-55. The major difference is the fact that the power amplifier contains high-level circuits and no voltage doubling is required. A 90-degree phase shift is obtained through capacitor C1515, paralleled by either C1512 or C1516 for bands 1 and 2, respectively. The frequencies of bands 3 and 4 are sufficiently high for a 90-degree phase shift without the use of a shunt capacitor across C1515. The capacity of neutralizing capacitor C1517 is sufficiently high at the frequencies involved that any phase shift may be ignored. The phase at the junction point of R1504 and R1503, therefore, may be considered 90 degrees with respect to the phase at the plates of the power amplifier stages. This phase relationship will exist only so long as the plates of the power amplifier stages are tuned to the same frequency as the grids. At resonance, the voltage across R1503 is equal to the voltage across R1504 and is of the opposite phase. Therefore, there will be no net voltage and the output through the parallel arrangement of R1519 and C1525 will be zero. Assume the plates of the power amplifier stages are off resonance in such a direction that the voltage across R1503 exceeds the voltage across R1504. In this case, a net current will flow through R1503, through R1507, and through CR1502, resulting in a net d-c voltage applied through the parallel arrangement of R1519 and C1525. If the plates are off resonance in such a direction that the voltage across R1504 exceeds the voltage across R1503, a net current will flow through paralleled resistors R1504 and R1524, through R1507, and through CR1501. The output through R1519 and C1525 would be a d-c voltage of the opposite polarity. Thus, the output of the power amplifier phase discriminator is a d-c voltage, polarity dependent upon the direction off resonance and amplitude dependent upon the magnitude of the frequency error. The output d-c voltage is developed across resistor R1520. The time constant formed by R1519 and C1525 prevents overcorrection or hunting while not destroying the sensitivity of the frequency correction circuits. The output voltage is grounded through contacts of antenna transfer relay K1501 except during channeling or when the 618S-1 or 618S-1A is keyed. This prevents the power amplifier correction circuits from operating during reception. The d-c output is applied through contacts of relay K1502 to contacts of chopper G601 within the pa servo amplifier subassembly. Relay K1502 is energized during centering operations of the power amplifier subassembly, thus preventing the setup circuits from operating during the centering cycle. The servo amplifier subassembly employed within the power amplifier correction circuits is identical to the one used for the tuner subassembly, described in paragraphs 4-57 and 4-58. In this case, servomotor B1501 is employed, and the roller of L1502 is set up rather than the tuner slugs. The pa servo amplifier and the tuner servo amplifier subassemblies are interchangeable without wiring changes. During the trouble isolation procedures, outlined in section V of this handbook, this interchangeability may be helpful.

4-62. TUNER AND POWER AMPLIFIER MECHANICAL FUNCTIONS.

4-63. BAND SELECTION. Refer to figure 7-14. Motor B103 is energized by operation of the channel selector of Radio Set Control 614C-2, as described in paragraph 4-51. Relay K101 is energized and pawl O107 is lifted from its stop wheel. The drive is transmitted through gears O101, O103, O109, O129, O112, and O113. Band selector switches S1002 and S1001 are rotated, selecting the correct tuned circuits. The drive is transferred through gears O1021, O1024, and O1022 for band selector switches S1003 through S1006, S1501 through S1504, and S1506. Seeking switch S102 is driven until an open circuit is reached, at which time relay K101 is de-energized and the proper band is selected.

4-64. TUNER FUNCTIONS. Servomotor B102 is energized through the tuner table centering circuits, as described in paragraph 4-53. The drive from B102 is transferred through gears O124 through O128, and through coupler O132 to the main tuning shaft. Gears O1020 and O1027 are driven, driving the tuner slugs toward the center position. Switch S1007 is driven through gears O1026 and O1025 to an open circuit position, reached when the tuner slugs are in the center of their respective inductors. The tuner centering circuits are de-energized and motor B102 is driven through the tuner discriminator action described in paragraphs 4-54 and 4-55. The slugs of the tuner subassembly are driven to the setup position by gears O1020 and O1027, at which time the tuner discriminator circuits are satisfied and servomotor B102 is de-energized. The action of relays K401 and K402 prevents B102 from being energized through switch S1007 after the tuner slugs have been set up as described in paragraph 4-53. Relays K401 and K402 are energized only during the channeling cycle of the r-f crystal oscillator, thus energizing the tuner centering circuits and B102 only when centering is required.

4-65. POWER AMPLIFIER FUNCTIONS. Switch S1506 operates whenever the band is changed, thus energizing the centering circuits of the power amplifier subassembly. Servomotor B1501 drives roller E1513 to the center position of the band selected on main tuning inductor L1502. The centering circuits are de-energized when switch S1505 is driven to the correct position and the power amplifier discriminator circuits are free to operate. Servomotor B1501 is driven through the action of the power amplifier discriminator, and roller E1513 is driven to the setup position on L1502. The action of sequence relay K801, described in figure 4-29, prevents the centering and setup functions from overlapping. Gears O1512, O1518, and O1519 couple the drive from B1501 to main tuning inductor L1502 and switch S1505 in figure 7-14.

4-66. GAIN AND BFO CONTROL CIRCUITS.

4-67. R-F GAIN. Refer to figure 4-30. The gain of four of the 618S-1 and 618S-1A stages is made variable through potentiometers within Radio Set Control 614C-2. When the 618S-1 and 618S-1A is in the key-up position, the cathode circuits of the second i-f amplifier, the receiver first mixer, and the first and second r-f amplifier stages are connected through contacts of switch S2603A to the sensitivity and threshold controls of Radio Set Control 614C-2. When in the PHONE position, potentiometer R2602 allows a limited control over the r-f receiver gain. Potentiometer R2602 is a screw driver adjustment located at the rear of the 614C-2 chassis, and is used to set the threshold level when receiving voice modulated signals. When in the CW position, potentiometer R2605 allows a large control over the r-f receiver gain. Potentiometer R2605 may be varied by operation of the small 614C-2 control knob. When the 618S-1 or 618S-1A is keyed, V902, V1005, and V1008 are removed from the circuit and the cathode circuit of V1009 is grounded through contacts of relay K1001.

4-68. AUDIO GAIN. The audio volume of the 618S-1 and 618S-1A is made variable through potentiometers within the 614C-2 for phone reception. No provision is made for audio volume control during cw reception.

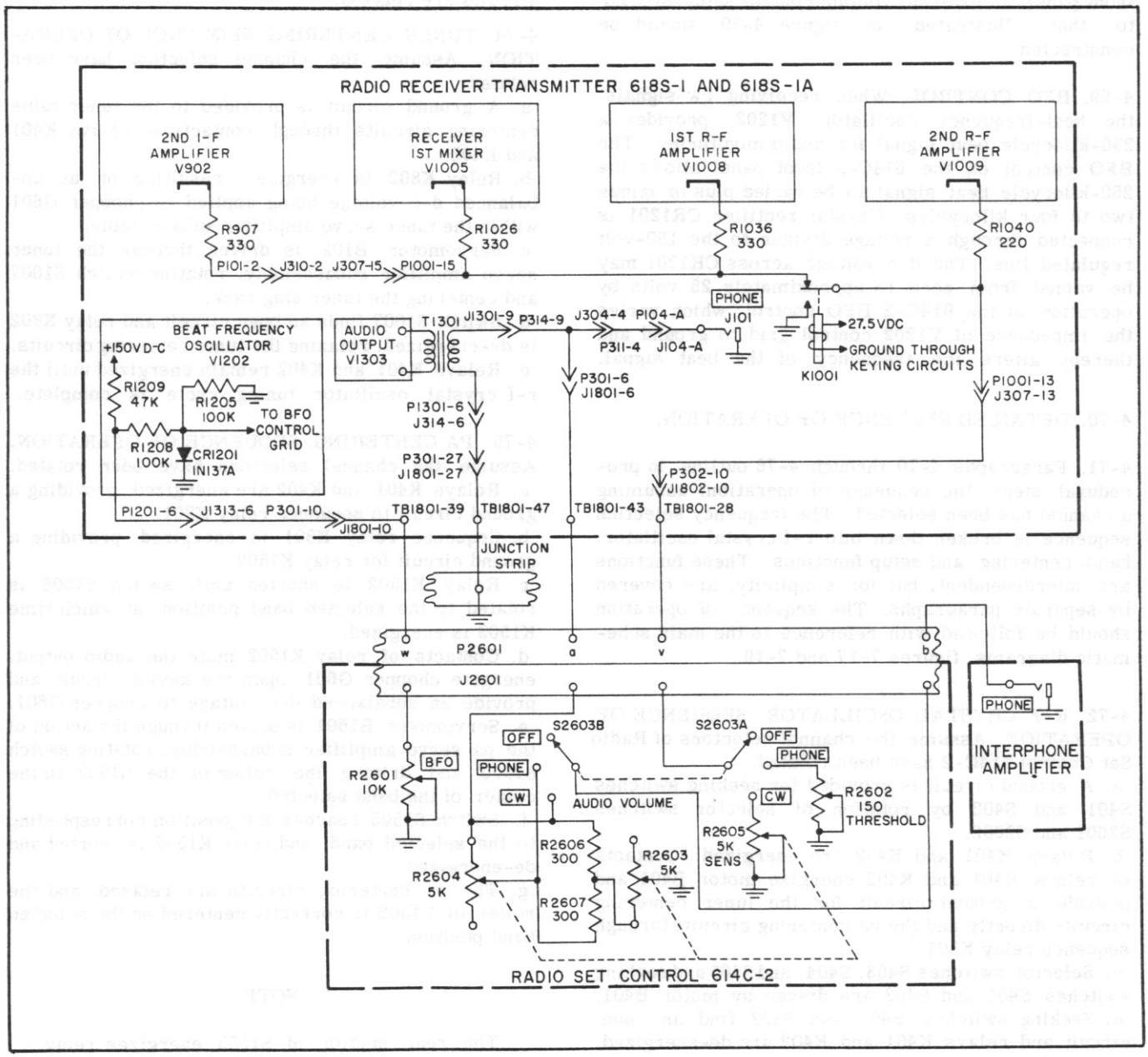

Figure 4-30. Gain and BFO Control Circuits, Simplified Schematic Diagram

as the gain is controlled in the r-f stages. When in the PHONE position, audio output transformer T1301 is connected through contacts of switch S2603B to potentiometers R2604 and R2603 and resistors R2606 and R2607. This resistor combination provides a means of varying the audio output level while maintaining a constant impedance across the secondary of T1301. Potentiometers R2604 and R2603 may be varied by operation of the small 614C-2 control knob. The output signal across R2604 and R2603 is applied to the PHONE jack of the external interphone amplifier. No provision is made for varying the audio output level applied to the 618S-1 or 618S-1A front panel PHONE jack. If it is desired to monitor the audio output directly from the 618S-1 or 618S-1A front panel, an external volume control setup, similar to that illustrated in figure 4-30, should be constructed.

4-69. BFO CONTROL. When receiving cw signals, the beat-frequency oscillator, V1202, provides a 250-kilocycle beat signal for audio monitoring. The BFO control on the 614C-2 front panel allows the 250-kilocycle beat signal to be varied plus or minus two to four kilocycles. Crystal rectifier CR1201 is connected through a voltage divider to the 150-volt regulated line. The d-c voltage across CR1201 may be varied from zero to approximately 25 volts by operation of the 614C-2 BFO control, which varies the impedance of V1202 control grid to ground and thereby alters the frequency of the beat signal.

4-70. DETAILED SEQUENCE OF OPERATION.

4-71. Paragraphs 4-70 through 4-76 outline, in procedural steps, the sequence of operation, assuming a channel has been selected. The frequency selection sequence is broken down into r-f crystal oscillator, band, centering, and setup functions. These functions are interdependent, but for simplicity, are covered by separate paragraphs. The sequence of operation should be followed with reference to the main schematic diagrams, figures 7-17 and 7-19.

4-72. R-F CRYSTAL OSCILLATOR, SEQUENCE OF OPERATION. Assume the channel selectors of Radio Set Control 614C-2 have been rotated.

a. A ground circuit is provided for seeking switches S401 and S402 by rotation of selector switches S2601 and S2602.

b. Relays K401 and K402 are energized. Contacts of relays K401 and K402 energize motor B401 and provide a ground circuit for the tuner centering circuits directly and the pa centering circuits through sequence relay K801.

c. Selector switches S403, S404, and S405 and seeking switches S401 and S402 are driven by motor B401.

d. Seeking switches S401 and S402 find an open circuit and relays K401 and K402 are de-energized.

e. Motor B401 comes to a stop, dissipating its kinetic energy in the slip clutches.

f. The correct crystal and bank is selected and the circuit is relaxed in the new position.

4-73. BAND SELECTION, SEQUENCE OF OPERATION. Assume the channel selectors of Radio Set Control 614C-2 have been rotated.

a. A ground circuit is provided for seeking switch S102 through switch S2602.

b. Relay K101 is energized, providing a ground circuit for motor B103 and an alternate ground circuit for pa centering relay K1502. (A ground circuit also is provided for K1502 through K801, discussed in the preceding paragraph.)

c. Switches S1001 through S1006, S1501 through S1504, and S1506 are driven by B103 to the correct band position.

d. Seeking switch S102 finds an open circuit and relay K1502 is de-energized. The band selection circuits are relaxed.

4-74. TUNER CENTERING, SEQUENCE OF OPERATION. Assume the channel selectors have been rotated.

a. A ground circuit is provided to the tuner table centering circuits through contacts of relays K401 and K402.

b. Relay K802 is energized, resulting in an unbalanced d-c voltage being applied to chopper G601 within the tuner servo amplifier subassembly.

c. Servomotor B102 is driven through the tuner servo amplifier subassembly, rotating switch S1007 and centering the tuner slug rack.

d. Switch S1007 finds an open circuit and relay K802 is de-energized, relaxing the tuner centering circuits.

e. Relays K401 and K402 remain energized until the r-f crystal oscillator tuning cycle is complete.

4-75. PA CENTERING, SEQUENCE OF OPERATION. Assume the channel selectors have been rotated.

a. Relays K401 and K402 are energized, providing a ground circuit to sequence relay K801.

b. Sequence relay K801 is energized, providing a ground circuit for relay K1502.

c. Relay K1502 is shorted until switch S1506 is rotated to the selected band position, at which time K1502 is energized.

d. Contacts of relay K1502 mute the audio output, energize chopper G601, open the keying circuit, and provide an unbalanced d-c voltage to chopper G601.

e. Servomotor B1501 is driven through the action of the pa servo amplifier subassembly, rotating switch S1505 and driving the roller of the L1502 to the center of the band selected.

f. Switch S1505 reaches the position corresponding to the selected band, and relay K1502 is shorted and de-energized.

g. The pa centering circuits are relaxed, and the roller of L1502 is correctly centered on the selected band position.

NOTE

The rear section of S1505 energizes relay K1502 if the roller of L1502 approaches either extreme end of travel, thus recycling the pa centering circuits and preventing the roller from disengaging L1502.

4-76. TUNER SETUP, SEQUENCE OF OPERATION. The following sequence will follow the completion of the tuner centering cycle.

a. Relay K802 is de-energized following the tuner centering cycle, grounding one contact of chopper G601.

b. The tuner discriminator functions, applying a d-c voltage to one of the contacts of chopper G601.

c. The d-c error voltage is amplified through the tuner servo amplifier subassembly, energizing servomotor B102.

d. Servomotor B102 drives the tuner slug rack toward the setup position.

e. The tuner slugs reach the setup position, and the tuner discriminator output becomes zero.

f. Servomotor B102 stops, and the tuner setup circuits are relaxed.

4-77. PA SETUP, SEQUENCE OF OPERATION. The following sequence will follow the completion of the power amplifier centering cycle.

a. Following the centering cycle, relay K1502 is de-energized, grounding one contact of chopper G601 and the cathode of V1302.

b. Relay K1501 is energized following the setup of the r-f crystal oscillator through contacts of sequence relay K801 and relay K708 of Automatic Antenna Tuner 180L-3.

c. Contacts of K1501 remove ground from the pa discriminator output and energize chopper G601.

d. The d-c output from the pa discriminator circuit is now free to operate servomotor B1501 through chopper G601 and the pa servo amplifier subassembly.

e. Servomotor B1501 is energized, driving the roller of L1502 toward the setup position.

f. The roller of L1502 reaches the position corresponding to resonance and the pa discriminator output becomes zero, de-energizing servomotor B1501.

g. Relay K708 is de-energized following the channeling cycle of Automatic Antenna Tuner 180L-3, which removes the ground from K1501 and the setup circuit is relaxed.

SECTION V
ORGANIZATIONAL MAINTENANCE

5-1. INTRODUCTION.

5-2. This section provides instructions essential for the maintenance of Radio Set 618S-1 and 618S-1A by organizational maintenance personnel. Before attempting to service and test this equipment, maintenance personnel should be thoroughly familiar with the physical makeup of the equipment and reasonably familiar with its theory of operation. Throughout this section, references are made to meter indications, attenuator settings, etc, of various pieces of test equipment. These indications are not necessarily equipment specifications, but are approximate values encountered on a large number of properly operating components. It is possible that the equipment will operate properly with varied indications from those stated, since many variable factors are involved. It is absolutely essential, however, that the test equipment in use be properly calibrated, properly terminated, and otherwise in excellent condition.

5-3. GENERAL. Organizational maintenance of the equipment is based on periodic inspections immediately before the equipment is put into use to insure continuity of operation. The periodic inspections and tests have been developed on the premise that the equipment has been installed and checked in accordance with the installation instructions presented in section III. Defects disclosed during these inspections, and by faulty operation of the equipment, should be corrected by use of the systematic trouble-shooting procedure, table XV, and by means of adjustment methods. To facilitate trouble-shooting procedures at the organizational maintenance level, a step-by-step procedure is presented in table XV to isolate the trouble to a subassembly within Radio Receiver-Transmitter 618S-1 or 618S-1A. The purpose of this trouble analysis system is to determine quickly the subassembly in which trouble exists, and to point out some of the most likely causes of trouble. When the trouble has been so analyzed, maintenance personnel can determine what action, depending upon the time element involved, should be taken to correct the trouble. To prevent excessive delays, those subassemblies which are defective should be exchanged for subassemblies known to be in good operating condition.

