INSTRUCTION BOOK

for

51 J-2 COMMUNICATIONS RECEIVER

Manufactured By

COLLINS RADIO COMPANY
Cedar Rapids, Iowa

520 9494 00
November 21, 1951

GUARANTEE

The equipment described herein is sold under the following guarantee:

Collins agrees to repair or replace, without charge, any equipment, parts or accessories which are defective as to design, workmanship or material, and which are returned to Collins at its factory in Cedar Rapids, Iowa, transportation prepaid, provided that the foregoing shall not be applicable to.

(a) Equipment or accessories as to which notice of the claimed defect is not given Collins within one year from date of delivery;

(b) Equipment and accessories manufactured by others than Collins, tubes and batteries, all of which are subject only to such adjustment as Collins may obtain from supplier thereof;

(c) Equipment or accessories which shall fail to operate in a normal or proper manner due to exposure to excessive moisture in the atmosphere or otherwise after delivery, any such failure not being deemed a defect within the meaning of the foregoing provisions.

Collins further guarantees that any radio transmitter described herein will deliver full radio frequency power output at the antenna lead when connected to a suitable load, but such guarantee shall not be construed as a guarantee of any definite coverage or range of said apparatus.

The guarantee of these paragraphs is void if equipment is altered or repaired by others than Collins.

Notice of any claimed defect must be given to Collins prior to return of any item. Such notice must give full information as to nature of defect and identification (including part number if possible) of part considered defective. Upon receipt of such notice, Collins will promptly advise respecting return of equipment. Failure to secure our advice prior to the forwarding of goods for return may cause unnecessary delay in the handling of such merchandise.

No other warranties, expressed or implied, shall be applicable to said equipment, and the foregoing shall constitute the Buyer's sole right and remedy under the agreements in this paragraph contained. In no event shall Collins have any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of the products, or any inability to use them either separately or in combination with other equipment or materials, or from any cause.

HOW TO ORDER REPLACEMENT PARTS

When ordering replacement parts, you should direct your order as indicated below and furnish the following information insofar as applicable:

Address: Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

Information Needed:

(A) Quantity required
(B) Part number of item
(C) Item number (obtain from Parts List or Schematic Diagram)
(D) Type number of unit
(E) Serial number of unit
(F) Serial number of equipment

HOW TO RETURN MATERIAL OR EQUIPMENT

If, for any reason, you should wish to return material or equipment, whether under the guarantee or otherwise, you should notify us, giving full particulars including the details listed below, insofar as applicable. Upon receipt of such notice, Collins will promptly advise you respecting the return. Failure to secure our advice prior to the forwarding of the goods or failure to provide full particulars may cause unnecessary delay in handling of your returned merchandise.

Address: Collins Radio Company
Sales Service Department
Cedar Rapids, Iowa

Information Needed:

(A) Date of delivery of equipment
(B) Date placed in service
(C) Number of hours in service
(D) Part number of item
(E) Item number (obtain from Parts List or Schematic Diagram)
(F) Type number of unit from which part is removed
(G) Serial number of unit
(H) Serial number of the complete equipment
(I) Nature of failure
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SECTION 1

GENERAL DESCRIPTION

1.1. GENERAL.

1.1.1. PURPOSE OF BOOK. - This instruction book has been prepared to assist in the installation, operation and maintenance of the Collins Model 51J Radio Communications Receiver.

1.1.2. PURPOSE OF EQUIPMENT. - The Model 51J Receiver is designed for communication applications where stability and dial accuracy of the highest order are the prime requisites. Under normal operating conditions, the receiver tunes the range of 0.5 to 30.5 mc with a total setting error and drift of less than 1 kc at any frequency within its range. The receiver is designed for amplitude-modulated and continuous wave reception, although its accuracy and stability make it suitable for many applications where it is desired to receive or set definite frequencies without searching or making frequent adjustments.

1.1.3. DESCRIPTION.

(a) MECHANICAL. - The 51J receiver is available in two styles. One is a panel and shelf assembly suitable for mounting in a standard rack cabinet. Overall panel dimensions are: width, 19 inches; height, 10-1/2 inches, and depth behind panel, 13 inches. A dust cover that fits over the top of the chassis is removable from the rear. The other assembly is in a cabinet suitable for table-mounting. Outside cabinet dimensions are: width, 21-1/8 inches, height, 12-1/4 inches, and depth, 13-7/8 inches. Available on special order is a speaker that matches this cabinet. The speaker's dimensions are: width, 13 inches; height, 11 inches; depth, 7 inches. The speaker, the cabinet of the table-mounting assembly, and the front panel of the rack-mounting receiver are finished in St. James Gray wrinkle.

The following controls are located on the front panel:

R-F GAIN	CRYSTAL FILTER SELECTIVITY
AUDIO GAIN	CRYSTAL FILTER PHASING
BFO ON-OFF	OFF-ON-STANDBY
CALIBRATE ON-OFF	MEGACYCLE TUNING (BAND SWITCH)
BFO PITCH	KILOCYCLE TUNING
AVC ON-OFF	ZERO ADJ
LIMITER OUT-IN	METER OUTPUT-INPUT
	CAL (100 KC ADJUSTMENTS)

The tuning range .5 to 30.5 mc is divided into 30 one-megacycle bands that are selected by the band switch knob and indicated by a slide rule dial

NOTE
Low end of operating range considered to be 540 kc. Lower frequencies approach the receiver's 500-kc IF frequency, resulting in limited operation with reduced performance.

having graduations at one-tenth megacycle (100 KC) intervals. The main tuning control covers each of these megacycle ranges with 10 turns of a 100 division dial calibrated at one kilocycle intervals. The receiver's frequency stability is consistent with this finely divided calibration even at the highest frequencies.

A headphone jack is provided on the front panel with the 4-ohm speaker output disconnected when the headphones are used. In addition to the speaker terminals, a 500-ohm audio output, a 300-ohm r-f input, and terminals for stand-by operation are provided on the rear of the chassis. A spare terminal is provided to allow other functions to be brought out as required for special applications. A heavy duty a-c power cord extends from the rear of the chassis.

(B) ELECTRICAL. - When advantageous, the Model 51J Communications receiver uses single, double or triple conversion in tuning the entire frequency spectrum of .5 to 30.5 mc. Sixteen tubes, three of which are dual, are employed in the receiver. With the exception of the rectifier tube and the variable frequency oscillator tube, all are of the miniature type. The tuning range of the 51J Receiver, .5 to 30.5 mc is divided into 30 one-megacycle bands by a system of switches and coils which form the r-f amplifier and first mixer circuits. Band changing consists of moving powdered iron "slugs" into the coils in one megacycle steps until inductance limits of the coils are reached, then changing coils and repeating. Injection voltage for the first mixer is obtained from the fundamental or harmonic output of an oscillator, the frequency of which is controlled by one of ten quartz crystals selected by the MEGACYCLE band switch. The main tuning control is a vernier dial calibrated in 100 one-kilocycle divisions. This control operates through a differential mechanism to move the band change "slugs" in the coils enough, to cover the range between the one-megacycle band change steps. Thus the Band Switch selects coils and crystals and also roughly positions the tuning slugs. At the same time one of the two ranges (1.5 to 2.5 mc or 2.5 to 3.5 mc) of the variable i-f channel is selected and tuned along with the r-f coils.

The crystal frequencies for first mixer injection are so chosen that the frequency produced by the first mixer will always fall in the 1.5 to 2.5 mc or 2.5 to 3.5 mc range of the variable i-f channel.

Exceptions to the operation just described are bands 1, 2, and 3. Band 1 (5. to 1.5 mc) uses an intermediate mixer between the first mixer and the variable i-f coils. This mixer accepts frequencies in the range 10.5 to 11.5 mc from the first mixer. A 12-mc signal developed by the crystal controlled oscillator is applied to the first mixer to determine these frequencies. The crystal controlled oscillator also applies an 8-mc voltage to the intermediate frequency mixer to produce a signal within the range of the i-f amplifier which tunes the 2.5 to 3.5 mc. Bands 2 and 3, which cover 1.5 to 2.5 mc, and 2.5 to 3.5 mc respectively, are identical in span to each band of the variable frequency i-f coils and thus feed through to the second mixer without utilizing the first mixer.

Following the variable i-f and the second mixer are the crystal filter and a three stage fixed intermediate frequency amplifier. Conversion to the fixed i-f of 500 kc is accomplished by injecting a 2 to 3 mc signal from a Collins 70E-7 oscillator to produce a difference of 500 kc from the frequency existing in either band of the variable i-f amplifier. Tuning of the 70E-7 oscillator is done by the "kilocycle" tuning control in step with all other circuits.