5-4. MINIMUM PERFORMANCE STANDARDS.

5-5. PREFLIGHT INSPECTION AND TESTS.

5-6. Certain operating checks must be made by the pilot or radio operator prior to actual operation. Careful observance of these procedures will reduce the chance of equipment failure in service, since any abnormal conditions may be reported quickly to maintenance personnel if correction is beyond the scope of the operator. A thorough inspection of the complete installation should be made before power is applied to the equipment and before any adjustments or tests are begun.

5-7. PREFLIGHT INSPECTION. Inspect the 618S-1 or 618S-1A installation for the following:

a. Antenna and terminal connections to Automatic Antenna Tuner 180L-3 must be secure.

b. Connections between Automatic Antenna Tuner 180L-3, Power Supply 416W-1, Radio Set Control 614C-2, and Radio Receiver-Transmitter 618S-1 or 618S-1A must be secure.

c. Cable connectors must be tightened properly. Tighten locking rings by hand if necessary. Inspect cables for broken wires and loose connections.

d. Inspect installation Mountings 350S-1 or 350S-3, 350D-3 and 350T-1 to make certain they are anchored securely to the radio equipment shelf and capable of sustaining severe vibration.

e. Make sure the component cover fasteners are tight.

f. Microphone, headset, and key cords must be unbroken and securely in place.

g. Check primary power source connections to make certain that no short circuits exist in the input power lines.

5-8. PREFLIGHT TEST. Test the 618S-1 or 618S-1A installation according to the procedures listed in steps a through m.

a. Place the OFF PHONE CW switch in the PHONE position. Allow approximately 10 minutes warmup time for the equipment before beginning this portion of the test.

b. Set the meter selector on the front panel of the 618S-1 or 618S-1A to the 28 V. position. The meter should indicate in the red portion of the scale. Check the 250 V. position. Indication should be within the red area.

c. Select a band 1 channel (2 to 3.75 megacycles). Allow the equipment to complete its tuning cycle.

NOTE

Extreme care should be taken to avoid interference with any local communication channel. After each new channel is selected, listen in the headphones to determine if the channel is in use before proceeding with the preflight test.

d. Turn the meter switch to the P.A. GRID position. Press the microphone push-to-talk button and check to see that the meter reading is 3 or greater.

e. Turn the meter selector to the P.A. PL. position and press the microphone push-to-talk button. The meter should read within the red area of the scale.

f. Turn the meter selector to the MOD. PL. position and press the push-to-talk button. The meter should read below 2 on its scale without modulation. Talk normally into the microphone and watch the meter for higher indications. Modulation peaks may show a meter indication of 6 or more. Listen in the headphones to monitor side tone while talking.

g. Release the microphone push-to-talk button and listen in the headset for background noise, an indication of normal receiver sensitivity. The 614C-2 sensitivity and threshold controls should be at maximum output for this check. The sensitivity control is the small 614C-2 knob, and the threshold control is a screw driver adjustment at the rear of the 614C-2 chassis.

h. Repeat the steps outlined above, selecting a channel in each of the remaining three bands. The bands are: band 1, 2 to 3.75 megacycles; band 2, 3.75 to 7.25 megacycles; band 3, 7.25 to 14.25 megacycles; and band 4, 14.25 to 25 megacycles.

i. If Automatic Antenna Tuner 180L-3 is located in a position where the SWR meter on its front panel can be observed, check this meter on each channel tested. The meter reading should be 3.5 or lower.

j. Operate the channel selector from the 2.00 mc channel to the 25.00 mc channel. Radio Receiver-Transmitter 618S-1 or 618S-1A should tune in 8 seconds or less; Automatic Antenna Tuner 180L-3 should complete its tuning cycle in 22 seconds or less.

NOTE

When checking cycling time, remember that the 618S-1 or 618S-1A must be keyed manually before the 180L-3 will function if the system is connected for "radio silence" operation.

k. If any tuning cycle continues 45 seconds or more without obtaining correct tuning conditions, a time delay relay (K711) in the 180L-3 will operate thermally, preventing further operation of the 618S-1 or 618S-1A system. If this occurs, wait for at least 60 seconds before attempting to start a new tuning cycle. If the system will not tune, check the antenna circuit for faults. Do not change channels more than once a minute. If channeling occurs at too frequent intervals, heat will build up in relay K711 preventing the 180L-3 from completing its tuning cycle.

CAUTION

The maximum duty cycle of Automatic Antenna Tuner 180L-3 is five minutes r-f on and five minutes r-f off. To insure reliable operation, do not exceed this duty cycle.

l. Place the OFF PHONE CW switch in the CW position and select an active CW channel. Operate the 614C-2 BFO control to determine if the cw tone is variable in frequency.

m. When tactical restrictions permit, check the 618S-1 or 618S-1A installation by two-way communication with a ground station or another aircraft.

5-9. DAILY INSPECTION.

5-10. The daily inspection is included to determine the general condition of the equipment and detect any major maladjustments. The inspection is not designed to show slight wear or aging of components. Perform a preflight inspection as outlined in paragraph 5-8 for the daily inspection.

5-11. 120-HOUR INSPECTION.

5-12. The 120-hour inspection includes a thorough inspection of all mechanical and electrical parts within the 618S-1 or 618S-1A system. Following a maximum of 120 hours service, the 618S-1 or 618S-1A components should be removed from the aircraft and placed in a well-equipped maintenance shop for complete bench checks. Steps a through p list the inspection procedures to be followed during each 120-hour inspection.

a. Remove all major components from the aircraft and place them on the test bench. To remove the 618S-1, 618S-1A, 180L-3, and 416W-1 from their mountings, disconnect all cables and unfasten the safety wires. Loosen the knurled fasteners or wing nuts and pull the equipment forward. The 614C-2 is removed by disconnecting the cable and unlocking the four Dzus fasteners.

b. Check mechanical operation of selector knobs and switches.

c. Remove the covers from the 618S-1 or 618S-1A, 180L-3 and 614C-2. To remove the 618S-1 or 618S-1A from its cover, loosen the two Dzus fasteners at the rear of the cover and pull the chassis forward. The 614C-2 cover is secured with two Dzus fasteners at the rear of the unit. The 180L-3 is removed from its case by loosening six machine screws located at the lower edges of the cover. The front panel cover is secured by four machine screws on the front of the 618S-1 or 618S-1A. The bottom plate of Power Supply 416W-1 should be removed by extracting four machine screws.

d. Remove dust from the inside of the components with a jet of clean, dry air.

e. Examine resistors, capacitors, wiring insulation, and cabling for evidence of overheating and cracking.

f. Check wiring and terminals for loose connections.

g. Remove the air filter from the 618S-1 or 618S-1A cover. Wash the filter in hot water and a solvent of strong soap solution. Rinse with clear water and dry. Dip the filter in (SAE-20) oil and drain for 24 hours.

h. Inspect gears and bearings for wear. If lubrication is necessary, follow the procedure outlined in paragraph 5-39.

i. Unfasten and remove the end bell covers of dynamotor D1601.

j. Remove dust and dirt from the dynamotor and end bell covers, using clean, dry air or a soft cloth.

k. Remove and inspect dynamotor brushes, being extremely careful not to nick or mark the edges of the brushes. Note the position and location from which each of the brushes is removed so that they may be replaced in the same position.

l. Check dynamotor commutators for excessive wear, dirt, and other defects. A highly polished commutator is desirable. However, a dark-colored commutator surface should not be mistaken for one which is burned. If the surface of the commutator is dirty, clean with a lint-free cloth moistened in carbon tetrachloride and wipe dry. If the commutator is grooved, replace the dynamotor. Avoid finger marks on the commutator.

m. Secure dynamotor brushes in their holders, making certain that they are replaced in exactly the same position from which they were removed.

NOTE

Replace brushes which are worn to approximately 1/4 inch or less. Check each new brush in its holder to see that it can move freely without being excessively loose.

n. Check dynamotor bearings to see that they are properly lubricated. If grease is needed, pack one third of ball race with MIL-G-3278 grease.

o. Reassemble the 618S-1 or 618S-1A components and replace in the aircraft.

p. Perform a preflight test, paragraph 5-8.

5-13. DETAILED PERFORMANCE TESTS.

5-14. The following tests present a method of checking each function of the 618S-1 or 618S-1A system at the organizational maintenance level. The detailed performance tests may be used to verify defects of functions within a particular component and as a final test after isolation and correction of trouble. The tests are designed for use with the test equipment listed in section II, table VII of this handbook. The main 618S-1 or 618S-1A component should be removed from its cover and placed in a bench test setup similar to that illustrated in figure 3-1. The cabling between the 618S-1 or 618S-1A components should simulate that of an actual aircraft and should be in accordance with figure 7-15 and paragraph 2-8.

WARNING

Certain plate voltages used in the 618S-1 and 618S-1A equipment are dangerous to life (600 volts). When operating the 618S-1 or 618S-1A receiver-transmitter component removed from the cover, special care must be taken to avoid contact with tube plate caps and circuit wiring carrying high voltage. Keep clothing, cleaning rags, etc, away from the mechanical drive of the 618S-1 or 618S-1A where there is a chance of these items being caught in the gear mechanisms. Always discharge high voltage filter capacitors before attempting work on any of the 618S-1 or 618S-1A components.

5-15. RECEIVER SENSITIVITY. Perform the following operations:

a. Connect test crystals to the r-f crystal oscillator subassembly as listed in table X, section III.

b. Connect Signal Generator AN/URM-25 to jack J109 (test point 3). Adjust for an output of 2.75 megacycles at 1000 microvolts, modulated 30% at 1000 cps. Use Frequency Meter AN/USM-26 to set the AN/URM-25 to frequency.

c. Connect Output Meter TS-585B/U to test point 4 and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

d. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

e. Operate the 614C-2 channel selectors to the A4 position (2.75 megacycles).

f. Adjust the sensitivity and threshold controls of the 614C-2 for maximum output. The threshold control (R2602) is a screw driver adjustment at the rear of the 614C-2, and the sensitivity control is the small knob on the 614C-2 front panel.

g. Adjust the AUDIO control (R109 on the 618S-1 or 618S-1A front panel) for an audio power output of 300 milliwatts as read on Output Meter TS-585B/U.

h. Reduce the output level of Signal Generator AN/URM-25 to 5 microvolts. Output Meter TS-585B/U should indicate not less than 100 milliwatts.

i. Remove the modulation. The signal-plus-noise to noise ratio should be at least 6 db (modulation on to modulation off ratio of 4 to 1 as read on Output Meter TS-585B/U).

j. Operate the OFF PHONE CW switch to the CW position and remove the modulation.

k. Remove the TS-585B/U and connect a headset to terminal b of P2601 (test point 8).

NOTE

When a 300-ohm headset such as the H-1/AR or the H-4/AR is connected to either the PHONE jack or to terminal b of P2601, Output Meter TS-585B/U should be removed from the PHONE jack. The TS-585B/U and a low-impedance headset should not be connected across the audio output terminals at the same time, or transformer T1301 will be mismatched, and the test results will be inaccurate. A high-impedance monitor, such as described in table VII, item 23, may be used in parallel with the TS-585B/U if it is desired to monitor the audio signal during the test procedures.

l. Adjust the 614C-2 BFO control for a signal of approximately 1000 cps.

m. Remove the headset and replace the TS-585B/U. Observe the power output indication of the TS-585B/U with Signal Generator AN/URM-25 adjusted to 5 microvolts output. Output Meter TS-585B/U should indicate at least 100 milliwatts.

n. Remove the r-f input signal and observe the indication of the TS-585B/U. The reading should change at least 10 db (indication in the r-f on position at least 10 times that in the r-f off position).

o. Repeat the sensitivity measurements outlined in steps a through m for frequencies listed in table XII of section III. It is not necessary to rotate the AUDIO control (step g) after it has been set correctly.

5-16. RECEIVER SELECTIVITY. The test crystals listed in table X of section III should be inserted for the following procedures. Perform the following operations:

a. Connect Output Meter TS-585B/U to the PHONE jack (test point 4) and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

b. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

c. Connect VTVM TS-375/U to terminal 5 of jack J310 (test point 7). Adjust the TS-375/U to read on the negative 3-volt scale.

d. Connect Signal Generator AN/URM-25 to jack J109, test point 3. Adjust the AN/URM-25 frequency to 2.75 megacycles with Frequency Meter AN/USM-26 and the output level to minimum r-f unmodulated.

e. Operate the 614C-2 channel selectors to the A4 position (2.75 megacycles).

f. Adjust the AN/URM-25 output level for a reading of exactly negative 1 volt d-c on VTVM TS-375/U.

g. Double the AM/URM-25 output level and detune both above and below 2.75 megacycles. Observe the frequencies on Frequency Meter AN/USM-26 where the reading on VTVM TS-375/U returns to negative 1 volt d-c. The difference between the two frequencies is an indication of the receiver bandwidth at the 6-db point and should be at least 5.5 kilocycles.

h. Increase the output level of the AN/URM-25 to 1000 times that determined in step f and detune both above and below 2.75 megacycles. Observe the frequencies on Frequency Meter AN/USM-26 where the reading on VTVM TS-375/U returns to negative 1 volt d-c. The difference between the two frequencies is an indication of the receiver bandwidth at the 60-db point and should be not greater than 14 kilocycles.

i. Repeat steps f through h with the 614C-2 channel selectors set to the following positions: position G4, 5.25 megacycles; position M4, 10.25 megacycles; position U4, 20.25 megacycles. For each position, Signal Generator AN/URM-25 should be adjusted to the operating frequency with Frequency Meter AN/USM-26.

5-17. FREQUENCY SELECTION. The test crystals listed in table X of section III should be inserted for the following procedures. Perform the following operations:

a. Connect the dummy load, VTVM TS-375/U, a 1-megohm resistor, and Frequency Meter AN/USM-26 to test point 1. All other test equipment should be disconnected.

b. Operate the 614C-2 OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

c. Refer to table X of section III. Operate the channel selector switches of Radio Set Control 614C-2 to each position listed and observe the output frequencies as read on Frequency Meter AN/USM-26. Frequencies should not vary over 0.007% of those listed in table X.

NOTE

Do not attempt to channel the 618S-1 or 618S-1A more than once a minute. If channeled too frequently, a time delay relay (K711) in the 180L-3 will heat and prevent the 618S-1 or 618S-1A system from completing its tuning cycle. Relay K711 will operate also if the total tuning time, following the centering cycle of the tuner subassembly, exceeds 45 seconds. If this happens, wait at least one minute before rechanneling.

d. Check the time interval required for the tuning cycle to complete when the channel selectors are operated from the A1 to the U9 position. Radio Receiver-Transmitter 618S-1 and 618S-1A should complete its tuning cycle in 8 seconds or less and Automatic Antenna Tuner 180L-3 should complete its tuning cycle in 22 seconds or less.

5-18. TRANSMITTER R-F POWER OUTPUT. The test crystals listed in table X of section III should be inserted for the following test. Perform the following operations:

a. Connect the dummy load and the r-f probe of VTVM TS-375/U from E102 of Automatic Antenna Tuner 180L-3 (test point 1) to ground.

b. Connect a telegraph key to test point 6 or a microphone to test point 5. All other test equipment should be removed for this test.

c. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup. After warmup, rotate the OFF PHONE CW switch to the CW position.

d. Operate the 614C-2 channel selectors to the A1 position (2.0 megacycles) and allow the 618S-1 or 618S-1A system to complete the tuning cycle.

e. Depress the telegraph key or microphone push-to-talk button and observe the indication on VTVM TS-375/U. The reading should be not less than 71.8 volts a-c, which corresponds to 100 watts r-f power output.

f. Repeat step e for each frequency listed in table XI of section III. The test results are also listed in table XI.

5-19. MODULATION. The test crystals listed in table X of section III should be inserted for the following

test. Remove all test equipment except as called out in the following procedures.

a. Connect the dummy microphone circuit to the MIC jack (test point 5). Refer to figures 2-1 and 3-1.

b. Connect VTVM TS-375/U and Audio Oscillator TS-382A/U to the dummy microphone as illustrated in figure 2-1. Adjust the TS-382A/U to 0.25 volt a-c at 1000 cps.

c. Connect Oscilloscope OS-8/U across the dummy load through a 25-micromicrofarad capacitor and connect to E102 (test point 1). Adjust the OS-8/U for a horizontal sweep capable of reproducing two or three modulated cycles at 1000 cps.

d. Connect a telegraph key to the KEY jack (test point 6).

e. Operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup.

f. Operate the 614C-2 channel selectors to the A1 position (2.0 megacycles).

g. Key the 618S-1 or 618S-1A by operating the telegraph key.

h. Adjust the CLIPPING control (R1404 on the bottom of the modulator subassembly) to the maximum clockwise position.

i. Adjust the GAIN control (R1403 on the bottom of the modulator subassembly) for 80% modulation. Use the following formula to calculate the percentage of modulation: Refer to figure 3-2.

$$\% \text{ Modulation} = \frac{\text{Maximum - Minimum}}{\text{Maximum + Minimum}} \times 100$$

NOTE

The minimum percentage of modulation that is allowable depends upon the r-f power output and therefore upon the band of operation. Refer to figure 3-3 for the minimum percentage of modulation allowable for different values of r-f power output. Examination of figure 3-3 will illustrate that a minimum modulation percentage of 95% is allowable with 100 watts r-f power output.

j. Adjust the CLIPPING control for threshold at the 80% modulation point.

k. Increase the output level of Audio Oscillator TS-382A/U by 12 db. This may be accomplished by increasing the output voltage of the TS-382A/U to 1 volt a-c. The waveform, as observed on Oscilloscope OS-8/U, should be clipped below the 100% modulation point.

l. Lock the CLIPPING and GAIN controls in position.

m. Reduce the TS-382A/U output level to that required for 60% modulation.

n. Vary the frequency of the TS-382A/U between 300 and 3500 cps while maintaining the audio input signal constant. The modulation percentage should remain between 40% and 70%.

o. Adjust the frequency of the TS-382A/U to 5000 cps. The modulation percentage should be not less than 22%.