Stability of the 70E-7 oscillator is assured by temperature compensated components operating in a sealed and moisture-proof housing.

Separate rectifiers are used to produce the audio and automatic volume control voltages. D-c amplification of the automatic volume control voltage is provided to obtain essentially uniform input to the detector. Audio power output is held within 10 db over signal input voltage ranges of five microvolts to one volt at the antenna terminals. A series type noise limiter clips the modulation at 50 to 85 percent. This allows good reception in the presence of strong noise pulses.

1.2. VACUUM TUBE TABLE.

The following table lists tubes employed in the circuits just described. The tubes are listed in numerical order according to the circuits symbol designations.

SYMBOL DESIGNATION	TUBE TYPE	FUNCTION
V-101	6AK5	Radio frequency amplifier
V-102	6BE6	First mixer
V-103	6BE6	Broadcast mixer
V-104	6BA6	Calibration oscillator
V-105	6BA6	High frequency crystal oscillator
V-106	6BE6	Second mixer
V-107	6BA6	First 500 kc i-f amplifier
V-108	6BA6	Second 500 kc i-f amplifier
V-109	6BA6	Third 500 kc i-f amplifier
V-110	12AX7	Detector and AVC rectifier
V-111	12AX7	AVC amplifier
V-112	12AX7	Noise limiter and first audio amplifier
V-113	6AQ5	Audio power amplifier
V-114	6BA6	Beat frequency oscillator
V-115	5V4	Power rectifier
V-001	6SJ7	Variable frequency oscillator

1.3 REFERENCE DATA

FREQUENCY RANGE: 500 kc to 30.5 mc.

TYPE OF RECEPTION: MCW, CW or voice.

CALIBRATION: Direct reading in megacycles and kilocycles.

TUNING: Straight line frequency with uniform bandspread.

FREQUENCY STABILITY: Overall stability within 2 kc at any frequency within the operating range.

TEMPERATURE RANGE: -20°C to +60°C.

SENSITIVITY: 3 microvolts gives 500 M.W. with 6 db s/n.

SELECTIVITY: Approximately 3 kc at 6 db down and 14 kc at 60 db down (total bandwidth). With crystal filter in operation, at 6 db down, the bandwidth is 0.2 kc, and at 60 db down it is 4.kc.

SPURIOUS FREQUENCY RESPONSE: Down at least 50 db.

AUTOMATIC VOLUME CONTROL: Less than 6 db increase in audio power output with an increase in r-f signal from 5 to 100,000 µv.

S METER: Meter calibrated in 20, 40, 60, 80, 100 db signal level and 10 to +6 db audio level (6mw reference).

NOISE LIMITER: Series type ahead of the first audio stage, effective in cw.

AUDIO POWER OUTPUT: 2-1/2 watts at 1000 cps with distortion less than 10%.

AUDIO FREQUENCY RESPONSE: (Overall): Within 6 db from 200 cps to 2500 cps.

OUTPUT IMPEDANCE: 4 and 500 ohms impedance.

R.F. INPUT IMPEDANCE: Balanced or unbalanced, 300 ohms (± 100 ohms) resistive.

POWER REQUIREMENTS: 85 watts at 115 volts 45/70 cps. Same power demand when connected for 230 volt 45/70 cps operation.

DIMENSIONS: Panel - 10-1/2" high, 19" wide, notched for standard rack mounting. Metal Cabinet - 21-1/8" wide, 12-1/4" high, 13-7/8" deep. Speaker in metal cabinet - 13" wide, 11" high, 7" deep.

WEIGHTS: Receiver - 35 pounds, cabinet 20 pounds. Speaker - 9 pounds.

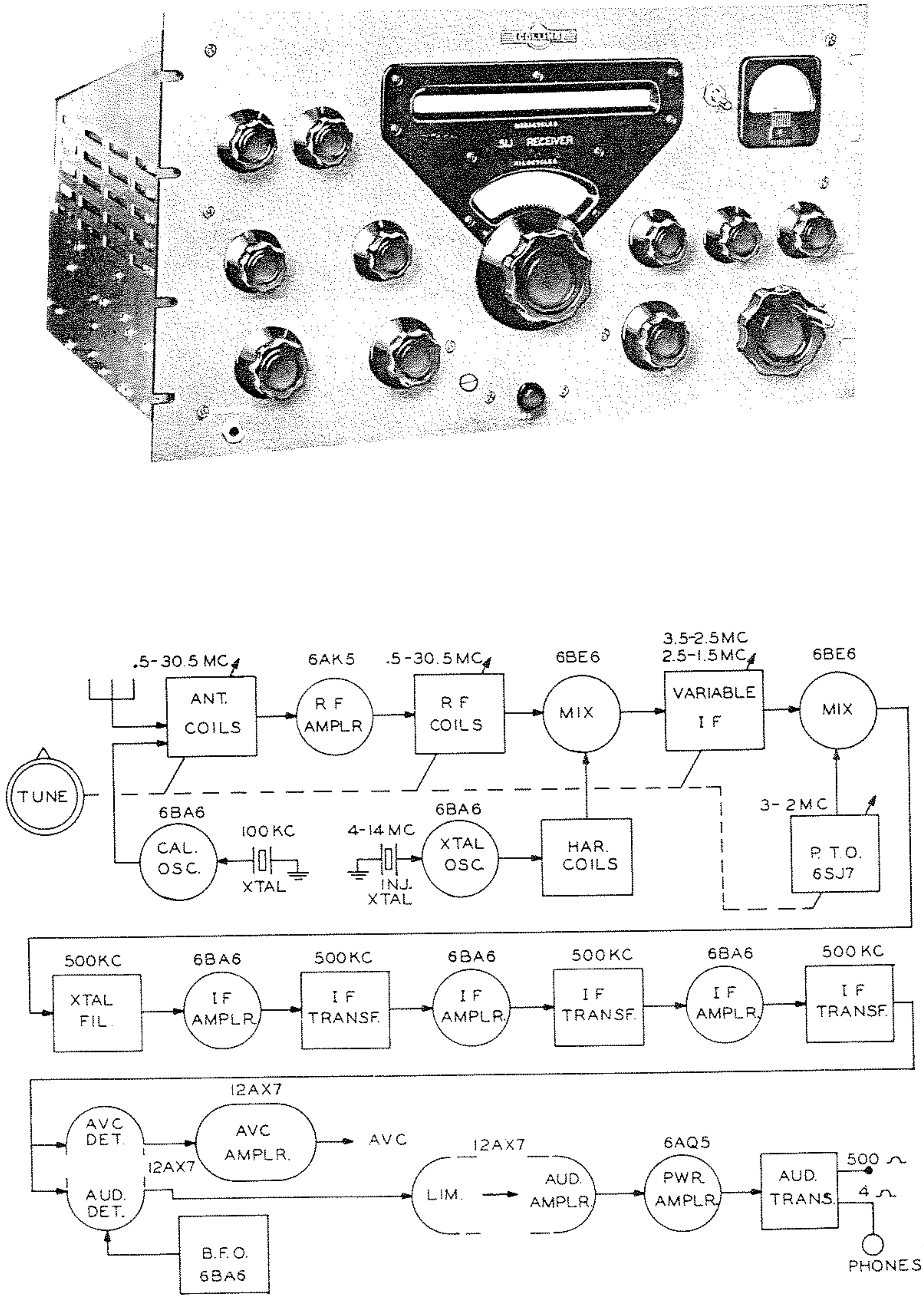


Figure 1-1 51J Receiver, Front View and Block Diagram

SECTION 2

INSTALLATION

2.1. UNPACKING.

2.1.1. PROCEDURE. - The model 51J receiving equipment is packed in a number of heavy cartons. Refer to the packing slip for a list of all equipment supplied on the order. Open cartons carefully to avoid damage to the units within. Remove the packing material and carefully lift the units out of the cartons. Search all of the packing material for small parcels. Extra pilot light bulbs and fuses are supplied with each equipment. Inspect each unit for loose screws and bolts. Be certain all controls such as switches, dials, etc. work properly. All claims for damage should be filed promptly with the transportation company. If a claim is to be filled, the original packing case and material must be preserved.