5-20. SIDE TONE. With the equipment setup as described in the preceding paragraph, perform the following operation:

a. Connect a headset to the PHONE jack (test point 4) or to terminal b of P2601.

b. Vary the level and frequency of Audio Oscillator TS-382A/U and notice if the varying signal can be heard in the headset.

c. Vary the PHONE SIDETONE control (R106 on the 618S-1 or 618S-1A front panel subassembly) and notice if the amplitude of the side-tone signal is variable.

d. With the TS-382A/U set for an output level of 1 volt at 1000 cps, adjust R106 for a comfortable headset level.

e. Operate the 614C-2 OFF PHONE CW switch to the CW position and listen for a 400-cps signal in the headset.

f. Adjust the CW SIDETONE control (R107) for a comfortable headset level.

5-21. CORRECTIVE MAINTENANCE.

5-22. An efficient job of locating trouble in Radio Set 618S-1 and 618S-1A depends upon the ingenuity of the operator and his familiarity with the circuits involved. In general, a quick check for open heaters and plate voltage to the various subassemblies of each component will provide a starting point for trouble shooting. Individual tube socket potentials may be checked and compared with the socket voltage and resistance diagrams, figures 7-1 through 7-9. If failure is only partial, or if an operating equipment fails to meet specifications as listed under paragraph 5-13, the trouble may be localized by noting at which points the grid-driving voltages deviate from normal values. Weak tubes should be checked as a reasonable possibility if receiver sensitivity is insufficient or transmitter power output is lower than normal. If performance is poor due to misalignment of circuits, detailed alignment instructions are presented in section VI, paragraphs 6-46 through 6-88 and paragraphs 6-96 through 6-101.

5-23. VACUUM TUBES. All tubes in the 618S-1 or 618S-1A are connected in series parallel across the 27.5-volt d-c supply in such a manner as to minimize the power dissipated in the dropping resistors. For this reason all tubes and subassemblies should be in the equipment before power is applied. The equipment should be in the PHONE key-up position before power is applied to allow the large tubes within the power amplifier and modulation subassemblies to warm up before full plate voltage is applied. A minimum of two minutes warmup time is recommended before keying the 618S-1 or 618S-1A. To avoid damage to the tubes, the d-c supply voltage should not exceed the normal 27.5 volts d-c by more than five to ten per cent. Excessive voltage for long periods of time will cause shortened tube life. Rated plate currents and plate dissipation should not be exceeded for the same reason.

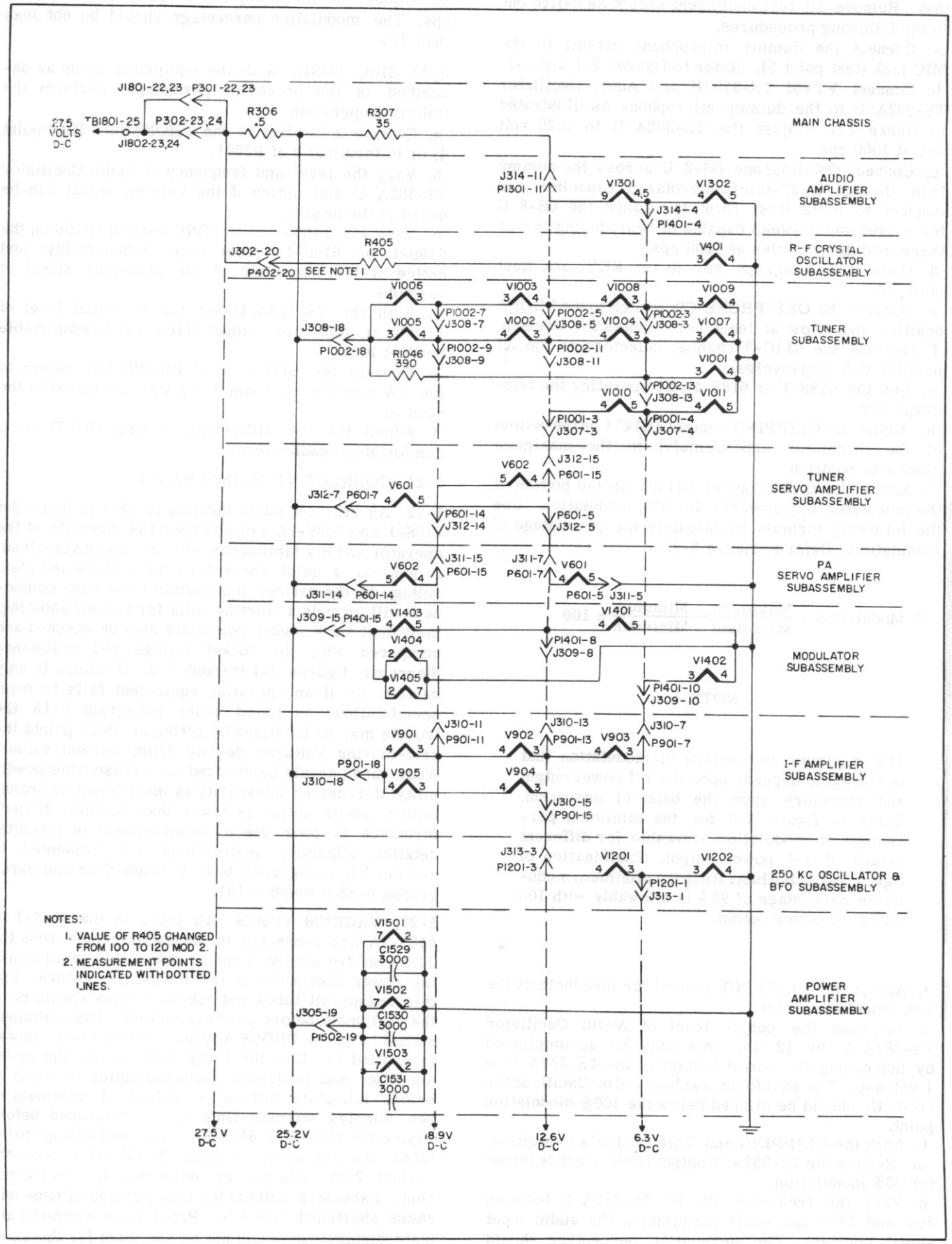

Figure 5-1. Radio Receiver-Transmitter 618S-1 and 618S-1A, Filament Circuit

5-24. TUBE REPLACEMENTS. Before any tube in the 618S-1 or 618S-1A equipment is removed for replacement or checking, make sure the 614C-2 OFF PHONE CW switch is in the OFF position. Check all replacement tubes carefully to be sure they are the correct type before replacing. If the tube failure is due to an open heater, it will cause an unbalance in the filament circuit, since the tubes are connected in series parallel. Measuring the voltage across the different sections of the heater circuits will sometimes help to locate which tube has failed. Reference is made to figure 5-1 for filament measurement points and voltages. The fastest method of finding the tube with an open heater is to disconnect the equipment from the 27.5-volt supply and apply a separate six-volt battery across the suspected section. Under this condition all tubes in the section should glow normally except the defective one. For this test it will be obvious that the six-volt battery must be free of ground, except when testing the grounded section of the heaters. Also, a dropping resistor may be necessary, depending upon the filament section under test. The connections can be temporarily made by clip leads to appropriate points in the equipment. If this method of heater testing is employed, the equipment must be turned off before connecting the battery, and the battery must be removed before the equipment is operated again. When an open heater is found, all tubes within the same series-parallel string as the defective one should be removed and checked on Tube Tester TV-3B/U to determine if they are damaged from an excessive heater current. Examination of figure 5-1 will show the individual filament strings.

5-25. SYSTEM TROUBLE ANALYSIS.

5-26. In trouble-shooting procedures, localization of the trouble to a specific component or subassembly of the 618S-1 or 618S-1A system must be accomplished first. Table XV, System Trouble Analysis, presents a complete step-by-step procedure to help isolate trouble within the equipment. The trouble analysis system is further amplified to include isolation of trouble to a detail part in section VI of this handbook. Radio Receiver-Transmitter 618S-1 or 618S-1A must be connected properly to Power Supply 416W-1, Radio Set Control 614C-2, and the primary power source in accordance with figure 7-15. Connection of the bench test setup must be in accordance with figure 3-1. Automatic Antenna Tuner 180L-3 may be used for the trouble isolation procedures if desired· however, the 180L-3 must be in proper operating condition. If trouble is suspected within the 180L-3, the Handbook Service Instructions, T.O. 31R2-4-38-1 should be consulted for applicable trouble-shooting procedures. The test crystals described in table X of section III should be inserted into the r-f crystal oscillator subassembly before proceeding with the steps outlined in table XV.

TABLE XV. SYSTEM TROUBLE ANALYSIS

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
1	Visual	None	Operate the OFF PHONE CW switch to the PHONE position and allow ten minutes for warmup. Then operate to the CW position.	Tube filaments light and blower motor B101 runs.	Proceed to step 3.	Proceed to step 2.
2	✡ TB1801	Multimeter TS-352/U	Measure the voltage at each of the following TB1801 terminals; 2, 7, 11, 21, 25, 40, 44, 45.	2, 600 volts d-c; 7, 6.3 volts a-c; 11, 250 volts d-c; 21, 18 volts a-c; 25, 27.5 volts d-c; 40, -65 volts d-c; 44, -50 volts d-c; 45, 115 volts a-c; 46, 115 volts a-c.	Trouble is in filter unit or main component. If not located, proceed to step 4.	Trouble is in Power Supply 416W-1.
3	Visual	None	Select several random frequencies and notice if the	Readings should correspond. Note that the r-f	Proceed to step 5.	Proceed to step 4.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
3 (cont)			channel selector settings correspond with the letter-number combinations in the r-f crystal oscillator subassembly window.	crystal oscillator letters are A through F and and the 614C-2 letters are A through Z. The letters A through F correspond to A through F, G through L, M through T, and U through Z.		
4	Visual	None	Replace the r-f crystal oscillator subassembly with one known to be in good operating condition and repeat step 3.	Same as step 3.	Trouble is in the original r-f crystal oscillator subassembly.	Trouble is in Radio Set Control 614C-2. Replace entire component.
5	Visual	None	Repeat step 3 and observe the tuner subassembly.	Tuner slugs should center and then move to the setup position.	Proceed to step 8.	Proceed to step 6.
6	Visual	None	Replace the tuner subassembly with one known to be in good operating condition and repeat step 3.	Same as step 5.	Trouble is in the original tuner subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 7.
7	Visual	None	Replace servomotor B102 unit with one known to be in good operating condition and repeat step 3.	Same as step 5.	Trouble is in original servomotor B102 unit.	Trouble is in the tuner servo amplifier subassembly or tube V401. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.
8	Visual	None	Keep the 618S-1 or 618S-1A and repeat step 3. Observe the power amplifier subassembly.	The roller of main tuning inductor L1502 should center and then move to the setup position.	Proceed to step 10.	Proceed to step 9.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
9	Visual	None	Replace the power amplifier subassembly with one known to be in good operating condition and and repeat step 8.	Same as step 8.	Trouble is in the original power amplifier subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Trouble is in the pa servo amplifier subassembly. Test the tubes, and, if normal, replace the pa servo amplifier subassembly.
10	Visual	None	Select several band positions and observe the band switches of the tuner and power amplifier subassemblies.	Switches rotate and select the correct band position.	Proceed to step 12.	Proceed to step 11.
11	Visual	None	Replace the bandchange autopositioner unit with one known to be in good operating condition and repeat step 10.	Same as step 10.	Trouble is in the original bandchange autopositioner unit.	Trouble is in Radio Set Control 614C-2.
12	✪ (J109), ✪ (J101)	Signal Generator AN/URM-25, Output Meter TS-585B/U, Frequency Meter AN/USM-26.	Perform steps b through f and h through i of paragraph 5-15, for one frequency of each band.	100 milliwatts and signal-plus-noise to noise ratio of 6 db.	Proceed to step 18.	Proceed to step 13.
13	Same as step 12.	Same as step 12.	Replace Radio Set Control 614C-2 with one known to be in good operating condition and perform steps b through f and h through i of paragraph 5-15, for one frequency on each band.	Same as step 12.	Trouble is in original Radio Set Control 614C-2.	Proceed to step 14.
14	Same as step 12.	Same as step 12.	Replace the r-f crystal oscillator subassembly with one known to be in good operating	Same as step 12.	Trouble is in original r-f crystal oscillator subassembly.	Proceed to step 15.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
14 (cont)			condition, and perform steps b through f and h through i of paragraph 5-15 for one frequency on each band.		Test tube V401 in Tube Tester TV-3B/U, and, if normal, replace subassembly.	
15	Same as step 12.	Same as step 12.	Replace the tuner subassembly with one known to be in good operating condition, and perform steps b through f and h through i of paragraph 5-15, for one frequency on each band.	Same as step 12.	Trouble is in original tuner subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 16.
16	Same as step 12.	Same as step 12.	Replace the i-f amplifier subassembly with one known to be in good operating condition and perform steps b through f and h through i of paragraph 5-15.	Same as step 12.	Trouble is in original i-f amplifier subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 17.
17	Same as step 12.	Same as step 12.	Replace the audio amplifier subassembly with one known to be in good operating condition and perform steps b through i of paragraph 5-15.	Same as step 12.	Trouble is in original audio amplifier subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Trouble is in AUX REC ANT or PHONE connectors.
18	③ (J109), ④ (J101), ⑤	Signal Generator AN/URM-25, Output Meter TS-585B/U, Frequency Meter AN/USM-26, Headset H-1/AR or H-4/AR	Set the AN/URM-25 frequency to 2.75 megacycles with Frequency Meter AN/USM-26 and connect the AN/URM-25 to test point ③. Perform steps j through n of paragraph 5-15.	100 milliwatts and signal-plus-noise to noise ratio of 10 db.	Proceed to step 20.	Proceed to step 19.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
19	Same as step 18.	Same as step 18.	Replace the 250 kc oscillator and bfo subassembly with one known to be in good operating condition.	Same as step 18.	Trouble is in original 250 kc oscillator and bfo subassembly. Test tube V1202 in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Trouble is in Radio Set Control 614C-2.
20	✪ (E102 or J110)	Bird Model 82 Dummy Load, VTVM TS-375/U	Perform steps a through f of paragraph 5-18.	71.8 volts a-c or 68.2 volts a-c; refer to table XI of section III.	Proceed to step 27.	Proceed to step 21.
21	Same as step 20.	Same as step 20.	Replace Radio Set Control 614C-2 with one known to be in good operating condition and perform steps a through f of paragraph 5-18.	Same as step 20.	Trouble is in original 614C-2.	Proceed to step 22.
22	Same as step 20.	Same as step 20.	Replace the r-f crystal oscillator subassembly with one known to be in good operating condition, and perform steps a through f of paragraph 5-18.	Same as step 20.	Trouble is in original tuner subassembly. Test tube V401 in Tube Tester TV-3B/U, and, if normal, replace tuner subassembly.	Proceed to step 23.
23	Same as step 20.	Same as step 20.	Replace the tuner subassembly with one known to be in good operating condition, and perform steps a through f of paragraph 5-18.	Same as step 20.	Trouble is in original tuner subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 24.
24	Same as step 20	Same as step 20.	Replace the power amplifier subassembly with one known to be in good operating condition, and	Same as step 20.	Trouble is in original power amplifier subassembly. Test the	Proceed to step 25.

TABLE XV. SYSTEM TROUBLE ANALYSIS (Cont)

STEP	TEST POINTS	TEST EQUIPMENT	CONTROL SETTINGS AND INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
24 (cont)			perform steps a through f of paragraph 5-18.		tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	
25	Same as step 20.	Same as step 20.	Replace the 250 kc oscillator and bfo subassembly with one known to be in good operating condition, and perform steps a through e of paragraph 5-18. (Test necessary only on one frequency.)	Same as step 20.	Trouble is in original 250 kc oscillator and bfo subassembly. Test tube V1201 in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Proceed to step 26.
26	Same as step 20.	Same as step 20.	Replace the relay subassembly with one known to be in good operating condition, and perform steps a through e of paragraph 5-18. (Test necessary only on one frequency.)	Same as step 20.	Trouble is in original relay subassembly. Replace defective part or entire subassembly.	Trouble is in ANT connector or system cabling.
27	(E102 or J110) (J102) (J103)	VTVM TS-375/U, Audio Oscillator TS-382A/U, Oscilloscope OS-8/U, Bird Model 82 Dummy Load, Telegraph Key, Dummy Microphone	Perform steps a through o of paragraph 5-19.	Refer to steps k, n, and o of paragraph 5-19.		Proceed to step 28.
28	Same as step 27.	Same as step 27.	Replace the modulator subassembly and perform steps a through o of paragraph 5-19.	Same as step 27.	Trouble is in original modulator subassembly. Test the tubes in Tube Tester TV-3B/U, and, if normal, replace subassembly.	Trouble is in MIC, KEY, ANT connectors, or transformer T301.

5-27. SUBASSEMBLY REMOVAL AND REPLACEMENT.

5-28. Radio Receiver-Transmitter 618S-1 and 618S-1A consists of a group of 13 subassemblies or units which plug into receptacles on the main chassis frame. The individual plug-in units and subassemblies which require mechanical linkage to each other or to the front panel subassembly are built with quick-disconnect, flexible Oldham, or pin-type couplers to allow removal of the subassemblies or units from the main chassis. Once these linkages are synchronized, and the proper procedure is followed, it is possible to remove and replace units without additional mechanical alignment. All electrical connections to the plug-in subassemblies and units are made through receptacles mounted on the main chassis which facilitates easy removal without unsoldering wires. Captive hold-down screws hold the individual units and subassemblies in place. The front panel subassembly is constructed to make good electrical contact with a dust cover that is removable from the rear of the equipment.

5-29. When removing the main chassis from the case, disengage the two Dzus fasteners at the rear of the 618S-1 or 618S-1A main component. Place the 618S-1 or 618S-1A in a standing position on the floor, with the back plate flat against the floor. The main chassis then can be lifted out of the case by pulling straight up on the two front handles. The main chassis normally is not fitted into a jig, since all plug-in units and subassemblies are accessible from the top. To aid the technician in removing a unit or subassembly, the screws which secure the units and subassemblies are painted red. They must be loosened, but should not be removed completely, to free the subassemblies and units. It is important that a Phillips screw driver of the proper size be used to prevent damage to the heads of the screws. When the screws are loosened, they cause some extraction of the plugs and jacks which connect the subassemblies and units to the main chassis. This is desirable to prevent bending pins during removal. It is important to rock the subassemblies and units loose as they are extracted from the chassis. Insert the plugs carefully when returning the subassembly or unit to the main chassis, checking for proper alignment between the pins and sockets.

5-30. GENERAL. When removing the 250 kc oscillator and bfo, i-f amplifier, audio amplifier, relay, tuner servo amplifier, pa servo amplifier, modulator, r-f crystal oscillator, or tuner subassemblies, the following procedure should be followed.

a. Loosen the redheaded captive screws until they turn freely. It will be observed that loosening the screws causes the connecting plug and jack to separate.

b. Lift the subassembly straight up.

c. The plate caps of the modulator tubes must be removed to free the modulator subassembly.

d. When reinstalling any of the above-mentioned subassemblies, carefully line up the pins of the plug with the mating jack. Make certain that the subassembly is not reversed by 180 degrees.

e. Push the subassembly straight down firmly until it is fully seated.

f. Tighten the redheaded captive screws alternately to secure the subassembly to the main chassis.

5-31. TUNER SUBASSEMBLY, 618S-1. Perform the following operations when removing and replacing the 618S-1 tuner subassembly. Refer to paragraph 5-32 for the 618S-1A tuner subassembly.

a. Channel the 618S-1 equipment to the position corresponding to 2.0 megacycles.

b. The fork and pin of the two front couplers should be in a downward position.

c. Loosen the four redheaded captive screws until they turn freely.

d. Disconnect plug P1503 from jack J1001.

e. Lift the tuner subassembly straight up and out of the main chassis.

f. When reinstalling the tuner subassembly, the pins on the bandchange autopositioner unit, servomotor B102 unit, and the power amplifier subassembly couplers should be pointing downward. The three forks on the couplers of the tuner subassembly also should point down with the slug rack near the bottom.

g. Insert the tuner subassembly carefully, observing that all couplers are properly meshed.

h. Tighten the four redheaded captive screws alternately to seat the tuner subassembly properly.

5-32. TUNER SUBASSEMBLY, 618S-1A. Perform the following operations when removing and replacing the 618S-1A tuner subassembly:

a. Same as step a, paragraph 5-31.

b. The red identification dots on the two front Oldham couplers should be straight up.

c. Same as step c, paragraph 5-31.

d. Same as step d, paragraph 5-31.

e. Same as step e, paragraph 5-31.

f. When reinstalling the tuner subassembly, the red dots on the two front Oldham couplers attached to the tuner subassembly should be straight. The long cutout on the slider portion of the couplers attached to the bandchange autopositioner unit and servomotor B102 unit, should be vertical and the pin toward the bottom. The rear coupler, attached to the power amplifier subassembly, should have the slider portion of the coupler vertical and the pin toward the bottom.

g. Same as step g, paragraph 5-31.

CAUTION

The pin on the slider portion of the Oldham coupler must match the 90-degree cutout of the fixed portion of the Oldham coupler when installing a subassembly or unit.

h. Same as step h, paragraph 5-31.

5-33. POWER AMPLIFIER SUBASSEMBLY, 618S-1. Perform the following operations when removing and replacing the 618S-1 power amplifier subassembly. Refer to paragraph 5-34 for the 618S-1A power amplifier subassembly.

a. To remove the power amplifier subassembly, the 618S-1 equipment must be channeled to band 4. Any frequency in band 4 may be used.

b. In this position, the fork and pin of the coupler is straight up.

c. Loosen the four redheaded captive screws until they turn freely.

d. Disconnect plug P1503 from jack J1001.

e. Lift the subassembly straight up and out of the main chassis.

f. When reinstalling the power amplifier subassembly, the pin of the power amplifier subassembly coupler and the fork on the tuner subassembly coupler should be pointing up.

g. Insert the power amplifier subassembly carefully, observing that the couplers mesh properly.

h. Tighten the four redheaded captive screws, taking each side up a little at a time in order to seat the subassembly properly.

i. Insert plug P1503 into jack J1001.

5-34. POWER AMPLIFIER SUBASSEMBLY, 618S-1A. Perform the following operations when removing and replacing the 618S-1A power amplifier subassembly:

a. Same as step a of paragraph 5-32.

b. In this position, the green dot on the Oldham coupler should be straight up.

c. Same as step c, paragraph 5-32.

d. Same as step d, paragraph 5-32.

e. Same as step e, paragraph 5-32.

f. When reinstalling the power amplifier subassembly, the green dots of the Oldham couplers on the power amplifier and tuner subassemblies should be up.

g. Same as step g, paragraph 5-32.

h. Same as step h, paragraph 5-32.

i. Same as step i, paragraph 5-32.

5-35. SERVOMOTOR B102 AND BANDCHANGE AUTOPOSITIONER UNITS, 618S-1. Perform the following operations when removing and replacing the 618S-1 bandchange autopositioner or servomotor B102 units. Refer to paragraph 5-36 for the 618S-1A bandchange autopositioner or servomotor B102 units.

a. Channel the 618S-1 equipment to the A1 position (2.0 megacycles).

b. To gain access to the bandchange autopositioner and servomotor B102 units, remove the four screws in the front panel cover and lift the cover off.

c. Disconnect the plug or jack of the unit being removed from the front panel plug or jack. Disconnect P106 from J106 when removing servomotor B102 unit, and disconnect P107 from J107 when removing the bandchange autopositioner unit.

d. Loosen the three redheaded captive screws and lift the unit free.

e. When reinstalling servomotor B102 unit, hold the unit so that the back plate with the silk-screened TUNING DRIVE is facing you. Turn the coupler clockwise as far as possible; then back off slightly until the coupler is vertical. This is the proper position for reinsertion.

f. When reinstalling the bandchange autopositioner unit, the fork and pin of the tuner subassembly coupler should be down and the bandchange autopositioner unit coupler properly mated in this position.

g. After the units have been replaced, tighten the redheaded captive screws alternately.

h. Replace the applicable plug in the jack from which it was removed.

5-36. SERVOMOTOR B102 AND BANDCHANGE AUTOPOSITIONER UNITS, 618S-1A. Perform the following operations when removing and replacing the 618S-1A bandchange autopositioner or servomotor B102 units:

a. Same as step a, paragraph 5-34.

b. Same as step b, paragraph 5-34.

c. Same as step c, paragraph 5-34.

d. Same as step d, paragraph 5-34.

e. When reinstalling servomotor B102 unit, hold the unit so that the back plate with the silk-screened TUNING DRIVE is facing you. Turn the coupler clockwise as far as possible; then back off slightly until the grooved portion of the coupler is in line with the line on the plate of the unit.

f. When reinstalling the bandchange autopositioner unit, the pin on the slider portion of the coupler must match the 90-degree cutout of the fixed portion of the coupler.

g. Same as step g, paragraph 5-34.

h. Same as step h, paragraph 5-34.

5-37. BLOWER MOTOR B101 UNIT.

a. To remove the blower motor B101 unit from either the 618S-1 or 618S-1A front panel, first remove the front panel cover to gain access to B101.

b. Remove plug P105 from jack J105.

c. Remove four Phillips-head screws securing the B101 unit to the front panel.

d. To reinstall blower motor B101 unit, reverse steps a through c.

5-38. LUBRICATION.

5-39. GENERAL. Components or subassemblies requiring lubrication, listed in table XVI, should be inspected at 1000-hour intervals. If the parts appear to be clean, sufficiently lubricated, and free running, lubrication may be omitted until the following lubrication period. If old lubricant has become hard or dirty, clean the parts to be lubricated with carbon tetrachloride O-C-141(4) or Stoddard solvent, and dry with compressed air. Refer to table XVI and figures 5-2 through 5-9.

CAUTION

The equipment should not be operated after having been cleaned with carbon tetrachloride until relubrication procedures have been performed.

NOTE

The Oldham couplers illustrated in figures 5-3 through 5-9 are used on the 618S-1A subassemblies; however, all indicated lubrication points are the same for both the 618S-1 and 618S-1A subassemblies.

TABLE XVI. LUBRICATION OF EQUIPMENT

COMPONENT OR SUBASSEMBLY	PART	REFERENCE NUMBER	FIGURE NO.	LUBRICANT	METHOD OF APPLICATION
RADIO RECEIVER-TRANSMITTER 618S-1 AND 618S-1A					
Blower Motor B101 Unit	Ball Bearings	1	5-2	MIL-G-3278	Brush
Bandchange Auto-positioner Unit	Gear Teeth	2	5-3	MIL-G-7421	Brush
	Ball Bearings	3	5-3	MIL-G-7870	Dropper
	Servomotor Bearings	4	5-3	MIL-G-7870	Dropper
Servomotor B102 Unit	Gear Teeth	5	5-4	None	Do not lubricate
	Ball and Motor Bearings	6	5-4	MIL-L-7870	Dropper
Tuner Subassembly	Gears	7	5-5, 5-6	MIL-G-7421	Brush
	Porous Bearings	8	5-5, 5-6	MIL-L-7870	Dropper
Power Amplifier Subassembly	Metal-to-Metal Gears	9	5-7	MIL-G-7421	Brush
	Porous and Ball Bearings	10	5-7	MIL-L-7870	Dropper
	Servomotor Bearings	11	5-7	MIL-L-7870	Dropper
R-F Crystal Oscillator Subassembly	Gear Teeth	12	5-8, 5-9	MIL-G-7421	Brush
	Porous Bearings	13	5-8, 5-9	MIL-L-7870	Dropper
	Ball Bearings	14	5-8, 5-9	MIL-L-7870	Dropper
MOUNTING 350S-1 OR 350S-3 AND MOUNTING 350T-1					
	Extractor Screw Shaft	15		MIL-G-7421 or MIL-G-3278	Brush
POWER SUPPLY 416W-1					
	Dynamotor Ball Bearings	16		MIL-G-3278	Brush
RADIO SET CONTROL 614C-2					
	Gears	17		MIL-G-7421	Brush
	Bearings	18		MIL-L-7870	Dropper
AUTOMATIC ANTENNA TUNER 180L-3					
Refer to Handbook Service Instructions, T.O. 31R2-4-38-1.					