2.2. INSTALLATION.

2.2.1. GENERAL. - The receiver is intended primarily for rack mounting. Refer to figure 2-1 for outline and mounting dimensions. The front panel is slotted for mounting at 1-1/2, 3-3/4, 6-3/4, and 9 inches from the bottom. The panel height is 10-1/2 inches; the panel width is 19 inches for rack mounting.

The cabinet in a table-mounted installation measures 21-1/8 inches wide. 12-1/4 inches high and 13-7/8 inches deep. Rubber mounting feet are provided on the receiver cabinet and the speaker cabinet. The speaker cabinet is 13 inches wide, 11 inches high, and 7 inches deep.

When choosing a position for the receiver give consideration to convenience of power, antenna, and ground connections, to the placement of cables, and to convenience in servicing the equipment.

2.2.2. ANTENNA AND GROUND CONNECTIONS. - Viewing the receiver from the rear, the antenna and ground connector strip is at the left hand edge of the chassis. Terminals on this strip are marked "G", "1", and "2". A good ground should be connected to "G" for each installation. If a doublet antenna or any antenna having a balanced transmission line is used, the transmission line should be connected to terminals "1" and "2". The impedance of the transmission line should be 300 ohms. If an unbalanced line is used, the hot side should be connected to terminal "2" and the cold side to terminal "1" and a jumper placed between terminals "G" and "1". Likewise, if a single wire antenna is employed, terminals "G" and "1" should be jumpered and the antenna placed on terminal "2". When the receiver is to be operated in the vicinity of a powerful transmitter, adequate means for protecting the receiver's input circuit should be provided. An antenna shorting relay, connected so that the antenna is removed from the receiver input terminals and the receiver input terminals are grounded during the time the transmitter is radiating, is usually the best protection.

2.2.3. SPEAKER CONNECTIONS. - Viewing the receiver from the rear, the speaker terminal strip is at the right hand edge of the chassis. The terminal marked "G" is at ground potential and is the common audio termination. The terminal marked "4" is intended for exciting the speaker voice coil, and the terminal marked "500" can be used to feed an audio line. When headphones are plugged into the headphone jack on the front panel, the 4-ohm output is disconnected, thereby silencing the speaker but not the line.

2.2.4. REMOTE STANDBY CONNECTIONS. - The center terminal strip at the rear of the chassis is used when remote operation of the receiver standby is desired. The terminals marked "1" and "2" are connected in parallel with the standby contacts on the ON-OFF switch S-113. In operation, these terminals are usually connected to a set of normally closed contacts on the carrier control relay of a transmitter to provide receiver silencing during signal transmission. Terminal "2" is at full B+ potential; terminal "1" is connected to the rotor of the standby section of switch S-113, and terminal "3" is a spare.

2.2.5. POWER CONNECTION. - The power connection is made by means of a 6-foot permanently-attached, rubber-covered cord equipped with a standard a-c plug. If 230v operation is desired, the power transformer should be reconnected as indicated in figure 7-3.

2.2.6. HEADPHONES. - Headphone connections are made by means of a panel jack and a standard 1/4 inch diameter plug. Although 500-ohm headphones work best, any higher impedance phone will serve quite satisfactorily.

2.2.7. TUBES. - Before turning on the equipment for the first time inspect the tubes. See that they are in their correct position and are firmly seated in their respective sockets.

2.2.8. FUSE. - The fuse is located on the chassis and can be removed for inspection by turning the cap of the fuse post to the left and pulling straight up until the cap and fuse come free. This fuse should have a rating of one ampere.