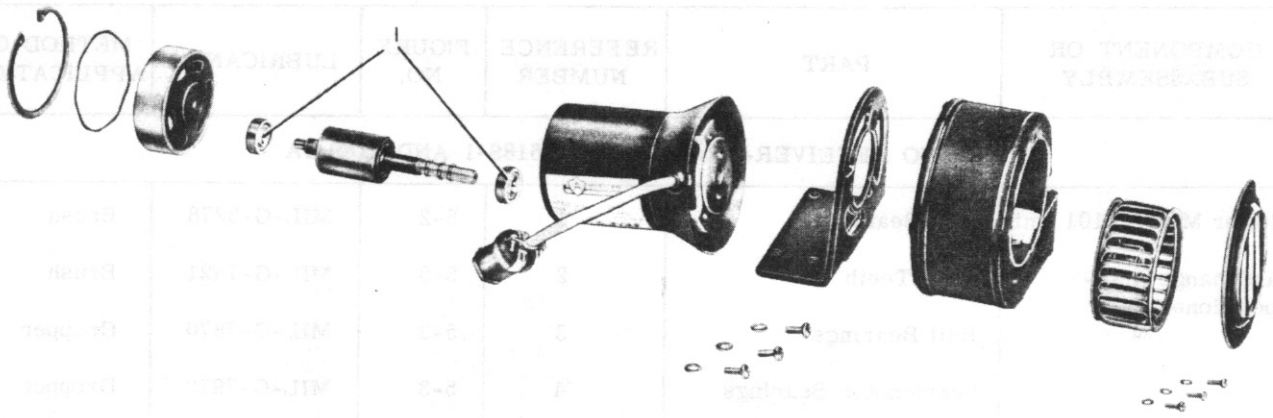

Figure 5-2. Blower Motor B101, Lubrication Points

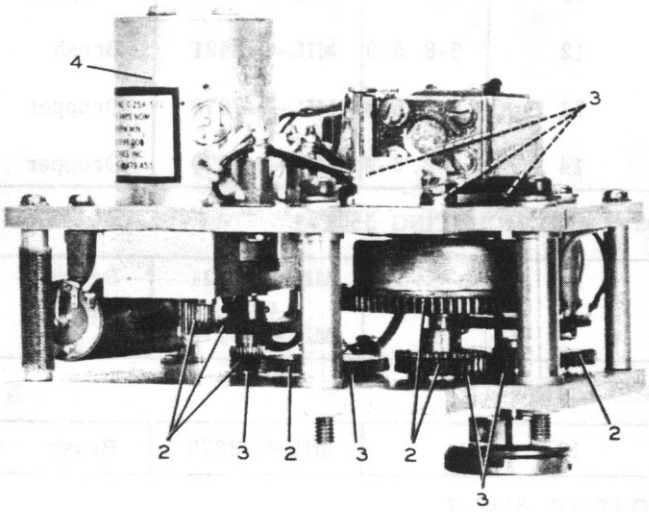

Figure 5-3. Bandchange Autopositioner Unit, Lubrication Points

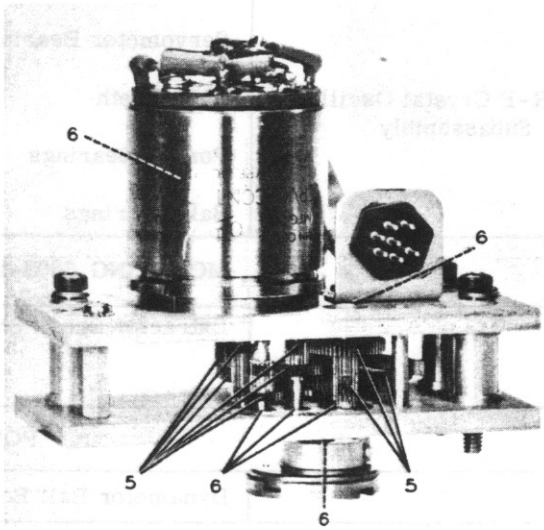

Figure 5-4. Servomotor B102 Unit, Lubrication Points

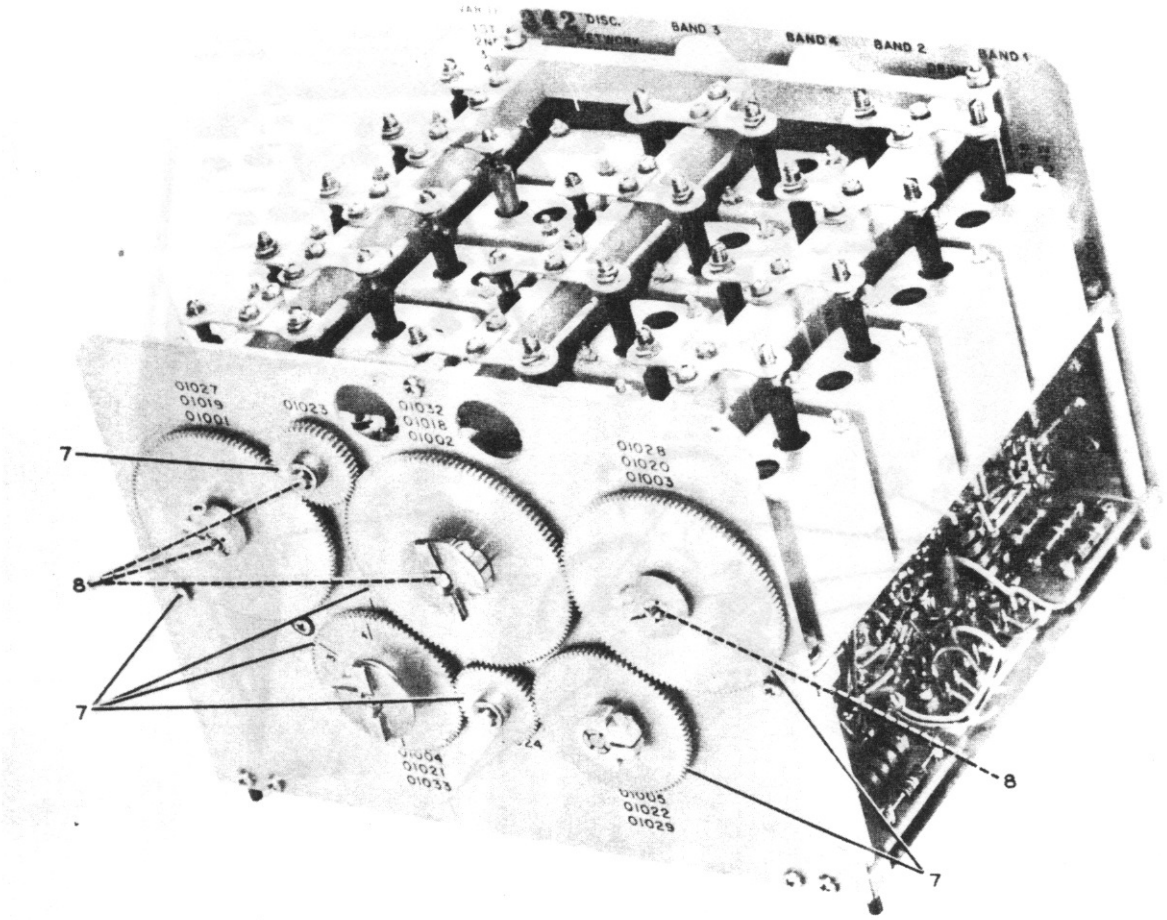

Figure 5-5. Tuner Subassembly, Front Oblique View, Lubrication Points

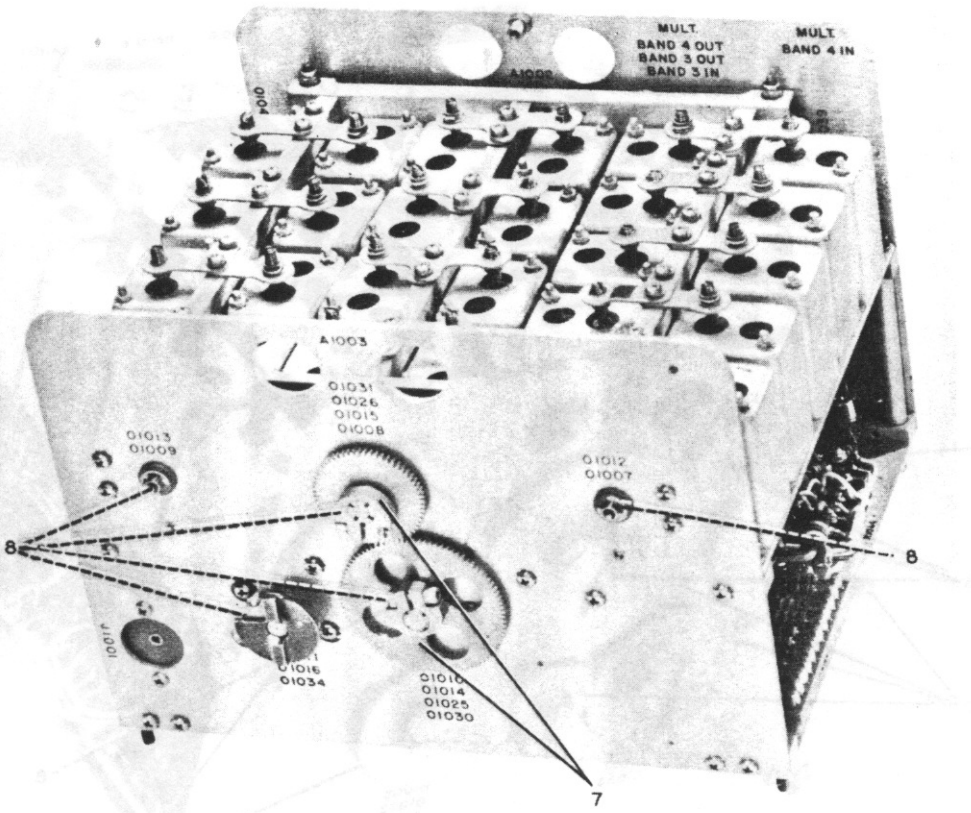

Figure 5-6. Tuner Subassembly, Rear Oblique View, Lubrication Points

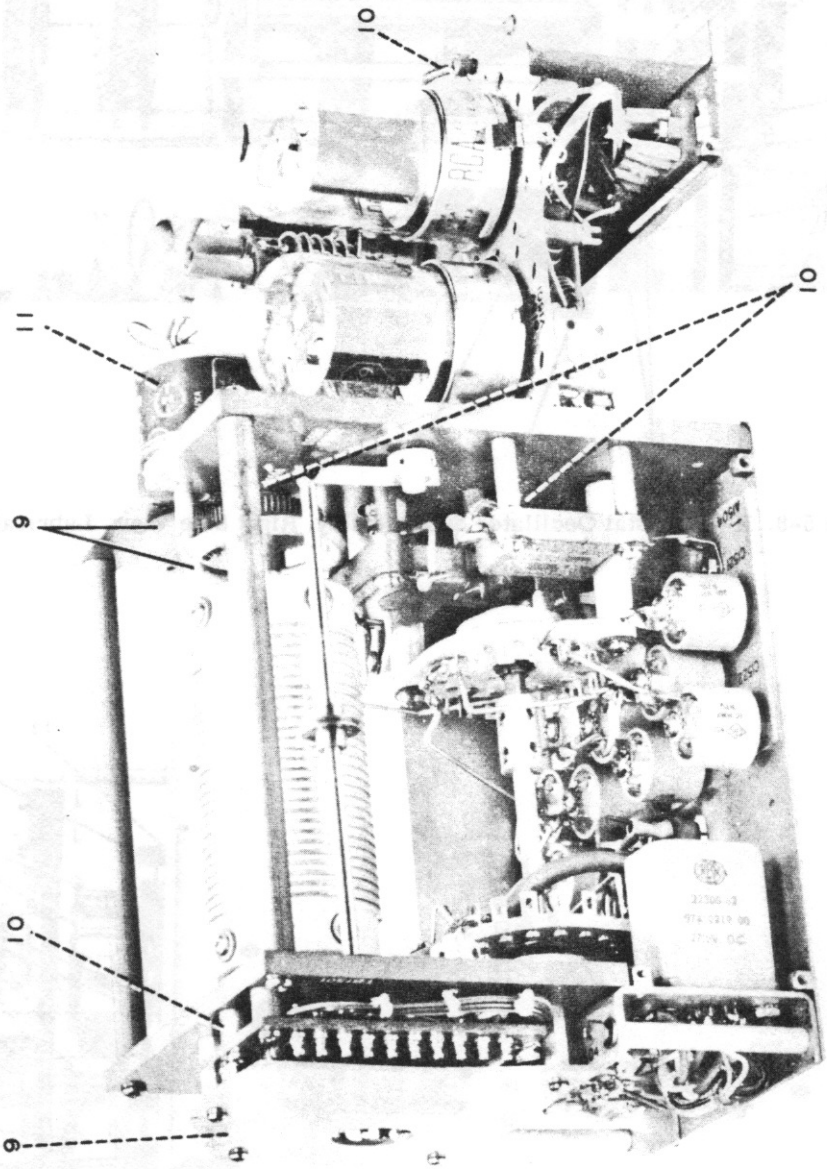

Figure 5-7. Power Amplifier Subassembly, Lubrication Points

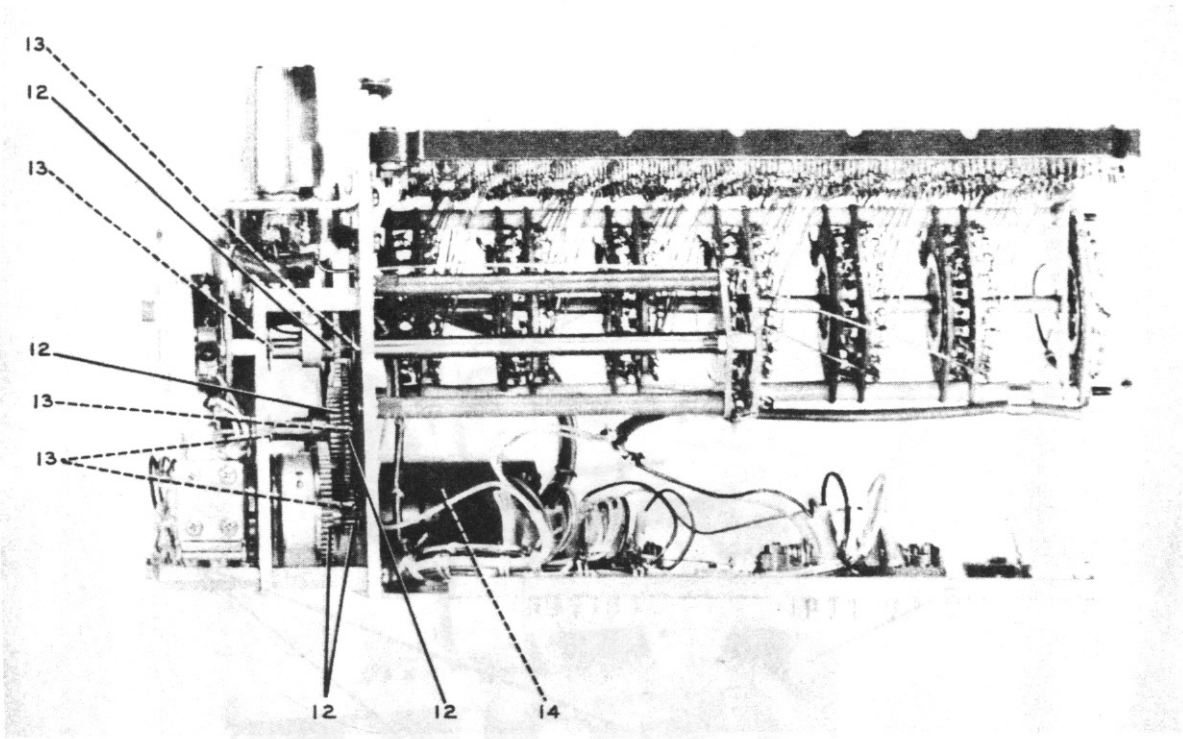

Figure 5-8. R-F Crystal Oscillator Subassembly, Right Side View, Lubrication Points

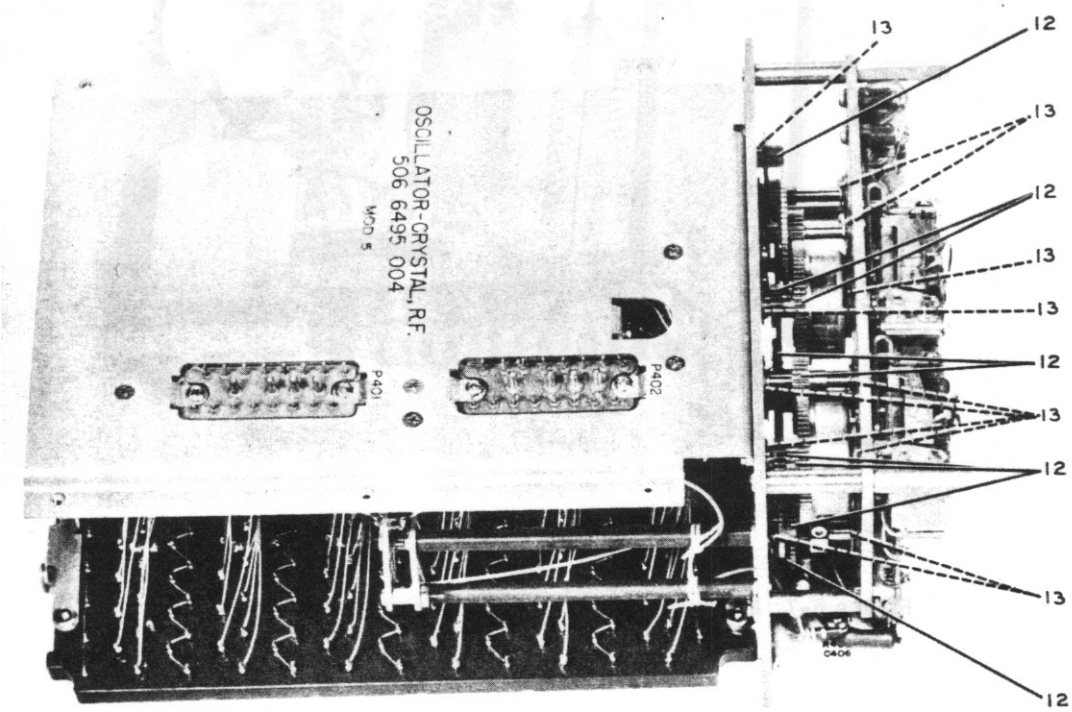

Figure 5-9. R-F Crystal Oscillator Subassembly, Bottom Oblique View, Lubrication Points

SECTION VI
FIELD MAINTENANCE

6-1. INTRODUCTION.

6-2. This section provides instructions essential for the maintenance of Radio Set 618S-1 and 618S-1A by field maintenance personnel. Before attempting to service and test this equipment, maintenance personnel should be thoroughly trained in maintenance practices and familiar with the theory of operation of this equipment. Maintenance procedures presented in this section are limited to those practices which are performed with test equipment and tools authorized for field maintenance personnel. Reference is made to T.O. 12R2-4-6-3, Handbook Overhaul Instructions, for maintenance procedures not covered in this handbook.

6-3. GENERAL. Field maintenance of the equipment is based on a complete test procedure designed to check completely an equipment component, and trouble isolation procedures, designed to isolate trouble to a detail part within a subassembly, or to a simple circuit within the equipment. Defects disclosed during the detailed performance tests should be corrected immediately by use of the trouble isolation tables or by adjustment or alignment procedures. A detailed alignment and tracking procedure for all subassemblies is presented in paragraph 6-46 and subsequent paragraphs. Alignment and tracking procedures should not be attempted unless it has definitely been established that malfunction exists because a subassembly is misaligned. Always check other possiblilties before attempting to perform alignment or tracking procedures on a subassembly. When reference is made to meter indications, attenuator settings, etc, on various pieces of test equipment, it should be remembered that these readings are only approximate values encountered on a large number of properly operating units. It is possible that the equipment will operate normally if the indications vary slightly from those stated. It is absolutely essential that the test equipment be properly calibrated, properly terminated, and otherwise in excellent condition.

6-4. In some instances it will be practical to examine and test a subassembly, with power applied, while it is removed from the main component. This can be accomplished by use of the two-foot extension cables described in section II. Refer to figures 2-5 through 2-9 and paragraph 2-9. Paragraphs 6-49 and 6-50 give a brief explanation of the use of Test Set 478H-1 and Maintenance Kit for 618S-1. If this test equipment is available, it may be included in the bench test setup.

WARNING

Operation of the 618S-1 or 618S-1A equipment involves voltages that are dangerous to life. When performing maintenance operations, special care must be taken to avoid contact with circuits carrying plate voltages. Also, clothing, rags, and test equipment should be kept free from the moving mechanical parts during the channeling cycle.

6-5. MINIMUM PERFORMANCE STANDARDS.

6-6. GENERAL. The test procedures outlined in paragraphs 6-7 through 6-13 provide minimum standards of performance for a complete 618S-1 or 618S-1A installation. The tests may be used as a means to analyze suspected trouble, or to test the equipment after trouble - shooting procedures have been completed. The detailed performance tests differ from the detailed performance tests outlined in paragraph 5-4 of this handbook, in that they provide a more comprehensive and detailed check, utilizing test equipment authorized for use by field maintenance personnel. The following tests are designed to supplement the performance tests in section V of this handbook. Field maintenance personnel should perform all test procedures under Organizational Maintenance, section V, paragraph 5-4 and following, before performing the test procedures in this section.

6-7. PREPARATORY. The radio equipment under test must be placed in a bench test setup in accordance with the procedures outlined in paragraphs 3-9 and 3-10. If only a particular subassembly has been sent to a field maintenance depot for repair, that subassembly must be substituted in a 618S-1 or 618S-1A known to be in good operating condition. Isolation of trouble in Power Supply 416W-1 may be accomplished by use of table XXVI. If Radio Set Control 614C-2 is not functioning properly, refer to table XXVII. Since each subassembly of Radio Receiver-Transmitter 618S-1 or 618S-1A is an integral part of the complete component, an individual test for each subassembly cannot be given, but by observing the trouble isolation procedures in tables XVIII through XXVII trouble can be isolated to a detail part. When performing the tests outlined in paragraphs 6-8 through 6-13, the 614C-2 sensitivity and threshold control should be in the maximum clockwise position unless otherwise indicated.

6-8. AVC CHARACTERISTICS. Perform the following operations:

a. Install the test crystals listed in table X of section III in the r-f crystal oscillator subassembly.

b. Connect Output Meter TS-585B/U to J101 (test point 4). Adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

c. Connect Signal Generator AN/URM-25 to J109 (test point 3), and adjust to 2.75 megacycles with Frequency Meter AN/USM-26.

d. Adjust the AN/URM-25 output level to 10 microvolts, modulated 30% at 1000 cps.

e. Operate the OFF PHONE CW switch to the PHONE position, and allow at least ten minutes for warmup.

f. Operate the channel selectors to the A4 (2.75 megacycle) position. Increase the output level of Signal Generator AN/URM-25 to 100,000 microvolts, and observe the change in power output as read on Output Meter TS-585B/U. The power output for 100,000 microvolts input should be not greater than 2.24 times that for 10 microvolts input which corresponds to a 3.5-db change.

g. Set the AN/URM-25 level to 1000 microvolts and then increase to 1 volt. The indication on Output Meter TS-585B/U should increase not more than 4 to 1, which corresponds to a 6-db change.

h. Perform the avc tests outlined in steps f and g for the following frequencies: 5.25 megacycles, position G4; 10.25 megacycles, position M4; and 20.25 megacycles, position U4.

6-9. FREQUENCY RESPONSE. Perform the following operations:

a. Same as step a, paragraph 6-8.

b. Same as step b, paragraph 6-8.

c. Connect Signal Generator AN/URM-25 to J109 (test point 3), and adjust to 2.0 megacycles with Frequency Meter AN/USM-26.

d. Adjust the AN/URM-25 output level to 100 microvolts, modulated 30% at 1000 cps.

e. Same as step f, paragraph 6-8.

f. Operate the channel selectors to the A1 (2.0-megacycle) position.

g. Record the reading of Output Meter TS-585B/U.

h. Change the modulation frequency to 300 cps, and observe the indication on the TS-585B/U. The indication should change not more than 3.5 db (2.24 to 1) from the recorded reading.

i. Change the modulation frequency to 3000 cps, and observe the indication on the TS-585B/U. The indication should change not more than 10 db (10 to 1) from the recorded reading.

j. Repeat the frequency response tests outlined in steps a through i for at least one frequency on each band of operations.

6-10. CW FREQUENCY RANGE. Perform the following range:

a. Same as step a, paragraph 6-8.

b. Same as step b, paragraph 6-8.

c. Connect Signal Generator AN/URM-25 to J109 (test point 3) and adjust to 2.0 megacycles with Frequency Meter AN/USM-26.

d. Adjust the AN/URM-25 output level to 50 microvolts unmodulated.

e. Operate the OFF PHONE CW switch to the PHONE position, and allow at least 10 minutes for warmup. After warmup, operate the OFF PHONE CW switch to the CW position.

f. Connect Frequency Meter AN/USM-26 to J101 (test point 4) through a 1-megohm isolating resistor.

g. Operate the channel selectors to the A1 (2.0-megacycle) position.

h. Vary the BFO control throughout its range and observe the indication on Frequency Meter AN/USM-26. Frequency Meter AN/USM-26 should read between 2000 and 4000 cps on both sides of zero beat.

6-11. CW GAIN CONTROL. Perform the following operations:

a. Same as step a, paragraph 6-8.

b. Same as step b, paragraph 6-8.

c. Connect Signal Generator AN/URM-25 to J109 (test point 3), and adjust to 2.0 megacycles with Frequency Meter AN/USM-26.

d. Adjust the AN/URM-25 output level to 10 microvolts unmodulated.

e. Operate the OFF PHONE CW switch to the PHONE position and allow at least 10 minutes for warmup. After warmup, operate the OFF PHONE CW switch to the CW position.

f. Operate the channel selectors to the A1 (2.0 megacycle) position.

g. Connect Frequency Meter AN/USM-26 to J101 (test point 4) through a 1-megohm isolating resistor, and adjust the BFO control for a reading of 1000 cps on the AN/USM-26.

h. Observe the indication on the TS-585B/U with the 614C-2 sensitivity control at the maximum clockwise position.

i. Increase the AN/URM-25 output level to 10,000 microvolts, and rotate the 614C-2 sensitivity control to the maximum counterclockwise position.

j. Output Meter TS-585B/U should indicate less power than observed in step h.

6-12. SIDE-TONE POWER.

a. Same as step a, paragraph 6-8.

b. Connect the dummy microphone (figure 2-1) to J102 (test point 5).

c. Connect Audio Oscillator TS-382A/U to the dummy microphone circuit. Set the TS-382A/U frequency to 1000 cps with Frequency Meter AN/USM-26.

d. Connect the dummy load and Oscilloscope OS-8/U to E102 or J110 (test point 1).

e. Connect Output Meter TS-585B/U to J101 (test point 4), and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

f. Operate the OFF PHONE CW switch to the PHONE position, and allow at least 10 minutes for warmup.

g. Operate the channel selectors to the A1 (2.0-megacycle) position.

h. Insert a telegraph key into J103 (test point 6) and depress.

i. Adjust the output level of Audio Oscillator TS-382A/U for 80% modulation of the carrier. Refer to step i of paragraph 3-14 and figure 3-2.

j. Adjust the front panel PHONE SIDETONE control (R106) for a power output of 300 milliwatts as read on Output Meter TS-585B/U.

k. Remove Audio Oscillator TS-382A/U and operate the OFF PHONE CW switch to the CW position.

l. Adjust the front panel CW SIDETONE control (R107) for a power output of 300 milliwatts as read on Output Meter TS-585B/U.

6-13. MODULATION FIDELITY. Perform the following operations:

a. Same as step a, paragraph 6-8.
b. Same as step b, paragraph 6-12.
c. Same as step c, paragraph 6-12.
d. Same as step d, paragraph 6-12.
e. Same as step e, paragraph 6-12.
f. Same as step f, paragraph 6-12.
g. Same as step g, paragraph 6-12.
h. Same as step h, paragraph 6-12.

i. Adjust the output level of Audio Oscillator TS-382A/U for 60% modulation of the carrier. Refer to step i of paragraph 3-14 and figure 3-2.

j. Keeping the output level of the TS-382A/U to that determined in step i, vary the TS-382A/U frequency between the limits of 300 and 3500 cps. The percentage of modulation should remain within the limits of 40% to 70%.

k. Keeping the TS-382A/U output level constant, change the modulation frequency to 5000 cps. The percentage of modulation should be not less than 21.8%.

l. Keeping the TS-382A/U output level constant, change the modulation frequency to 6500 cps. The percentage of modulation should be not more than 11.5%.

m. Perform the modulation fidelity tests outlined in steps a through l for at least one frequency on each band of operation.

6-14. TROUBLE ISOLATION PROCEDURES.

6-15. GENERAL. Trouble isolation procedures for Radio Set 618S-1 and 618S-1A consist of determining what detail part, or group of detail parts, is causing a particular malfunction in the equipment. Trouble isolation procedures are a continuation of the system trouble analysis procedures, table XV, in section V of this handbook. Accurate determination of which section of the equipment is at fault is essential in the trouble-shooting procedure, since the following trouble isolation procedures are presented for various subassemblies and sections of the complete equipment.

6-16. VOLTAGE DISTRIBUTION IN RADIO SET 618S-1 AND 618S-1A.

6-17. PRIMARY VOLTAGE DISTRIBUTION. All voltages are supplied to the 618S-1 or 618S-1A through P1601/J1601 of Power Supply 416W-1. Figure 6-1 illustrates the distribution of voltages to the various connectors and relays. Measure voltages at the jacks when attempting to isolate trouble. Compare with the voltages indicated in figure 6-1. Careful study of this diagram will indicate that certain voltages are supplied to jacks and relays through contacts of other relays. The proper use of this information will reduce the time required for trouble isolation.

6-18. The +27.5 volt d-c enters Power Supply 416W-1 through J1601-23/P1601-23 and is connected to one side of switches S1601 and S1602 (silk-screened RESET). The other contact of S1601 is connected to one contact of K1601, and the other contact of S1602 is connected to one contact of K1602 and to one side of relays K1602 and K1603. Placing S2603 (located in Radio Set Control 614C-2) in the PHONE or CW position grounds one side of K1602 and K1603, thus energizing K1602 and K1603. Contacts of relay K1602 supply voltage to the filament circuit, while contacts of relay K1603 complete the a-c circuits in Power Supply 416W-1. Operation of the a-c circuits permits K1604 to operate, its contacts completing the circuit for K1601. K1604 is, therefore, a type of bias relay which prevents K1601 and dynamotor D1601 from operating until sufficient voltage has been supplied for proper operation of the equipment.

6-19. Dynamotor D1601 will operate only when three conditions are satisfied. First, the OFF PHONE CW switch of Radio Set Control 614C-2 must be in the PHONE or CW position. If in the PHONE position, the microphone push-to-talk button must be depressed. Secondly, K1604 and K1601 must be energized. In addition, 27.5 volts d-c must be supplied to P1601-19, the dynamotor interlock voltage point. The 27.5-volt d-c is supplied to this point from the keying relay interlock in the 180L-3 through contacts of relay K801 located in the relay subassembly of the 618S-1 or 618S-1A. Make sure to check these points if the dynamotor fails to operate. Also check F1601 and F1602 to make certain a-c voltage is being applied.

6-20. The a-c primary power source consists of 115 volts, 400 cps and 115 volts, 320-1000 cps. The variable frequency power source (115 volts, 320-1000 cps) is optional, and may be replaced with the 115-volt, 400-cps power source. The 115-volt power sources supply the following voltages to the 618S-1 or 618S-1A system: 6.3 volts, 400 cps; 18 volts, 400 cps; 115 volts, 400 cps; 250 volts d-c; -50 volts d-c; and -65 volts d-c. The 250-volt d-c supply is used within Radio Receiver-Transmitter 618S-1 or 618S-1A during both transmission and reception differing from the 250-volt d-c supplied by dynamotor D1601 which is used only during transmission. Transformer T1601 steps down the 115-volt a-c to 6.3 volts, and autotransformer L1606 steps down the 115-volt a-c to 18 volts a-c. The 6.3-volt a-c is used within the 618S-1 or 618S-1A as a reference voltage to chopper coils. The 18-volt a-c is not used in the 618S-1 or 618S-1A installation. The -50 and -65 volt d-c provide bias to the modulator and power amplifier tubes, respectively.

NOTE

The functions of all relays and circuits of Power Supply 416W-1 are covered in detail in the theory of operations section of this handbook, paragraphs 4-40 through 4-45.

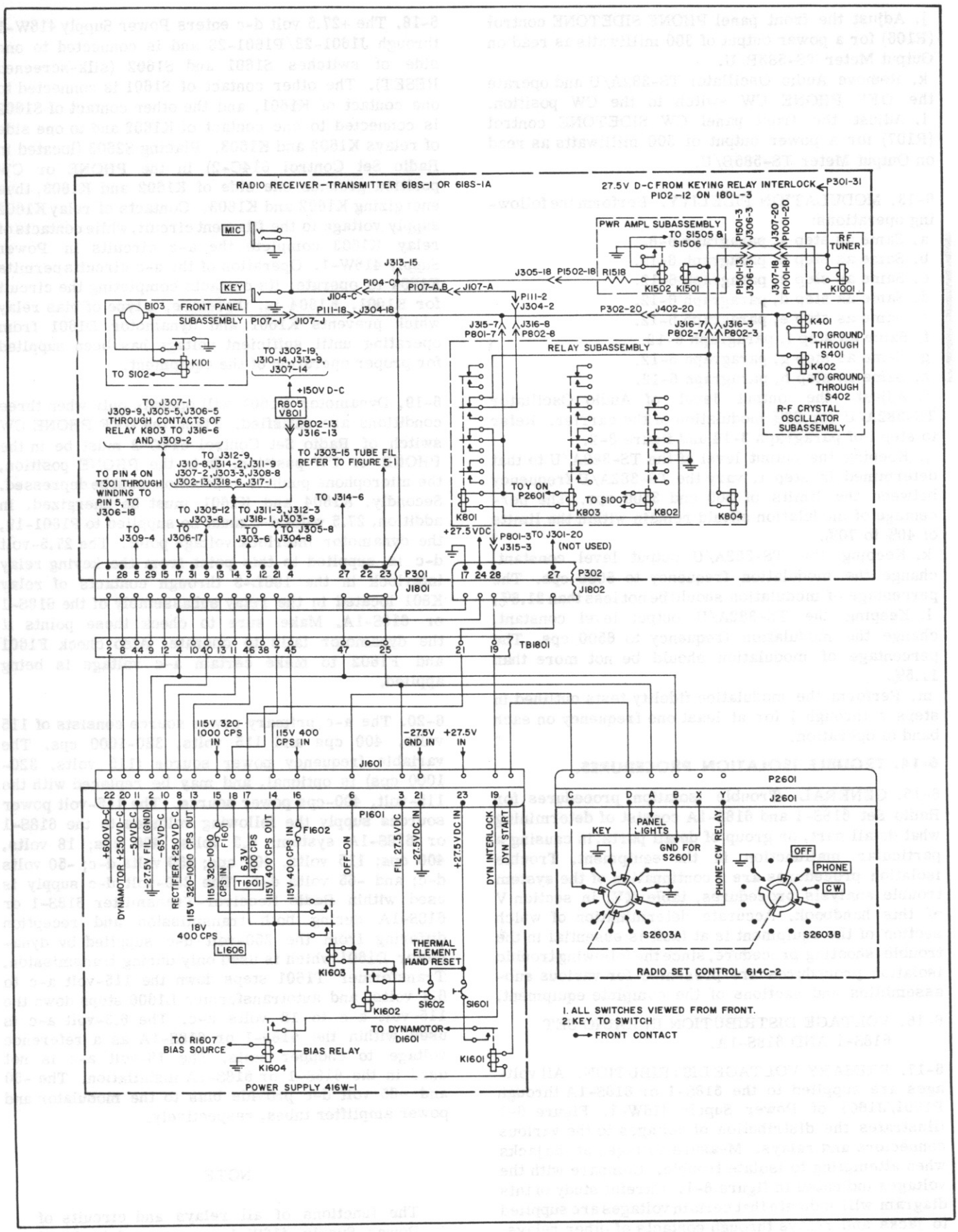

Figure 6-1. Radio Set 618S-1 and 618S-1A, Voltage Distribution

6-21. B-PLUS VOLTAGE DISTRIBUTION. Two 250-volt d-c supplies are employed, as stated in the preceding paragraph. One originates with the 27.5-volt d-c power source, which is stepped up by dynamotor D1601 to 250 volts d-c and applied through terminal 20 of P1601/J1601, through terminal 12 of TB1801, and through terminal 15 of J1801/P301 to subassemblies within Radio Receiver-Transmitter 618S-1 or 618S-1A. The other 250-volt supply originates in the 115-volt, 400-cps power source. This supply is rectified and filtered through circuits within Power Supply 416W-1 and applied through terminal 8 of P1601/J1601, through terminal 11 of TB1801, and through terminal 14 of J1801/P301 to subassemblies within Radio Receiver-Transmitter 618S-1 or 618S-1A.

6-22. The 600-volt d-c supply originates in the 27.5-volt d-c power source. The voltage is stepped up by dynamotor D1601, and applied through terminal 22 of P1601/J1601, through terminal 2 of TB1801, and through terminal 1 of J1801/P301 to the modulator and power amplifier plates.

6-23. The 150-volt regulated supply originates in the 115-volt, 400-cps power source. The 250-volt d-c rectifier supply, described in paragraph 6-21, is applied through terminal 13 of J316/P802 to dropping resistor R801 and voltage regulator V801. The resultant 150-volt d-c supply is applied to jacks J302, J310, J313, and J307.

6-24. VOLTAGE AND RESISTANCE MEASUREMENTS. Voltage and resistance measurements for the various plug-in subassemblies are given in figures 7-1 through 7-9. Since the pins of the tubes are not readily accessible while the subassemblies are in place, tube socket adapters were used to obtain most of the measurements. By plugging the tube under measurement into the adapter and then plugging the adapter into the tube socket, measurements can be made from the top of the subassembly. In figures 7-1 through 7-9, voltages are indicated above the line and resistance values below. Table XVII lists the d-c resistances of the transformers and inductors used in the 618S-1 and 618S-1A systems. These resistance values are for information in case of emergency replacement or for trouble-shooting procedures and are not intended to be absolutely correct in measurement. Variations may occur when making measurements with the equipment still in excellent operating condition.

TABLE XVII, D-C RESISTANCE VALUES OF TRANSFORMERS AND INDUCTORS

SYMBOL NUMBER	LOCATION	TERMINALS	D-C RESISTANCE (OHMS)
B102	Front Panel Subassembly	1-3, 2-4*	150
T301	Main Chassis	1-2, 2-3 4-5 6-7	85 40 150
L401	R-F Crystal Oscillator Subassembly		43
T601	Tuner and PA Servo Amplifier Subassemblies	1-2 3-4	550 6500
FL901	I-F Amplifier Subassembly	Input and Output	170
L901, L903, L904			7
L905			7.5
L1026	Tuner Subassembly		7.5
L1027, L1028			18
L1201, L1202	250 Kc Oscillator and BFO Subassembly		17
L1203			15
L1204, L1205			9

TABLE XVII, D-C RESISTANCE VALUES OF TRANSFORMERS AND INDUCTORS (Cont)

SYMBOL NUMBER	LOCATION	TERMINALS	D-C RESISTANCE (OHMS)
T1301	Audio Amplifier Subassembly	1-2 3-4, 4-5	.1000 11
L1401, L1402	Modulator Subassembly		450
L1501, L1505	Power Amplifier Subassembly		17
B1501		1-3 2-5, 4-6	160 80
L1601, L1602	Power Supply 416W-1		10
L1604			11
L1605			4
T1601		1-2 3-4, 4-5	120 4

*Terminals 5 and 6 must be jumpered.

6-25. TROUBLE ISOLATION TABLES.

6-26. The following trouble isolation tables are a continuation of the system trouble analysis procedures of section V. These tables provide a procedure for isolation of trouble to a detail part within a subassembly. Before proceeding to the steps outlined in tables XVIII through XXVII, trouble should be known to exist within the subassembly under test. Also, all test equipment, as well as the microphone and headset, should be in good operating condition. Perform all the test procedures outlined in the paragraph pertaining to the test subassembly and then proceed to the applicable table.

6-27. R-F CRYSTAL OSCILLATOR SUBASSEMBLY. After trouble has been isolated to the r-f crystal oscillator subassembly, the test procedures presented in this paragraph and the listings under table XVIII will help isolate trouble to a detail part or group of detail parts. The tests presented in this paragraph assume that all of the minimum performance standard tests in both sections V and VI of this handbook have been performed and trouble is known to exist within the circuitry of the r-f crystal oscillator subassembly. The equipment should be placed in a test bench setup similar to that illustrated in figure 3-1 and a tube adapter placed under tube V401. The tube voltage and resistance measurements presented in figure 7-1 should be performed, as well as the checks presented in steps a through c. After completing steps a through c, and if the trouble has not yet been located, refer to table XVIII.

a. With the 618S-1 or 618S-1A equipment in unkeyed operation in either the PHONE or CW positions, measure the voltage at terminal 2 of J302 (test point 10) with the r-f probe of VTVM TS-375/U. Reading should be approximately 1.8 volts d-c.

b. If no reading is obtained in step a, try several random channels.

c. If no reading is obtained in step b, check continuity of switches. Refer to figure 7-17.

NOTE

For purposes of simplicity, the Autopositioner system employed in the r-f crystal oscillator subassembly is covered by a separate trouble isolation table. If trouble is encountered within the circuitry of the r-f crystal oscillator subassembly, refer to table XVIII. If trouble is encountered within the r-f crystal oscillator autopositioner system, refer to table XIX.

TABLE XVIII. R-F CRYSTAL OSCILLATOR SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Readings obtained in step b of paragraph 6-27 but none in step a.	1. Defective crystal. 2. Defective switch S401, S402, S403 S404, or S405.	Replace defective crystal. Replace defective switch.
2. No reading obtained in steps a or b of paragraph 6-27.	1. Defective V401. 2. Plugs P401 or P402 defective. 3. Defective switch as determined in step c of paragraph 6-27. 4. Defective detail part within the r-f oscillator circuit.	Replace V401. Replace or repair as necessary. Replace defective switch. Replace defective detail part.
3. Filament of V401 does not light.	1. Defective V401. 2. Resistor R405 open. 3. Detail part E402, E403, C408, K402, or K401 defective. 4. Plug P402 defective.	Replace V401. Replace R405. Replace defective detail part. Replace or repair as necessary.

6-28. AUTOPOSITIONER SYSTEM. When trouble is encountered within the Autopositioner system of the r-f crystal oscillator subassembly, the trouble isolation procedures outlined in table XIX should be performed. Before proceeding with the steps of table XIX, the detailed performance tests in sections V and VI of this handbook should have been performed. Make certain that the trouble exists within the r-f crystal oscillator subassembly, and the Autopositioner system, in particular. Before proceeding to table XIX, make certain the bandchange autopositioner unit is in good operating condition. This may be accomplished by replacement with one known to be in good operating condition. Reference is made to paragraphs 5-35 and 5-36 for the removal and replacement procedures. If, after ascertaining the condition of the bandchange autopositioner unit and completing the tests and trouble isolation procedures in sections V and VI, the trouble has not yet been located, proceed to table XIX.

TABLE XIX. AUTOPOSITIONER SYSTEM, TROUBLE ISOLATION

SYMPTOM	CAUSE	REMEDY
1. Motor B401 continues to run after autopositioner sets up.	1. Contacts bent on K401 or K402. Spring weak, pawl does not seat fully. 2. Seeking switch out of synchronization, causing pawl to drop late and catch on far side of notch. 3. Intermittent or continuous short on negative side of motor B401.	Straighten contacts. Replace relay, replace spring, or remove and bend spring to increase tension. Refer to paragraph 6-56. Adjust switch. Refer to figure 6-3 and paragraph 6-57. Remove cause of short.