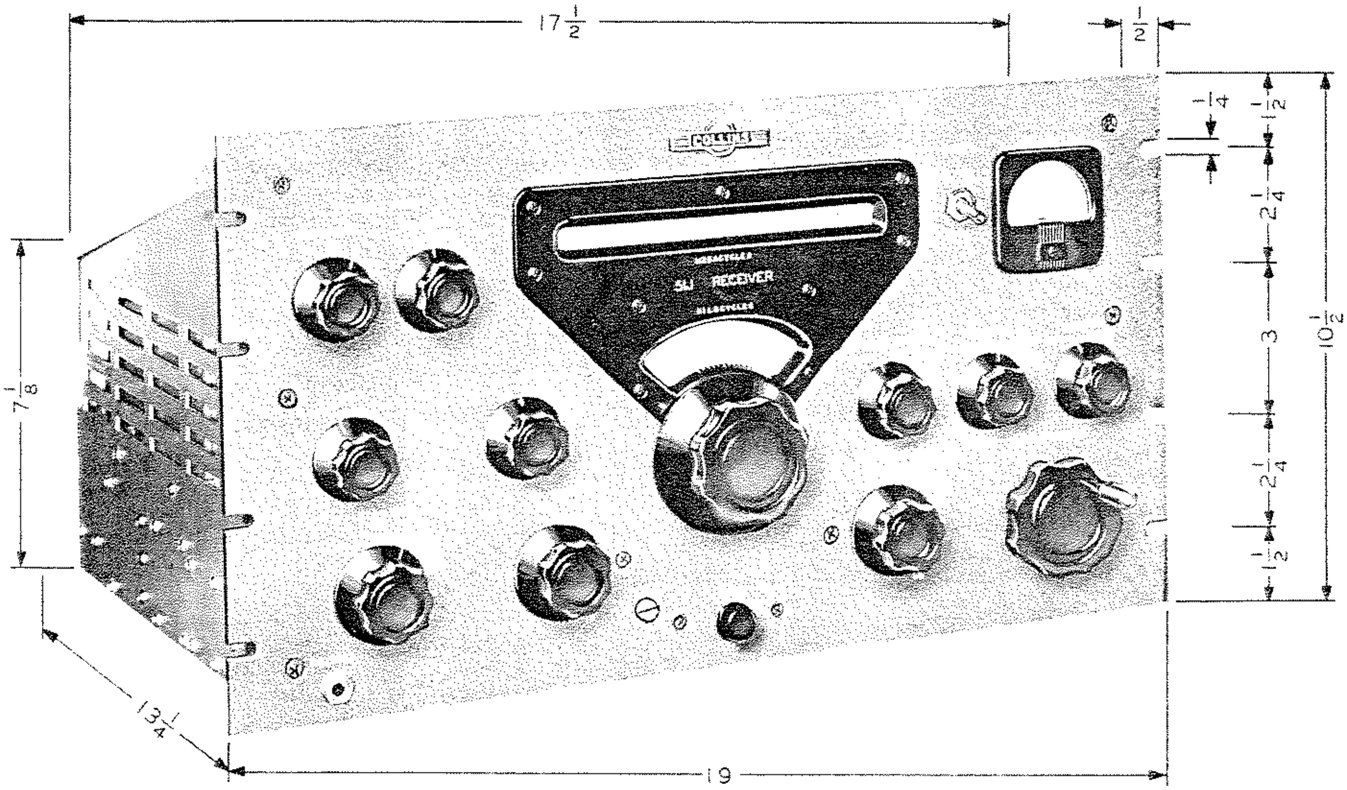


Figure 2-1 5LJ Receiver, Mounting Dimensions

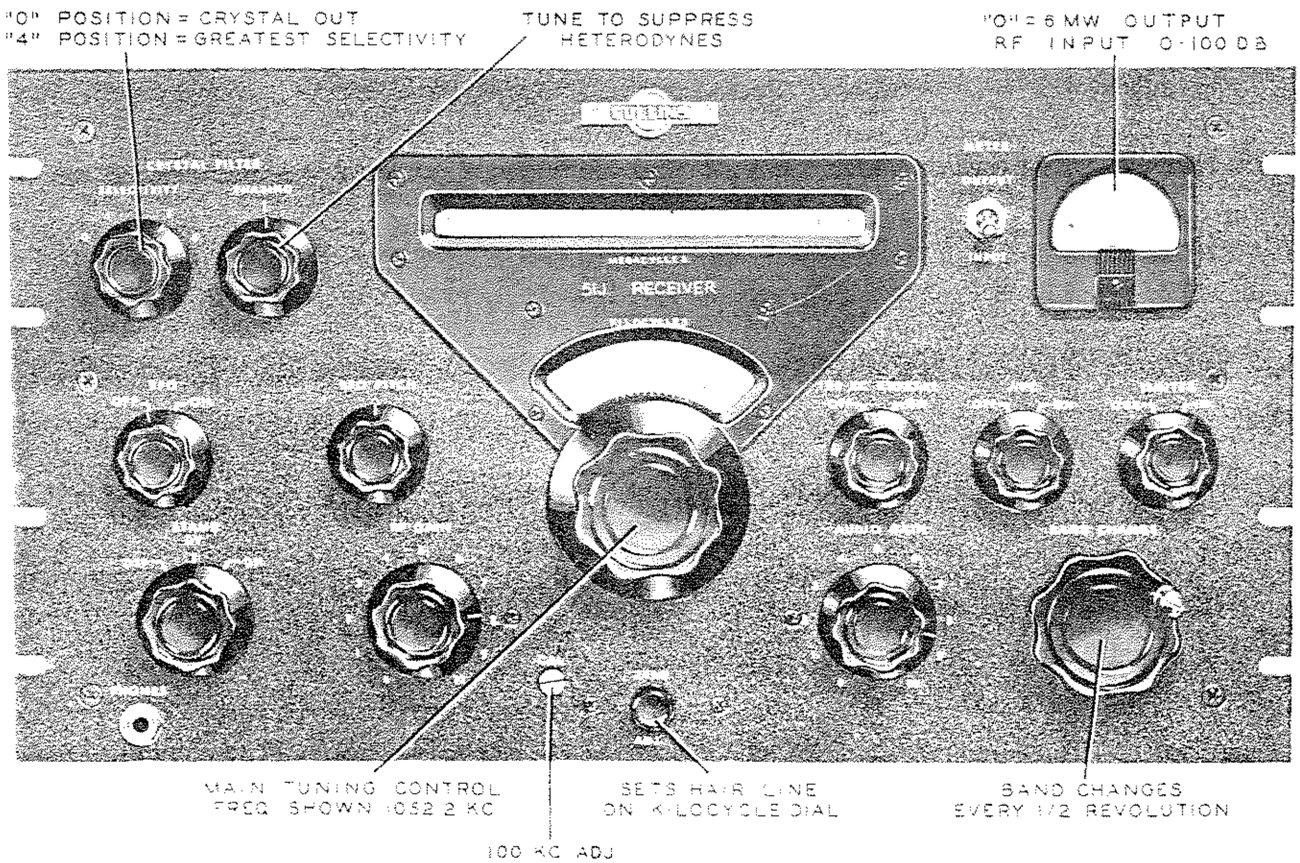


Figure 3-1 5LJ Receiver, Operating Controls

SECTION 3

ADJUSTMENT AND OPERATION

3.1. ADJUSTMENT.

3.1.1. GENERAL. - Other than zeroing the "S" meter, no pre-operational adjustments are necessary. Should the "S" meter require zeroing, turn the receiver ON, BFO OFF, AVC ON, and the 100 KC CRYSTAL OFF; then turn the RF GAIN fully clockwise. Short the antenna terminals; then turn the meter zeroing control until the "S" meter reads zero. Refer to figure 5-1 for location of this control.

3.2. OPERATION.

3.2.1. FUNCTION OF CONTROLS. - Operation of the 51J receiver is simple if the functioning of the controls is understood. The following paragraphs explain the functions of controls on the receiver's front panel.

(a) OFF-STANDBY-ON. - In the OFF position this control opens the primary power circuit to turn the equipment completely off. In the STANDBY position the power transformer is excited, thus producing filament voltage for all stages and plate voltage for all except the three i-f amplifier stages, thus disabling the receiver. If a standby relay is used, this control is kept in the STANDBY position at all times. When this control is placed in the ON position, the receiver is completely operative.

(b) RF GAIN. - The RF GAIN control is located in the grid return circuit of the avc controlled tubes and is operative at all times. It varies the amount of fixed bias placed upon the grids of these tubes.

(c) AUDIO GAIN. - The AUDIO GAIN control is located in the grid circuit of the first audio amplifier and is operative at all times. It varies the amount of a-f signal applied to the grid of this tube, and thereby controls the amount of audio power produced by the receiver.

(d) BAND CHANGE. - By means of this knob any one of the 30 bands may be selected at 1/2-revolution intervals. A stiff detent accurately positions the band switches on each band.

(e) MEGACYCLE. - The MEGACYCLE scale is on the slide-rule type dial. This scale is calibrated in ten 100 kc divisions, each of which equals one full turn of the circular KILOCYCLE dial. The 1.5 to 2.5 mc and 2.5 to 3.5-mc bands are printed in red, indicating that the red scale on the KILOCYCLE dial must be used when operating on these bands. Beginning with the 3.5 mc band, amateur bands from 3.5 mc to 29.5 mc are indicated by greeen stripes on the MEGACYCLE scale. The pointer on the MEGACYCLE dial is operated by the KILOCYCLE control. The scale is changed by operation of the BAND SWITCH.

(f) KILOCYCLE. - The KILOCYCLE dial is the main tuning control on the 51J receiver. Each division on its circular face represents 1 kilocycle. One full turn of the dial represents 100 kilocycles or one division of the MEGACYCLE scale.

When reading the tuning dials, it is only necessary to combine the figures of the MEGACYCLE dial with those of the KILOCYCLE dial to arrive at the frequency in kilocycles. For example, a reading of 14.1 on the MEGACYCLE dial and a reading of 78 on the KILOCYCLE dial indicate a frequency of 14178 kc. The scale for the 1.5 to 2.5 mc and 2.5 to 3.5-mc bands is in reverse order to the scale for the rest of the bands, and is printed in red similar to that used for corresponding scales on the MEGACYCLE dial.

(g) ZERO ADJUST. - For calibration purposes, the ZERO ADJUST moves the indicator line on the KILOCYCLE control a few divisions in either direction. The receiver may be calibrated against any receivable station whose frequency is known or against the internal calibration oscillator. The internal calibration oscillator emits a harmonic at every 100 kc in the tuning spectrum. An example of how the receiver may be calibrated by means of the internal calibration oscillator follows. If, for instance, the signal whose frequency is desired is about 14,100 kc, turn the 100 KC CRYSTAL and the BFO ON. Next, using the KILOCYCLE knob, tune to zero beat with the 100-kc marker at 14,100 kc; then move the ZERO ADJ. control until the hair line is exactly on 14,100 kc. The dial now reads accurately in this region, and the receiver may be set within a few hundred cycles of the desired frequency.

NOTE

WHEN READING THE FREQUENCY OF AN INCOMING SIGNAL, LEAVE THE BFO PITCH CONTROL IN THE SAME POSITION AS IT WAS WHEN THE RECEIVER WAS CALIBRATED.

A ten-division scale (five divisions either side of center), is engraved on the lower edge of the escutcheon opening for the KILOCYCLE dial. The scale is used to log the calibrated position of the hair line and various bands in lieu of recalibrating each time the band is used.

(h) METER INPUT-OUTPUT. - The METER switch is a momentary spring-return type toggle switch. In the normal or INPUT position the meter is connected as an "S" meter. In the OUTPUT position, the meter is connected in the aduio output circuit as a db meter.

(i) BFO OFF-ON. - In the ON position this control turns on the beat frequency oscillator for cw reception. In the OFF position it grounds the screen grid of the beat frequency oscillator tube.

(j) BFO PITCH. - The BFO PITCH control varies the frequency of the beat frequency oscillator to change the pitch of the audio tone produced by the combination of the beat frequency oscillator and the incoming signal. A range of about ± 3 kc can be obtained with this control. Special bfo coils are available to give ± 6 kc.

(k) CALIBRATE ON-OFF. - This switch is in the cathode circuit of the 100-kc oscillator tube, V104, and turns the 100-kc oscillator on or off. For a more detailed explanation of how to use the 100-kc oscillator, see paragraph (g) ZERO ADJ above.

(l) AVC. - The AVC OFF-ON switch turns the avc on or off. In practically every instance, the avc control is in the ON position for both phone and cw reception but, if desired, may be placed in the OFF position for cw reception.

(m) LIMITER OUT-IN. - The automatic noise limiter is useful in both phone and cw reception. When noise is not a problem, it is recommended that the LIMITER switch be placed in the OUT position as the distortion will be somewhat less. When noise of the impulse type is being received, the LIMITER control should be placed in the IN position.

(n) CRYSTAL FILTER:

SELECTIVITY. - In position 0 of this control, the crystal filter is not used and receiver selectivity is determined by the tuned circuits of the receiver alone. In positions 1 through 4, the crystal filter is in the circuit with the selectivity increasingly greater as position 4 is approached. Position 4 will give a bandwidth in the order of 200 cps.

PHASING. - The PHASING control is used primarily to assist in rejecting unwanted heterodynes. The control, when positioned on the panel mark (straight up), is properly set for crystal phasing. No rejection notch is evident. In the event a high frequency heterodyne is interfering with reception, the control should be moved back and forth in the vicinity of the panel mark until the heterodyne is attenuated. If the heterodyne is of lower frequency, the control should be moved farther to left or right of the panel mark. This control will attenuate heterodynes ranging from 1 to 3 kc.

(o) TUNING METER. - The tuning meter is calibrated in 20, 40, 60, 80, and 100 db above avc threshold when reading r-f input. When reading output, the meter is calibrated (on the lower scale) -10 to +6 db with the "0" being 6 milliwatts into a 500-ohm load.

(p) CAL. - To attain supreme accuracy it is desirable to check the frequency of the 100-kc oscillator against WWV or some other station whose frequency is known to be very accurate. The frequency of the 100 kc oscillator is made variable within small limits if the CAL control is turned by a screwdriver. Additional range can be obtained by adjusting condenser C169, located just behind the 100-kc crystal.

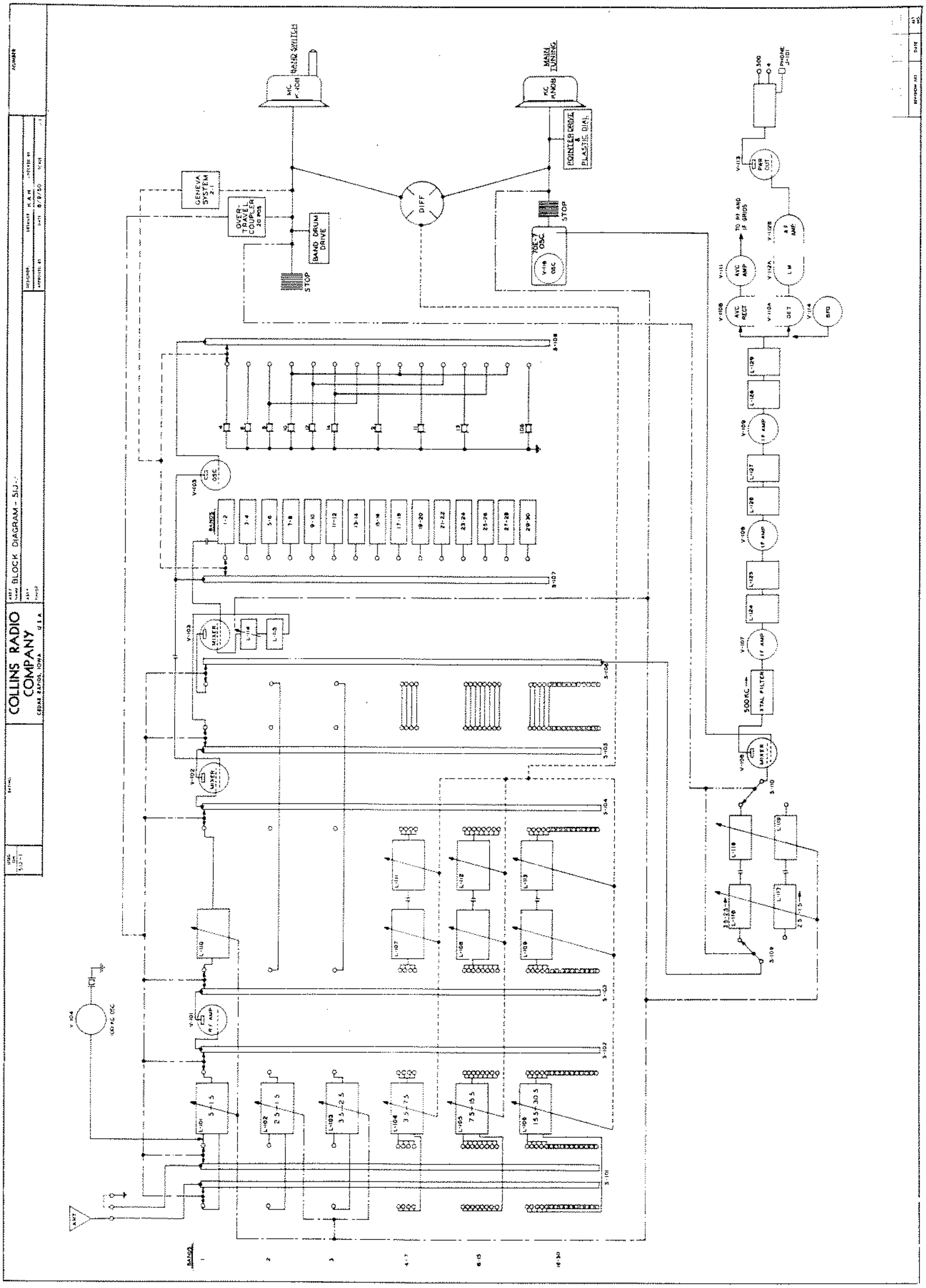


Figure 4-1 Band Change and Tuning System, Block Diagram

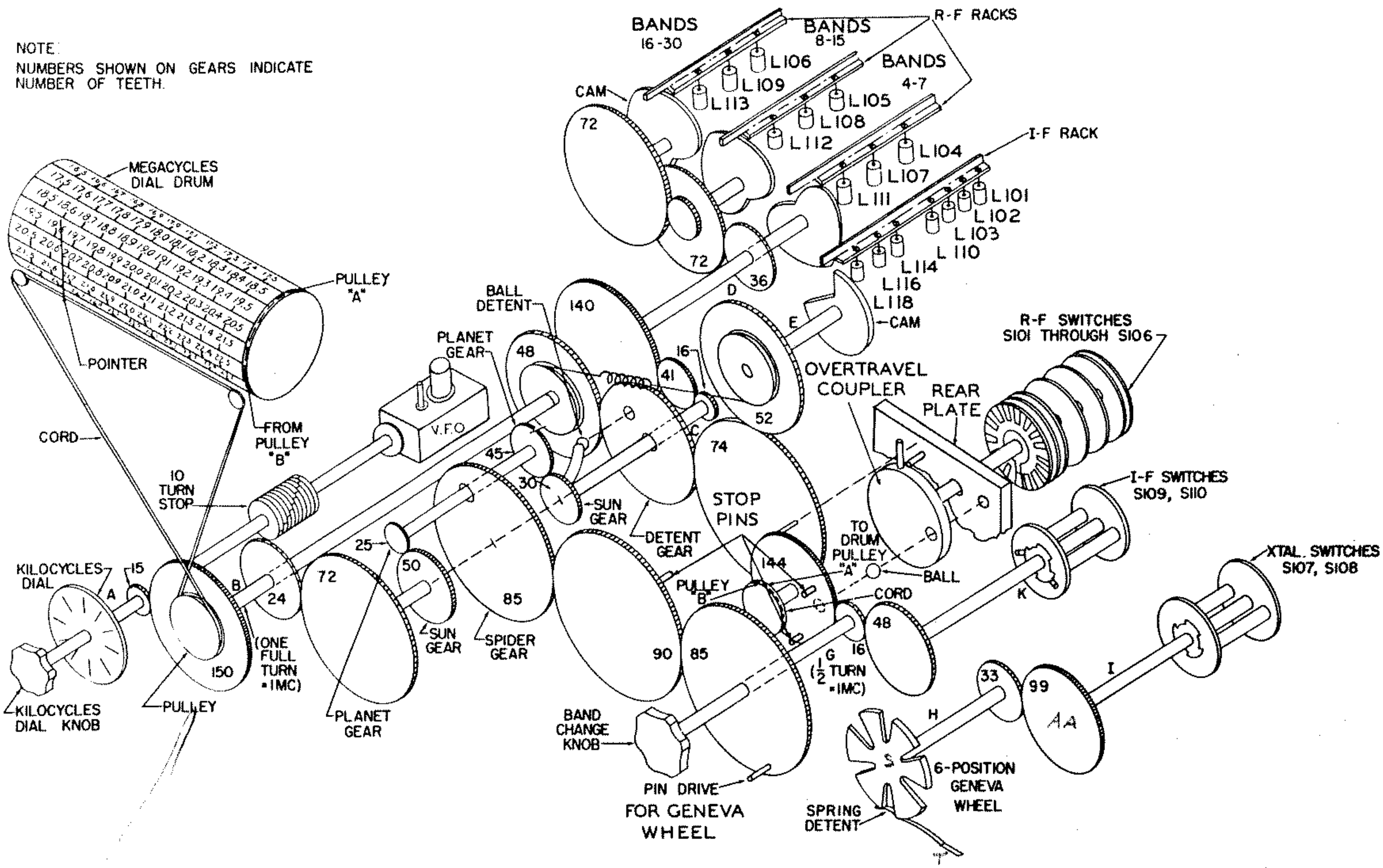


Figure 4-2 Mechanical Block Diagram

SECTION 4

CIRCUIT DESCRIPTION

4.1. MECHANICAL DESCRIPTION.

4.1.1. BAND CHANGE. - Collins 51J-2 Receiver covers the frequency range of 0.5 to 30.5 mc in 30 bands: 0.5 to 1.5, 1.5 to 2.5, and so on up to 30.5 mc. Each band is one megacycle wide. Circuits affected by band changes are the r-f amplifier grid, first, second, and third mixer grids, crystal selector, and crystal harmonic tuning circuits. The third mixer is switched in only on band 1 (.5 to 1.5 mc). See figure 4-1.