TABLE XIX. AUTOPOSITIONER SYSTEM, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
2. Autopositioner sets up on wrong channel occasionally.	1. Broken wire or poor connection on one or more control wires.	Note which channels give ambiguous results. Check control wires for those channels and correct defect.
3. Autopositioner sets up on one channel, but continues to run on others.	1. Control wire shorted to ground.	Note which channel sets up correctly and check control wire for that channel. Correct fault.
	2. Switch out of synchronization, allowing pawl to drop too early or too late.	Check visually when set up. Realign as necessary. Refer to figure 6-3 and paragraph 6-57.
4. Autopositioner does not set up on any channel, stop wheel turns freely, relay opens momentarily each revolution of shaft.	1. Spring bent, pawl does not engage stop wheel with sufficient force to hold.	Replace relay, replace spring, or remove and bend spring to increase tension. Refer to paragraph 6-56.
	2. Switch out of synchronization.	Realign switch. Refer to figure 6-3 and paragraph 6-57.
	3. Pawl sticks on its pivot.	Remove relay. Remove pawl and clean pivot pin. Reassemble pawl and lubricate pivot with MIL-L-644A oil. Replace and realign relay. Refer to paragraph 6-56.
	4. Relay shifted. Does not allow pawl to seat properly.	Realign relay. Refer to paragraphs 6-55 and 6-56.
	5. Pawl tip shape severely altered; does not hold.	Remove relay. Replace pawl with new pawl. Reassemble and readjust relay. Refer to paragraph 6-56.
5. Autopositioner does not set up on any channel, stop wheel turns freely, relay remains energized continuously.	1. Wire from relay to seeking switch shorted to ground.	Find and remove cause of short.
	2. Several or all control wires shorted to ground.	Find and remove cause of short.
6. Autopositioner does not set up, stop wheel does not turn freely, relay energized, motor B401 runs.	1. Pawl does not lift clear of notch. Relay shifted away from pawl.	Realign relay. Refer to paragraphs 6-55 and 6-56.
	2. Pawl does not lift clear of notch. Relay has insufficient travel.	Readjust. Refer to paragraphs 6-55 and 6-56.
	3. Driven elements jammed by physical obstruction.	Find and remove obstruction.
	4. Gear jammed	Find and remove cause of jam.

TABLE XIX. AUTOPOSITIONER SYSTEM, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
6. (cont)	5. Pawl sticks on its pivot.	Remove relay and pawl. Clean pawl and pivot pin. Replace pawl and lubricate pivot with MIL-L-644A oil. Replace and realign relay. Refer to paragraph 6-56.
	6. Improper lubrication on bearings at low temperature.	Disassemble and clean bearings as required. Lubricate in accordance with instructions in table XV.
	7. Insufficient clutch torque due to broken clutch springs.	Replace spring or entire r-f crystal oscillator subassembly.
	8. Insufficient clutch torque due to glazing of clutch surfaces.	Replace clutch drum and clutch shoe assembly or entire r-f crystal oscillator subassembly.
7. Autopositioner sets up, then recycles by itself.	1. Spring bent, does not hold pawl in notch properly.	Remove spring. Carefully bend spring to increase tension. Reassemble and readjust relay air gap. Refer to paragraph 6-56.
	2. Relay shifted. Pawl does not seat fully.	Realign relay. Check and readjust air gap, if necessary. Refer to paragraphs 6-55 and 6-56.
	3. Pawl tip altered; excessive slope or radius causes pawl to be pushed out of slot.	Remove relay. Replace pawl with new pawl. Reassemble and readjust relay. Refer to paragraph 6-56.
	4. Intermittent short circuit between control wires or from wires or switch to ground.	Find and remove cause of short.
	5. Switch out of synchronization, operation marginal.	Realign switch. Refer to figure 6-3 and paragraph 6-57.
8. Autopositioner relay closes, motor B401 does not operate.	1. Relay contacts bent, not closing motor B401 circuit.	Adjust contacts. Refer to paragraphs 6-55 and 6-56.
	2. Open circuit from relay to motor B401.	Find and correct cause of open circuit.
	3. Contacts dirty.	Clean or replace contacts. Check contact adjustment and readjust to obtain proper contact spacing and pressure. Refer to paragraphs 6-55 and 6-56.
	4. No power on positive side of motor B401.	Find and correct cause of open circuit.

TABLE XIX. AUTOPOSITIONER SYSTEM, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
8. (cont)	5. Motor B401 armature burned out.	Replace motor B401.
	6. Reduction gears jammed.	Find and remove obstruction.
9. Autopositioner relay does not operate.	1. No power on positive side of relay.	Correct cause of open circuit.
	2. Open circuit from relay to seeking switch.	Correct cause of open circuit.
	3. Control wire circuit open.	Correct cause of open circuit.
	4. Relay coil burned out.	Replace relay coil.
	5. No air gap on relay.	Readjust air gap. Refer to paragraphs 6-55 and 6-56.

6-29. TUNER SUBASSEMBLY. Before undertaking any of the trouble-shooting steps for the tuner subassembly, make a visual inspection for mechanical faults, such as a sticky slug rack, weak or broken springs on the slugs, broken slugs, loose or unmeshed gears, broken leads, solder shorts, and overheated detail parts. Check tubes V1001 through V1011. In trouble-shooting the tuner subassembly, remember that several stages are common to both the receiving and transmitting circuits. This fact can be used in isolating troubles. If, for instance, the equipment functions properly during reception, but lacks drive to the power amplifier during transmission, the driver stages, V1010 and V1011, or the transmitter mixers, V1004 and V1003, are probably at fault. The preceding r-f tuner stages, V1008 and V1009, could not be defective and have the equipment function properly during reception. By a similar process of elimination, other faulty stages can be isolated.

6-30. Install tube adapters and measure r-f voltages at the grids and plates of the various tubes. Compare with those in 7-3. This will isolate the trouble to the defective stage in the tuner subassembly. After isolating the trouble to its stage, make voltage and resistance checks to determine the faulty component. Check the operation of the tuner discriminator circuit by measuring the d-c voltage at terminal 4 of J308 (test point 11). During channeling cycle, a d-c voltage, varying in amplitude and polarity, should be measured. A zero reading should be obtained after the channeling cycle is complete. If the tuner slug rack centers when a new frequency is selected but will not tune, the trouble is in the tuner discriminator circuit. If the slug rack will move in one direction only, a portion of the tuner discriminator network, Z1001, is defective. In isolating the trouble to a particular detail part, operate the equipment on several bands. This will aid in isolating troubles to one stage. If the trouble is found to be misalignment, perform applicable portions of paragraphs 6-62 through 6-73. Refer to table XX for trouble isolation procedures.

TABLE XX. TUNER SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	CAUSE	REMEDY
1. Slug rack centers but does not set up.	1. Defective V1001.	Replace V1001.
	2. Defective detail part within the tuner discriminator circuit.	Replace defective detail part.
	3. Plug P1002 defective.	Replace or repair as necessary.

TABLE XX. TUNER SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
2. Slug rack will not center or set up.	1. Switch S1007 defective	Replace switch S1007.
	2. Plug P1002 defective.	Replace or repair as necessary.
	3. Defective mechanical drive.	Locate mechanical trouble and repair as necessary.
3. Filaments do not light.	1. Defective tube filament.	Locate and replace defective tube. Refer to figure 5-1.
	2. Resistor R1046 defective.	Replace R1046.
	3. Plugs P1001 or P1002 defective.	Replace or repair as necessary.
4. Low or zero output at J1001 (test point 12). Output should be not less than 85 volts r-f during transmission.	1. Defective V1004, V1007, V1003, V1002, V1009, V1010, or V1011.	Replace defective tube.
	2. Defective detail part of V1004, V1007, V1003, V1002, V1009, V1010, or V1011.	Replace defective detail part.
	3. Plugs P1001 or P1002 or jack J1001 defective.	Replace or repair as necessary.
	4. Defective transmitter tuned circuit; Z1002 through Z1009 and Z1014 through Z1025.	Replace defective tuned circuit.
5. No output during reception.	1. Defective V1005, V1002, V1006, V1007, V1008, or V1009.	Replace defective tube.
	2. Detail part of V1005, V1002, V1006, V1007, V1008, or V1009 defective.	Replace defective detail part.
	3. Plugs P1001 or P1002 defective.	Replace or repair as necessary.
	4. Defective receiver tuned circuit; Z1002 through Z1021.	Replace defective tuned circuit.
6. Receiver and transmitter output varies with frequency.	1. Tuned circuit Z1001 defective.	Replace Z1001.
	2. Resistor R1006 defective.	Replace R1006.

6-31. POWER AMPLIFIER SUBASSEMBLY. Before undertaking any of the trouble isolation procedures presented in table XXI, make a thorough visual inspection for mechanical faults such as loose or unmeshed gears, broken leads or connectors, solder shorts, and overheated detail parts. Test tubes V1501, V1502, and V1503 in Tube Tester TV-3B/U. Also, the detailed performance tests presented in sections V and VI of this handbook should have been performed. Make certain that the trouble exists within the power amplifier subassembly, and not within another subassembly. The voltage and resistance measurements presented in table 7-4 should be made to help isolate the trouble to a detail part or group of detail parts. After completion of the tests and trouble isolation procedures presented in sections V and VI, and after the pa tubes have been tested and measured, proceed to table XXI if the trouble has not yet been located.

TABLE XXI. POWER AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	CAUSE	REMEDY
1. Tubes do not light.	1. Defective tube filament.	Locate and replace defective tube. Refer to figure 5-1.
	2. Resistor R306 open.	Replace R306.
	3. Plug P1502 defective.	Replace or repair as necessary.
2. R-f drive present at J1001/P1503 (test point 12) (85 volts minimum) but reverse grid current (P.A. GRID position of meter) with 618S-1 or 618S-1A keyed.	1. Grid-to-cathode short on V1501, V1502, or V1503.	Replace defective tube.
3. Low current reading on P.A. PL position of meter and zero output.	1. Plate or screen voltage not getting to tubes.	Locate source of trouble and repair. Check P1502, R1522, C1502, C1503, C1504, E1501, E1502, E1503, C1522 , L1503, C1524, and P1501.
	2. Defective contacts on relay K1501.	Replace relay K1501.
	3. Dirty sliding contacts on L1502.	Clean and burnish contacts.
	4. Coaxial cable to J110 (ANT) open or shorted to ground.	Repair or replace cable.
4. Power amplifier does not automatically tune to resonance.	1. D-c voltage from pa discriminator is not being supplied to the pa servo amplifier subassembly.	Locate and correct fault. Check pa discriminator circuit, relay K1502, relay K1501, plug P1501, and plug P1502.
	2. Defective detail part in discriminator circuit.	Replace defective detail part.
	3. Defective mechanical drive.	Repair as necessary.
	4. No 400-cps voltage at terminal 4 of B1501.	Locate break in 400-cps line and repair. Check P1502.
	5. Motor B1501 defective.	Replace B1501.

TABLE XXI. POWER AMPLIFIER SUBASSEMBLY TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
5. Power amplifier subassembly does not set up to proper band. Observe the roller of L1502 (E1513) as the band position is changed. Refer to figure 4-28.	1. Bandswitch S1501, S1502, S1503, S1504, or S1506 defective.	Locate defective switch and repair or replace.
	2. Mechanical coupling between band switch drive and band switches loose or defective.	Tighten loose coupler in correct position or repair as necessary.
	3. Misaligned band switches.	Realign switches. Refer to paragraph 6-76 and figures 6-12 and 6-13.
	4. Motor B1501 defective.	Replace B1501.
6. Parasitics in power amplifier circuits.	1. Defective parasitic suppressor; E1501 through E1506.	Replace defective detail part.
	2. Open screen bypass capacitor; C1502, C1503, or C1504.	Replace defective capacitor.
	3. Open neutralizing capacitor; C1517, C1532, or C1513.	Replace defective capacitor

6-32. MODULATOR SUBASSEMBLY. Table XXII presents a summary of the more probable troubles within the modulator subassembly. Before performing the isolation procedures outlined in table XXII, the performance tests in sections V and VI should have been completed, and the tube voltage and resistance measurements outlined in figure 7-5 should have been made. Test all the modulator subassembly tubes in Tube Tester TV-3B/U, and if the trouble still has not been located, proceed to table XXII. When performing the trouble isolation procedures, watch closely for the following symptoms; no modulation, low modulation, and distorted modulation.

TABLE XXII. MODULATOR SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	CAUSE	REMEDY
1. No modulation; low current reading at meter position MOD. PL.	1. No microphone d-c supply voltage.	Locate break in supply and repair. In the modulator subassembly, check P1401, R1401, R1402, C1401, and C1422.
	2. Gain and clipping controls misaligned.	Refer to paragraph 6-85 for the alignment procedure.
	3. Open coupling capacitor C1409, C1410, or C1412.	Locate and replace defective capacitor.
	4. Defective tube V1401, V1402, V1403, V1404, or V1405.	Locate and replace defective tube.
	5. Defective modulation transformer T301.	Replace T301. Refer to table XVII for winding resistances.
	6. Open connection between terminals 2 and 4 of transformer T301.	Repair connection or replace T301.

TABLE XXII. MODULATOR SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	CAUSE	REMEDY
2. No modulation; zero current reading at MOD. PL. position of meter.	1. No filament voltage.	Locate and repair break in filament supply. Refer to figure 5-1.
	2. Defective tube.	Check tubes. Replace defective tubes.
3. Insufficient modulation.	1. Controls misaligned.	Refer to paragraph 6-85.
	2. Low B-plus voltage.	Check P1401, T301, and the plate and screen detail parts of the modulator subassembly.
	3. Defective tube or tubes.	Check tubes and replace faulty tube, or tubes.
	4. Low microphone supply voltage.	Locate defect and correct. Check R1401, R1402, C1401, C1422, and P1401.
4. Excessive distortion.	1. Misaligned controls.	Refer to paragraph 6-85.
	2. Feedback circuit open, R305, C301, and circuit connections.	Check R305, C301, and circuit connections. Replace defective detail part or repair defective connections.
	3. Low B-plus voltage or voltages.	Check P1401, T301, and the plate and screen detail parts of the modulator subassembly.
	4. Defective tube or tubes.	Check tubes and replace defective tubes.

6-33. I-F AMPLIFIER SUBASSEMBLY. Table XXIII presents a summary of the more probable troubles encountered within the i-f amplifier subassembly. Before performing the trouble isolation procedures outlined in table XXIII, the detailed performance tests in sections V and VI of this handbook should be performed. Also, the tube voltage and resistance measurements outlined in figure 7-6 should be made, and each of the i-f amplifiers subassembly tubes should be checked in Tube Tester TV-3B/U. If, after completion of the detailed performance tests and the voltage and resistance measurements, the trouble has not yet been located, proceed to table XXIII.

TABLE XXIII. I-F AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. No audio output, but normal avc voltage.	1. Defective tube, V904, or V905.	Check V904 and V905 and replace defective tube.
	2. Series noise limiter not opening.	Defective detail part; R917, R918, or C919. Replace defective detail part.
	3. Defective output coupling capacitor.	Check C921 and replace, if necessary.

TABLE XXIII. I-F AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
2. No avc voltage; audio output normal.	1. Defective tube	Check V904 and V905. Replace defective tube.
	2. Open coupling capacitor, C918.	Check C918 and replace, if necessary.
3. Avc voltage in i-f amplifier subassembly, but not in tuner subassembly; audio output normal.	1. Capacitor C922 shorted.	Replace C922.
	2. Resistor R921 open.	Replace R921.
	3. Plug P901 defective.	Replace or repair as necessary.
4. Avc voltage in tuner subassembly but not in i-f amplifier subassembly; audio output normal.	1. Capacitor C931 shorted.	Replace C931.
	2. Resistor R920 open, or resistor R924 shorted.	Replace defective resistor.
5. Low i-f sensitivity.	1. Defective tubes V901, V902, or V903.	Check V901, V902, and V903. Replace defective tube.
	2. Improper screen-grid voltages.	Check regulated 150-volt circuit and correct defects. Check screen resistors of V901, V902, and V903.
6. Distortion at high signal levels.	1. Tubes V904 or V905 defective.	Replace defective tube.
	2. Avc line open.	Check avc line within the i-f amplifier subassembly and repair as necessary.

6-34. AUDIO AMPLIFIER SUBASSEMBLY. Table XXIV presents a summary of the more probable troubles encountered within the audio amplifier subassembly. Before performing the trouble isolation procedures outlined in table XXIV, the detailed performance tests in sections V and VI of this handbook should be performed. Also, the tube voltage and resistance measurements outlined in table 7-7 should be made and each of the audio amplifier subassembly tubes should be checked in Tube Tester TV-3B/U. If, after completion of the detailed performance tests and the voltage and resistance measurements, the trouble has not yet been located, proceed to table XXIV.

TABLE XXIV. AUDIO AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. No audio output; side tone or receive.	1. Defective tube, V1301 or V1302.	Replace defective tube.
	2. No B-plus voltage.	Refer to figure 7-19. Check wiring and the plate and screen detail parts of V1301 and V1302.

TABLE XXIV. AUDIO AMPLIFIER SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
1. (cont)	3. Plug P1301 defective.	Replace or repair as necessary.
	4. Transformer T1301 defective.	Replace transformer T1301. Refer to table XVII for resistance values.
	5. Defective coupling capacitor, C1302, or C1303.	Replace defective capacitor.
	6. Defective detail part of V1301 or V1302.	Replace defective detail part.
2. Audio output during reception but not during transmission.	1. Plug P1301 defective.	Replace or repair as necessary.
	2. Capacitor C1301 defective.	Replace C1301.
3. Side tone audio output during transmission but no audio output during reception.	1. Plug P1301 defective.	Replace or repair as necessary.
	2. Coaxial lead from terminal 7 of P1301 to pin 2 of V1301 open.	Replace or repair as necessary.