Operations involved in the changing of bands consist of selecting the proper coils in these circuits by means of tap switches and changing the position of the r-f amplifier and first mixer slug tables. All stages are permeability tuned by powdered iron slugs. The r-f amplifier and first mixer slug tables change position a full megacycle in tuning each time a band is changed. This is true of all three slug tables which tune L101 through L113. However, the tap switches select the proper set of coils for the frequency desired.

Slug tables are driven from two sources: the main tuning knob and the BAND CHANGE knob. These two driving sources are connected to the slug tables through a differential gear mechanism. This is necessary since the coils for bands 4 to 7, 8 to 15, and 16 to 30 cover these tuning ranges with one complete excursion of the tuning slugs. For instance, the band 4 to 7 slug table tunes its associated coils through four megacycles; in one megacycle jumps when operated by the BAND CHANGE knob, and in complete coverage in between when operated by the tuning knob. An interesting feature of the differential gearing is its ability to combine the movements of the two driving sources so that the slug table is moved exactly one megacycle in each band change. The otner slug tables operate similarly to the 4 to 7 table, except that the band 8 to 15 table tunes its associated coils through 8 mc, and the band 16 to 30 table tunes its associated coils through 15 mc. These three slug tables are moved simultaneously by means of separate cams.

Switch sections of the band switch are ganged with the three slug tables through an overtravel coupler. This overtravel coupler drops the band switch at band 16 and continues to operate one position for each band as usual. Refer to figure 4-2. This mechanical diagram shows the gears and connecting shafts associated with band change and tuning. Shafts associated with changing bands are C, D, G, H, I, K, and the overtravel shaft. On band 1 radio frequency coils L101 and L110 are switched by means of the BAND CHANGE knob through the overtravel shaft and shaft G. On bands 2 and 3, the r-f coils are selected by the BAND CHANGE knob through the overtravel shafts and shafts G and K, variable i-f coils L116 through L119 being used as additional r-f coils on these bands. On bands 4 to 7, the coils are selected by the BAND CHANGE knob through the overtravel shaft and shaft G, and the position of the slug table is changed through shafts A, B, C, and D. On these bands the same coils are used for each band. Band change is accomplished by moving the tuning slug in the coil an amount equal to one megacycle in frequency. The slug moves in the coil 0.250 inches for a one megacycle change. On bands 8 to 15, the r-f coils are changed by the overtravel shaft and shaft G, and the position of the slug table is changed one megacycle per band through shafts A, B, C and D. The movement of the slug table for a one megacycle change is 0.125 inches. On bands 16 to 30, the r-f coils are switched through the overtravel shaft and shaft G to position 16 where the band switch remains for bands 16 to 30 while the overtravel coupler allows shaft G to rotate through to the thirtieth band. Slugs in the r-f coils are driven through shafts A, B, C, and D. The slugs travel 0.0625 inches during band change. During operation on any band between 4 and 30 the variable i-f channel is alternated from one variable i-f to the other by shafts G and K. Crystals are selected by operation of the BAND CHANGE knob through the 15-position Geneva system and shafts G, H, and I.

4.1.2. TUNING. - All r-f, mixer and variable i-f coils, as well as the variable frequency oscillator coil, are permeability-tuned by powdered iron cores. While tuning, these slugs move in and out of the coils at a rate determined by a cam or by a lead screw. Four slug racks or tables are used in the 51J-2 receiver to perform the function of tuning the r-f, mixer and variable i-f stages. The group of three slug tables in the rear portion of the chassis tunes the r-f and first mixer stages when the receiver is operating in the 3.5 to 30.5 mc frequency range (bands 4 to 30). The fourth slug table, located at the right hand edge of the receiver, tunes the r-f stage, the first mixer grid, the third mixer grid and the variable i-f coils when receiving in the range 0.5 to 1.5 mc. It tunes the r-f stage and variable i-f coils L116 and L118 when receiving in the range 1.5 to 2.5 and 2.5 to 3.5 mc. When receiving in the range 3.5 to 30.5 mc, this slug table tunes only the variable i-f coils L116 and L118. During tuning, positions of the slug tables are varied by a system of gears and cams; see figure 4-2. On band 1 (0.5 to 1.5 mc) coils L101 and L110 are tuned through this frequency range by the main tuning knob through shafts A, B, C, and E. On bands 2 and 3 (2.5 to 1.5 and 3.5 to 2.5), tuning is done by the main tuning knob through the same shafts -- A, B, C and E. On band 4 to 7, the main tuning knob tunes coils L104, L107 and L111 over one-fourth of their tuning range through shafts A, B, C and D and the differential shafts. The BAND CHANGE knob moves this same rack through shafts G, C, D and the differential in four steps. Each step is equal to one-fourth of the coils' tuning range, and the shafts are positioned by means of the detent. Thus L104, L107, and L111 are tuned in one megacycle steps by the BAND CHANGE knob, and between these steps are tuned by the main tuning knob. On bands 8 to 15, coils L105, L108, and L112 are tuned through shafts A, B, C, D and the differential. Bands 16 to 30 are also tuned through shafts A, B, C, D and the differential. Each of the two variable frequency i-f channels covers one megacycle range and is tuned by means of the main tuning knob through shafts A, B and E. The proper channel is selected by the BAND CHANGE knob through shafts G and K.