6-35. 250 KC OSCILLATOR AND BFO SUBASSEMBLY. Table XXV presents a summary of the more probable troubles encountered within the 250 kc oscillator and bfo subassembly. Before performing the trouble isolation procedures outlined in table XXV, the detailed performance tests in sections V and VI of this handbook should be performed. Also, the tube voltage and resistance measurements outlined in figure 7-2 should be made, and each of the 250 kc oscillator and bfo tubes should be checked in Tube Tester TV-3B/U. If, after completion of the detailed performance tests and the voltage and resistance measurements, the trouble has not yet been located, proceed to table XXV.

TABLE XXV. 250 KC OSCILLATOR AND BFO SUBASSEMBLY, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. No 250-kc oscillator output. (Output should be 1.75 volts a-c at terminal 8 of J313, test point ⑲.)	1. Defective V1201	Replace V1201.
	2. Defective Y1203.	Replace Y1203.
	3. Filaments do not light.	Check tubes in series parallel branch and replace defective tube. Check filament voltage. Refer to figure 5-1.
	4. Defective detail part of V1201 circuit.	Replace defective detail part.
	5. Defective P1201.	Replace or repair as necessary.

TABLE XXV. 250 KC OSCILLATOR AND BFO SUBASSEMBLY, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
2. No bfo output. (No beat note during cw reception.)	1. Defective V1202.	Replace V1202.
	2. Filaments do not light.	Check tubes in series parallel branch and replace defective tube, check filament voltage. Refer to figure 5-1.
	3. Defective detail part of V1202 circuit.	Replace defective detail part.
	4. P1201 defective	Replace or repair as necessary.

6-36. RELAY SUBASSEMBLY. When isolating trouble within the relay subassembly, the complete 618S-1 or 618S-1A system must be taken into account. Each of the four relays within the relay subassembly perform several functions which affect the entire system. Paragraphs 6-37 through 6-40 outline the functions of each relay. By observing the faults encountered within the 618S-1 or 618S-1A system, and by study of the relay functions presented in paragraphs 6-37 through 6-40, the relay or circuit at fault can be analyzed. When the faulty relay or other detail part has been located, the fault should be corrected either by replacement or repair as necessary. Field maintenance personnel should not attempt to burnish relay contacts or perform major overhauls on any of the relays. If a relay is found to be defective, the entire relay should be replaced and the defective relay returned to the overhaul base.

6-37. Steps a through d describe the functions of sequence relay K801. Sequence relay K801 is energized during the 618S-1 or 618S-1A channeling cycle. If trouble has been isolated to the relay subassembly, check the 618S-1 or 618S-1A functions against the functions of relay K801. In this manner, relay K801 and its circuit connections may be checked. Contacts of relay K801 perform the following functions after being energized:

a. Provide a ground pulse to Automatic Antenna Tuner 180L-3, energizing the 180L-3.

b. Open the keying circuit between the MIC and KEY jacks and keying relays K804, K1001, and K1501.

c. Open the dynamotor start circuit, preventing dynamotor D1601 from running during the channeling cycle.

d. Provide a ground to relay K1502, energizing the power amplifier centering circuit.

6-38. Steps a through c describe the functions of the tuner centering relay, K802. Relay K802 is energized during the channeling cycle through contacts of relays K401 or K402. If trouble has been isolated to the relay subassembly, check the 618S-1 or 618S-1A functions against the functions of relay K802. In this manner, relay K802 and its circuit connections may be checked. Contacts of relay K802 perform the following functions after being energized.

a. Provide a self-locking ground during the tuner centering cycle.

b. Connect the tuner table centering circuit to the tuner servo amplifier subassembly, driving the tuner servo amplifier subassembly and servomotor B102.

c. Provide a holding ground for relay K801 during the tuner centering cycle.

6-39. Steps a through d describe the functions of the phone-cw relay, K803. Relay K803 is energized through contacts of switch S2603B when the OFF PHONE CW switch is in the CW position. If trouble has been isolated to the relay subassembly, check the 618S-1 or 618S-1A functions against the functions of relay K803. In this manner, relay K803 and its circuit connections may be checked. Contacts of relay K803 perform the following functions after being energized:

a. Remove the B-plus voltage from the screen grids of modulator tubes V1404 and V1405 and ground the modulator screen grids.

b. Ground the avc voltage applied to the tuner subassembly through resistor R807, reducing the avc voltage during cw reception.

c. Provide a ground circuit for the cathode of bfo tube V1202 through contacts of relay K804.

d. Remove the phone side-tone circuit and complete the cw side-tone circuit.

6-40. Steps a through d describe the functions of keying relay K804. Relay K804 is energized whenever the telegraph key or microphone push-to-talk button is operated. If trouble has been isolated to the relay subassembly, check the 618S-1 or 618S-1A functions against the functions of relay K804. In this manner, relay K804 and its circuit connections may be checked. Contacts of relay K803 perform the following functions after being energized:

a. Complete both the phone and cw side-tone circuits to the audio amplifier subassembly.

b. Open the cathode circuit of bfo tube V1202.
c. Provide a ground to choppers within Automatic Antenna Tuner 180L-3.
d. Provide a ground circuit for tubes V1201, V1003, V1004, V1010, and V1011.

6-41. TUNER AND PA SERVO AMPLIFIER SUBASSEMBLIES. When trouble shooting either the tuner servo amplifier subassembly or the pa servo amplifier subassembly, the complete servo system must be taken into account. If, for example, the slug rack of the tuner subassembly remains at rest when a new channel has been selected, the tuner servo amplifier subassembly may have no output or the input from the discriminator may be missing. In general, follow a logical sequence in determining where the trouble is located.

6-42. Assuming that either of the servo amplifier subassemblies is at fault, the most logical trouble is a defective chopper or tube. Remove the tube shield and feel the chopper during the channeling. If no vibration is apparent, replace the chopper. If a replaced chopper does not operate, check the 6.3-volt, 400-cps source. Observe the tube filaments. If unlighted, refer to figure 5-1 and determine the filament arrangement. Check the tubes of the defective string in the Tube Tester TV-3B/U and replace the defective tube or tubes.

6-43. Other troubles in the servo amplifier subassemblies normally are of a more subtle nature, generally resulting from improper feedback conditions. Improper B-plus decoupling, for example, could cause this condition. Check capacitors C603 and C604 and replace if defective. An unbalanced bridge circuit also may result in feedback through transformer T601 and produce a drive to servomotor B102 or B1501 at a time when they normally are at rest. The motors then may oscillate. Use the following procedure to balance the bridge circuit.
a. Remove the faulty servo amplifier subassembly from the chassis.
b. Connect VTVM TS-375/U to terminals 3 and 4 of T601.
c. Remove R612 and connect a decade box containing all values of R612 (150 to 470 ohms) across R612 location in the circuit.
d. Procure values of R612 indicated in the Illustrated Parts Breakdown T.O. 12R2-4-6-4. These values are 150, 180, 220, 270, 330, 390, and 470 ohms.
e. Replace the servo amplifier subassembly in the chassis.
f. Operate the channel selectors and stall servomotor B102 or B1501 by blocking the gear coupler with a screw driver.
h. Adjust the decade box for minimum voltage reading on VTVM TS-375/U. Read the decade box and insert resistor R612 of equal value into the circuit.

6-44. POWER SUPPLY 416W-1. Table XXVI presents a summary of the more probable trouble encountered within Power Supply 416W-1. Before performing the trouble isolation procedures outlined in table XXVI, the detailed performance tests in sections V and VI of this handbook should be performed. Also, the output voltages listed in steps a through k of this paragraph should be measured at TB1801 (test point 9). If a faulty reading is obtained at TB1801, the indicated voltages also should be measured at J1601 of Power Supply 416W-1 to ascertain if the trouble is in the cabling between components. Refer to figure 7-15. If, after completion of the detailed performance tests and the tests outlined in steps a through k, the trouble has not yet been located, proceed to table XXVI. Perform the following operations:
a. With the 618S-1 or 618S-1A system in a test bench setup (figure 3-1), operate the OFF PHONE CW switch to the PHONE position and allow at least ten minutes for warmup. After warmup, operate the OFF PHONE CW switch to the CW position.

CAUTION

Do not leave the OFF PHONE CW switch in the CW position for more than five minutes at a time. When in the CW position, dynamotor D1601 runs continuously, which is desirable for the following tests; however, damage may result if left on for longer than five-minute intervals. The duty cycle is five minutes on, five minutes off.

b. Connect VTVM TS-375/U between the terminals listed in the following steps and ground. Adjust the TS-375/U to the correct a-c or d-c range in each case.
c. Measure voltage at terminal 12 of TB1801. Normal indication, 250 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 20 of J1601.
d. Measure voltage at terminal 40 of TB1801. Normal indication, -65 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 10 of J1601.
e. Measure voltage at terminal 44 of TB1801. Normal indication, -50 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 11 of J1601.
f. Measure voltage at terminal 46 of TB1801. Normal indication, 115 volts a-c. If indication is abnormal, measure the indicated voltage at terminal 13 of J1601.
g. Measure voltage at terminal 7 of TB1801. Normal indication, 6.3 volts a-c. If indication is abnormal, measure the indicated voltage at terminal 17 of J1601.
h. Measure voltage at terminal 45 of TB1801. Normal indication, 115 volts a-c. If indication is abnormal, measure the indicated voltage at terminal 14 of J1601.
i. Measure voltage at terminal 11 of TB1801. Normal indication, 250 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 8 of J1601.
j. Construct a voltage divider for the TS-375/U and measure voltage at terminal 2 of TB1801. Normal indication, 600 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 22 of J1601.
k. Measure voltage at terminal 25 of TB1801. Normal indication, 27.5 volts d-c. If indication is abnormal, measure the indicated voltage at terminal 3 of J1601.

TABLE XXVI. POWER SUPPLY 416W-1, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Zero voltage at terminal 3 of J1601.	1. Plug P1601 defective. 2. One of the following detail parts defective; K1602, S1602, and C1615.	Replace or repair as necessary. Replace defective detail part.
2. Zero voltage at terminal 17 of J1601.	1. Plug P1601 defective. 2. One of the following detail parts defective; T1601, R1606, K1603, and F1602.	Replace or repair as necessary. Replace defective detail part.
3. Zero voltage at terminal 14 of J1601.	1. Plug P1601 defective. 2. One of the following detail parts defective; K1603 or F1602.	Replace or repair as necessary. Replace defective detail part.
4. Zero voltage at terminal 10 of J1601.	1. Plug P1601 defective. 2. One of the following detail parts defective; R1604, CR1602, R1603, K1603, and F1601.	Replace or repair as necessary. Replace defective detail part.
5. Zero voltage at terminal 11 of J1601.	1. Plug P1601 defective. 2. One of the following detail parts defective; R1608, R1609, CR1602, R1603, K1603, and F1601.	Replace or repair as necessary. Replace defective detail part.
6. Zero voltage at terminal 8 of J1601.	1. Plug P1601 defective. 2. One of the following detail parts defective; L1602, CR1603, CR1601, C1601A, C1601B, R1601, K1603, and F1601.	Replace or repair as necessary. Replace defective detail part.
7. Zero voltage at terminal 13 of J1601.	1. Plug P1601 defective. 2. One of the following detail parts defective; K1603 or F1601.	Replace or repair as necessary. Replace defective detail part.
8. Zero voltage at terminal 20 of J1601.	1. Plug P1601 defective. 2. One of the following detail parts defective; L1601, L1604, D1601, L1603, K1601, S1601, K1603, and K1604. 3. Detail part of the -50 volt bias supply defective.	Replace or repair as necessary. Replace defective detail part. Replace defective detail part.

TABLE XXVI. POWER SUPPLY 416W-1, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
9. Zero voltage at terminal 22 of J1601.	1. Plug P1601 defective.	Replace or repair as necessary.
	2. One of the following detail parts defective; L1605, D1601, L1603, K1601, S1601, K1603, and K1604.	Replace defective detail part.
	3. Detail part of the -50 volt bias supply defective.	Replace defective detail part.
10. Blows fuses.	1. Refer to figure 7-16. Check detail parts such as, resistors and capacitors between voltage carrying lines and ground.	Replace defective detail part.
	2. Shorted turns on the following detail parts; T1601 and L1606.	Replace defective detail part.
11. No output or low output from dynamotor D1601.	1. Poor commutation, resulting from a dirty commutator.	Refer to Handbook Overhaul Instructions, T.O. 12R2-4-6-3. Replace D1601.
	2. Low input voltage	Check input circuit for loose connections.
	3. Shims "end loading" bearings.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	4. Defective armature.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	5. Broken or sticky brushes.	Replace brushes. Refer to paragraph 5-12, steps k and m.
12. Dynamotor D1601, noisy mechanically.	1. Dry bearings.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	2. Bent shaft.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	3. High commutator bar.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	4. Dynamotor D1601 mounting not secure.	Tighten mounting screws.
13. Dynamotor D1601 overheating.	1. Bearings dry or damaged.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	2. Shims "end loading" bearings.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	3. Bent shaft.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	4. Sticking brushes	Refer to T.O. 12R2-4-6-3. Replace D1601.

TABLE XXVI. POWER SUPPLY 416W-1, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
14. Dynamotor D1601 noisy electrically.	1. Arcing at brushes.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	2. Broken or cracked brushes.	Replace brushes. Refer to paragraph 5-12, steps k and m.
	3. Brushes sticking in holder.	Correct trouble.
	4. High commutator bar.	Refer to T.O. 12R2-4-6-3. Replace D1601.
	5. Dirty commutator	Clean commutator.
15. Excess vibration	1. Bent shaft	Refer to T.O. 12R2-4-6-3. Replace D1601. Refer to paragraph 5-12, step l.
	2. Loose mounting	Tighten mounting screws.

6-45. RADIO SET CONTROL 614C-2. Table XXVII presents a summary of the more probable troubles encountered within Radio Set Control 614C-2. Before performing the trouble isolation procedures outlined in table XXVII, the detailed performance tests in sections V and VI of this handbook should be performed. The trouble should be known to exist within the 614C-2 and not within the external wiring or within another of the 618S-1 or 618S-1A components. If, after completion of the detailed performance tests, the trouble has not yet been located, proceed to table XXVII.

TABLE XXVII. RADIO SET CONTROL 614C-2, TROUBLE ISOLATION

SYMPTOM	PROBABLE CAUSE	REMEDY
1. Channel selected within the r-f crystal oscillator subassembly does not correspond to the setting of the 614C-2.	1. Switch S2601 defective.	Replace S2601.
	2. Switch S2602 defective.	Replace S2602.
	3. Switch S2601 or S2602 misaligned.	Realign switch. Refer to figure 6-15 and paragraph 6-88.
2. Motor B401 runs continuously.	1. Switch S2601 or S2602 shorted to ground.	Replace defective switch or repair as necessary.
	2. Control wire shorted to ground.	Locate and repair as necessary. Refer to figure 7-17.
	3. Jack J2601 defective.	Replace or repair as necessary.
3. Rotation of the 614C-2 channel selectors does not energize Autopositioner system.	1. Switch S2601 or S2602 defective.	Replace defective switch.
	2. Jack J2601 defective.	Replace or repair as necessary.
	3. Control wire or wires open.	Locate and repair as necessary. Refer to figure 7-17.

TABLE XXVII. RADIO SET CONTROL 614C-2, TROUBLE ISOLATION (Cont)

SYMPTOM	PROBABLE CAUSE	REMEDY
4. Dynamotor D1601 will not start.	1. Switch S2603 defective.	Replace S2603.
	2. Jack J2601 defective.	Replace or repair as necessary.
5. Beat signal not variable during cw reception.	1. Potentiometer R2601 defective.	Replace R2601.
	2. Jack J2601 defective.	Replace or repair as necessary.
6. Audio volume not variable.	1. Switch S2603 defective.	Replace S2603.
	2. Potentiometers R2603 and/or R2604 of three-ganged potentiometer defective.	Replace three-ganged potentiometer.
	3. Resistor R2606 or R2607 defective.	Replace defective resistor.
	4. Jack J2601 defective.	Replace or repair as necessary.
7. Gain not variable during cw reception.	1. Switch S2603 defective.	Replace S2603.
	2. Potentiometer R2605 of three-ganged potentiometer defective.	Replace three-ganged potentiometer.
	3. Jack J2601 defective.	Replace or repair as necessary.

6-46. ALIGNMENT PROCEDURE.

6-47. The procedures for precision alignment of Radio Set 618S-1 or 618S-1A are discussed in the following paragraphs. Follow these procedures exactly, aligning the plug-in subassemblies in the order that they appear in these instructions. When the alignment and tracking procedures have been completed, the 618S-1 or 618S-1A should be subjected to the detailed performance tests outlined in paragraphs 5-13 and 6-5. The alignment procedures assume that the 618S-1 or 618S-1A equipment is connected in a test bench setup, described in paragraphs 3-9 and 3-10. Refer to figure 3-1 and figures 6-21 through 6-23 for identification of test points used in subsequent paragraphs.

WARNING

The 618S-1 and 618S-1A equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment. Clothing, rags, and test equipment should be kept away from the moving parts during the channeling cycle.

6-48. ALIGNMENT EQUIPMENT.

6-49. TEST SET 478H-1. Test Set 478H-1 was specifically designed for trouble analysis and alignment of the plug-in subassemblies of Radio Receiver-Transmitter 618S-1 or 618S-1A. The 478H-1 consists of a chassis with a main panel, on which are mounted jacks for mating the plugs of the 618S-1 or 618S-1A subassemblies. The 478H-1 provides a method of making "go-no go" checks on the 618S-1 or 618S-1A subassemblies while removed from the main chassis. Also, each of the 618S-1 or 618S-1A subassemblies may be aligned while removed from the main chassis. Included with the 478H-1 is a band switch control, which provides a method of checking the operation of the Autopositioner system within the r-f crystal oscillator subassembly. Test Set 478H-1 is designed to operate with Power Supply 413F-1, which provides all power necessary for the 618S-1 or 618S-1A subassemblies, as well as the 478H-1. If Test Set 478H-1 is available to field maintenance personnel, it should be used throughout the following alignment procedures.

6-50. MAINTENANCE KIT FOR 618S-1. Maintenance kit for 618S-1 is designed for use with the 478H-1 to simplify trouble-shooting and alignment procedures.