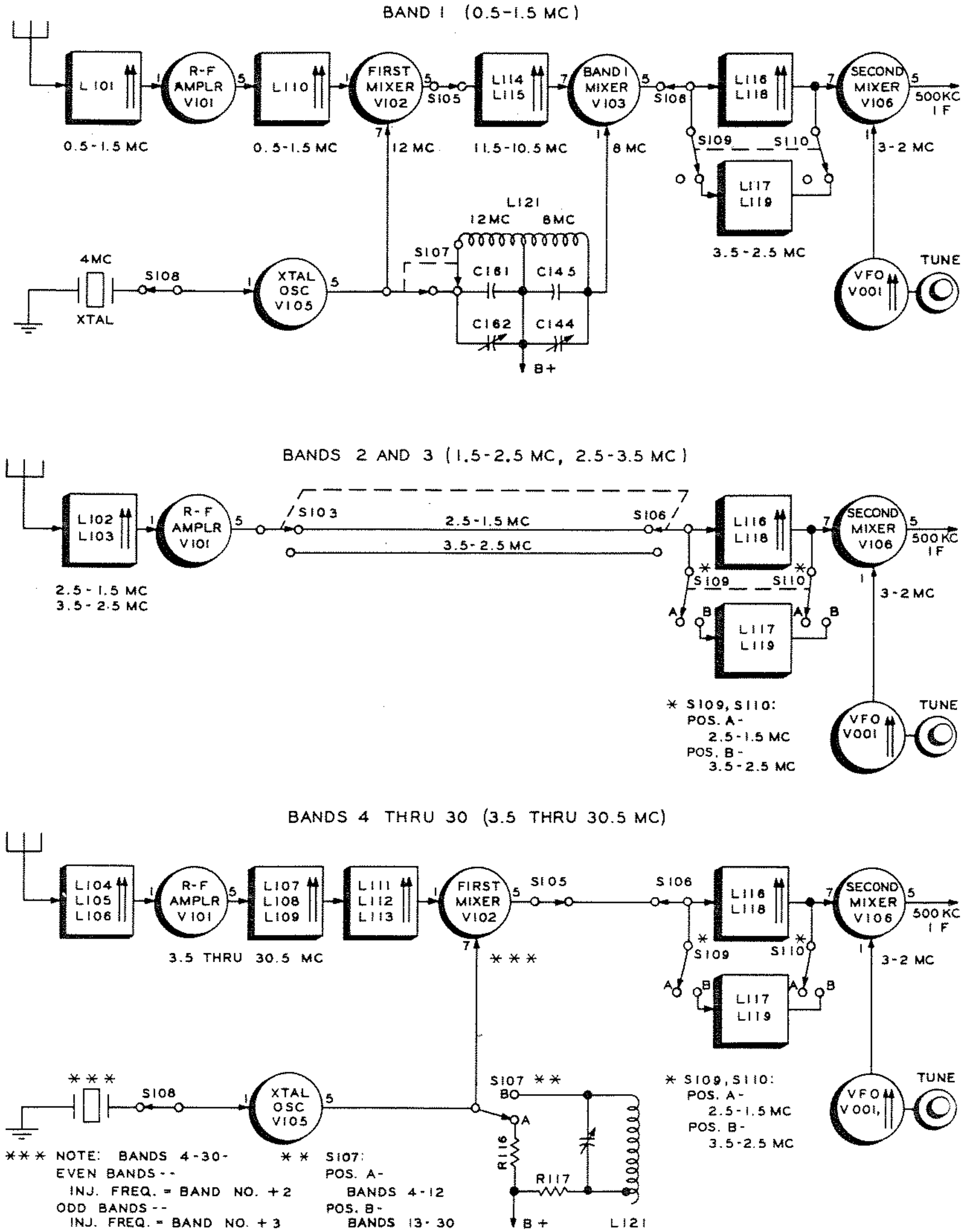


Figure 4-3 Frequency Conversion Circuits

4.1.3. FREQUENCY INDICATION. - The band on which the receiver is operating is indicated on the drum dial that is rotated by the BAND CHANGE knob through shaft G. The 100-kc divisions are indicated by a pointer on the slide rule dial. This pointer is driven from the main tuning knob through shaft A. Kilocycle divisions are indicated by the plastic dial mounted on shaft A. Two scales are necessary on this dial because bands 2 and 3 run in opposite directions. Mechanical stops are mounted on the control shafts to prevent overtravel.

4.2. ELECTRICAL DESCRIPTION.

4.2.1. GENERAL. - Collins 51J-2 Receiver is a complete coverage superheterodyne receiver capable of AM and CW reception in the frequency range of 0.5 to 30.5 megacycles. The set covers the tuning range in 30 bands, each band one megacycle wide. Various portions of the tuning spectrum use single, dual and triple conversion. Three stages of intermediate-frequency amplification and a crystal filter produce the desired degree of selectivity. The receiver also features a low impedance avc, a good noise limiter, two stages of audio amplification and a 100-kc frequency spotter or calibrator.

The receiver employs dual conversion on most bands and single or triple on others in order to obtain full coverage economically with a minimum of image and other spurious responses on all bands. Band 1, 0.5 to 1.5 mc uses triple conversion, bands 2 and 3, 1.5 to 3.5 mc, use single conversion, and bands 4 to 30, 3.5 to 30.5 mc, use dual conversion. Each band is numbered on the band's center frequency. For instance, band 1 covers 0.5 to 1.5 mc, band 2 covers 1.5 to 2.5 mc, and so on.

On band 1, where triple conversion is necessary, an intermediate mixer is employed between the first and second mixers used in the regular dual conversion scheme. The 0.5 to 1.5-mc carrier on band 1 is fed to the first mixer where it is beat against a 12-mc signal from the h-f crystal oscillator to produce an 11.5 to 10.5-mc signal. This signal is beat against an 8-mc signal in the intermediate mixer to produce the variable i.f. of 3.5 to 2.5 mc. The variable i.f. is then combined with the 3 to 2-mc variable oscillator output to produce the fixed 500-kc i.f. On bands 2 and 3, the 1.5 to 3.5-mc carrier is fed directly to the second mixer where it is combined with the same variable oscillator output to produce the 500-kc fixed i.f. On bands 4 to 30 the regular dual conversion scheme is employed. On the even numbered bands the signal frequency is beat against the high frequency oscillator output to produce a variable i.f. of 2.5 to 1.5 mc. On the odd numbered bands a variable i.f. of 3.5 to 2.5 mc is produced. The variable i.f. is then combined in the second mixer with the vfo output to produce the 500-kc fixed i.f. The detailed operation of the various receiver circuits is outlined in the following paragraphs.

4.2.2. RADIO FREQUENCY AMPLIFICATION. - Refer to the block diagram, figure 4-1. One stage of radio frequency amplification is (V101) used on all bands. A type 6AK5 miniature r-f pentode is employed in this stage because of its low noise and good sensitivity characteristics at high frequencies. The antenna is transformer coupled to the grid of the r-f stage on all bands, with a resulting antenna termination impedance of 300 ohms. The r-f coils for bands 1, 2 and 3 are mounte in the variable i-f group and are tuned by slugs mounted on the variable i-f slug table which is at the extreme right-hand edge of the receiver as viewed from the front. The coils for bands 4 to 30 are clustered at the rear of the chassis and are tuned by slugs mounted on the three r-f and mixer slug tables.

When operating in the American broadcast band (band 1), the plate circuit of the r-f tube is impedance-coupled to the grid circuit of the first mixer tube by resistor R105, capacitor C117, and inductor L110. On bands 2 and 3 the plate of the r-f amplifier tube V101 is switched directly to primary coils of the variable i-f tuner where additional selectivity is obtained, single conversic being used on these two bands. When operated on bands 4 to 30, the plate circuit of the r-f stage is tuned and capacitively-coupled to the tuned circuit in the grid of the first mixer stage.

4.2.3. MIXER STAGES.

(a) FIRST MIXER. - The first mixer stage consists of a type 6BE6 miniature converter tube. This stage is used on band 1 and bands 4 to 30 (0.5 to 1.5 mc and 3.5 to 30.5 mc) but not on bands 2 and 3 (2.5 mc to 1.5 mc and 3.5 mc to 2.5 mc). In the range .5 to 1.5 mc the grid circuit of this tube is tuned by L110 and C118 and C119. In the range at 3.5 to 30.5 mc the grid circuit is capacitively coupled to the tuned plate circuit of r-f stage V101. The plate circuit of first mixer tube V102 is tuned to either 2.5 to 1.5 mc or 3.5 to 2.5 mc, depending on which band between 4 and 30 is being operated. However, this circuit is tuned to the 11.5 to 10.5 mc spectrum when the receiver is tuned to the American broadcast band (band 1). On bands 13 to 30, the heterodyning signal for the first mixer is obtained from crystal oscillator stage V105 through the proper crystal oscillator plate tuning capacitors in conjunction with plate harmonic selector coil L121. On bands 4 to 12 the plate circuit is not tuned. On bands 4 to 30 the output of the first mixer is always between 1.5 to 2.5 mc or 2.5 to 3.5 mc. When used on band 1, the first mixer is fed a 12-mc heterodyning signal from oscillator tube V105. The output of the first mixer is 11.5 to 10.5 mc which, when mixed in the third mixer with an 8-mc signal from the crystal oscillator, produces a 3.5 to 2.5 mc voltage for presentation to the variable i-f coils. Output of the first mixer is switched from the variable i-f coils to the grid of the third mixer by means of switch pies S105 and S106.

(b) SECOND MIXER STAGE. - The second mixer stage, V106, also employs a 6BE6 miniature converter tube. Input to this stage is always either 3.5 to 2.5 mc or 2.5 to 1.5 mc from the variable i-f coils L116/L118 and L117/L119. The 3 to 2-mc output of the 70E-7 permeability tuned vfo is fed into the second mixer tube at grid number 1 to heterodyne against the input signal to produce a 500 kc intermediate frequency. This mixer stage is always used for allbands.

(c) THIRD MIXER STAGE. - The third, or band 1, mixer stage is used only when receiving on band 1. A type 6BE6 miniature converter tube is used in this application also. Grid number 3 of this tube is excited by a 11.5 to 10.5-mc signal from the plate circuit of first mixer tube V101, and grid number one is excited by a heterodyning 8-mc signal from the crystal oscillator. The output of the third mixer is then 3.5 to 2.5 mc, which is then fed to the grid of the second mixer through the variable i-f coils. This, of course, takes place only when receiving on band 1 as this stage is not used on the other bands.

4.2.4. HIGH FREQUENCY OSCILLATOR. - The high frequency oscillator, V105, uses a 6AK5 miniature pentode tube in a modified Colpitts oscillator circuit. No tuned coils are needed to make the circuit oscillate because in-phase feedback voltage is produced across r-f choke L120. Ten quartz crystals are used to control the frequency of the oscillator output for the various bands. At the minimum, each crystal is used for two adjacent bands, i.e. 1-2, 3-4, 5-6 and so on. The harmonics of certain crystals are used also for other higher bands. For instance, the 8-mc crystal used for bands 5 and 6 is also used for bands 13 and 14 by utilizing its second harmonic at 16 mc. In those instances where harmonic operation is used, a tuned circuit picks off the correct harmonic. This tuned circuit is in the plate circuit of oscillator tube V105 and consists of the primary coil of L121 and a number of tuning capacitors. The latter are selected for the proper band by switch pie S107. The secondary of coil L121 is tuned to 8 mc and is used when operating on band 1 to furnish the third mixer with an 8-mc heterodyning signal (second harmonic of the 4-mc crystal). At the same time, the primary of L121 is tuned to 12 mc (third harmonic of the 4 mc crystal) to supply the first mixer with the required 12-mc heterodyning signal. A list of the crystals and the bands upon which they function is outlined below:

CIRCUIT FREQUENCY

CRYSTAL FREQUENCY	RECEIVER FREQUENCY	BAND	INJECTION FREQUENCY
4	0.5 to 1.5	1	8 and 12
	1.5 to 2.5	2	None
	2.5 to 3.5	3	None
6	3.5 to 4.5	4	6
8	4.5 to 5.5	5	8
	5.5 to 6.5	6	8
	12.5 to 13.5	13	16
	13.5 to 14.5	14	16
10	6.5 to 7.5	7	10
	7.5 to 8.5	8	10
	16.5 to 17.5	17	20

CIRCUIT FREQUENCY (CONT)

CRYSTAL FREQUENCY	RECEIVER FREQUENCY	BAND	INJECTION FREQUENCY
10 (cont)	17.5 to 18.5	18	20
	26.5 to 27.5	27	30
	27.5 to 28.5	28	30
12	8.5 to 9.5	9	12
	9.5 to 10.5	10	12
	20.5 to 21.5	21	24
	21.5 to 22.5	22	24
14	10.5 to 11.5	11	14
	11.5 to 12.5	12	14
	24.5 to 25.5	25	28
	25.5 to 26.5	26	28
9	14.5 to 15.5	15	18
	15.5 to 16.5	16	18
11	18.5 to 19.5	19	22
	19.5 to 20.5	20	22
13	22.5 to 23.5	23	26
	23.5 to 24.5	24	26
10.67	28.5 to 29.5	29	32
	29.5 to 30.5	30	32

4.2.5. VARIABLE INTERMEDIATE FREQUENCY. - The variable intermediate frequency section consists of two channels, one for a frequency of 2.5 to 1.5 mc and the other for 3.5 to 2.5 mc. The 2.5 to 1.5-mc i.f. is used on the even numbered bands which employ double conversion, and the 3.5 to 2.5-mc i.f. is used on the odd numbered bands which employ double conversion. The 2.5 to 1.5-mc i.f. is also used on band 2 as an additional tuned r-f circuit. The 3.5 to 2.5 variable i.f.

is used on band 3 as an additional tuned r-f circuit and on band 1, in the usual application, as a variable i.f. for the odd numbered bands. Use of two variable i-f channels in this manner cuts in half the number of crystals needed by the high frequency oscillator, since each crystal's fundamental frequency or useful harmonic is used for two bands. Inductors L116 and L118 form the lower frequency i-f coils (2.5 to 1.5) and are the coils in which the tuning slug travels. The 3.5 to 2.5-mc i.f. is obtained by shunting L116 across L117, and L118 across L119 to lower the inductances of L116 and L118. Switch sections S109 and S110 alternately switch the shunting coils in and out as the BAND CHANGE knob is rotated. The variable i-f coils are in the grid circuit of the second mixer stage.

4.2.6. VARIABLE FREQUENCY OSCILLATOR. - The receiver circuits described so far have the function of receiving the spectrum in 1-megacycle bands that are presented to the grid of the second mixer. The scheme for obtaining high stability is completed by a method of heterodyning the signals to a lower, fixed intermediate frequency. In this application, a highly stabilized 3 to 2-mc permeability tuned oscillator, Model 70E-7, is employed to heterodyne against the 2.5 to 1.5 and the 3.5 to 2.5-mc output of the variable frequency i.f. The resulting 500-kc signal is amplified by the 500-kc i-f amplifier.

The coil in the oscillator is cam wound to produce extremely linear frequency change with linear movement of the tuning slug. The circuit is temperature compensated and the components are sealed against changes in humidity. The ambient humidity in the oscillator enclosure is maintained at a very low level by means of a replaceable desiccant capsule which protrudes from the top of the oscillator; the need for replacement of the capsule being determined by the color of the desiccant material. This material can be viewed through the sides of the clear plastic body of the capsule. Normally the color of the desiccant material is blue; a change to pink indicating a spent capsule.

4.2.7. CRYSTAL FILTER. - Selectivity of the 51J-2 receiver is improved greatly by use of a crystal filter in the 500-kc i-f channel. The crystal filter circuit consists primarily of 500-kc i-f input transformer T101, a 500-kc crystal, and a high impedance tuned circuit T102, connected as shown in figure 7-3. When SELECTIVITY switch S114 is in position 0 the crystal is shorted and T101 is connected directly to T102. Thus, there is no crystal filter action when S114 is in position 0; selectivity is determined by the receiver's tuned circuits alone. When S114 is in any other position, crystal filter action takes place - - position 4 giving the greatest selectivity.

To analyze the operation of this circuit consider only the loop containing T101 secondary, crystal Y112, and tuned circuit T102. Assume that S114 is in position 1. The secondary of T101 is a low impedance coil with a grounded center tap. The primary of T101 is tuned to 500 kc. Consider crystal Y112 in series with T102 as a voltage divider, grid voltage to V107 being taken from the point between Y112 and T102. For an i.f. of exactly 500 kc, impedance of the crystal is very low - - of the order of 2000 to 4000 ohms, and the impedance of T102 is of the order of 100,000 ohms. Thus, at 500 kc practically all the voltage appearing across T101 secondary is fed to the grid of V107.

For frequencies a few kilocycles farther away from 500 the impedance of the crystal increases greatly. When the crystal impedance equals that of T102, only one-half the voltage on T101 secondary appears on the grid of V107. As the crystal impedance becomes still greater, the voltage appearing on V107 grid decreases. This results in a narrower i-f response curve, or in greater selectivity than that obtained without crystal filtering. Switching S114 to positions 2, 3, or 4 merely shunts T102 with resistance, which effectively lowers the impedance of T102 for those positions. This results in a more rapid decrease in V107 grid voltage as the i.f. deviates to either side of 500 kc. Hence, as the effective impedance of T102 lowers, selectivity increases. In the sharpest position the bandwidth at 6 db down is from 200 to 300 cps.

The primary purpose of PHASING capacitor C188 is to produce a controllable rejection notch in the i-f response curve so that unwanted heterodynes may be tuned out. The section of C188 connected to the bottom end of T101 secondary provides a capacitive path around the crystal that balances out the shunt capacitance of the crystal in its holder and external capacitor C187. Varying C188 either side of the balance point varies the anti-resonant frequency of the crystal circuit within 3 kc either side of 500. Since the impedance of the crystal circuit at anti-resonance is extremely high, the crystal filter rejects signals at the anti-resonant frequency.

In order to avoid detuning tuned circuit T102 when varying C188, a second section of C188 is shunted across T102. Since C188 has a split stator and a single rotor, the total shunt capacitance across T102 remains practically constant as the setting of C188 is varied.

4.2.8. SECOND INTERMEDIATE FREQUENCY. - The second intermediate frequency is fixed tuned to 500 kc. It consist of three stages and employs 6BA6 tubes in all three stages. Input tube V107 is excited by the crystal filter output coil T102. Permeability-tuned transformers, with output taps taken off the secondary coils near the ground end, are used to produce the desired i-f selectivity. All three stages are supplied with avc voltage.

4.2.9. DETECTOR. - The detector in the 51J receiver consists of one half of a 12AX7 dual triode tube, V110 (pin numbers 6, 7, and 8). The tube is used as a diode, with rectification taking place between the plate and cathode, the grid being connected to the plate. R150 and R151 serve as load resistors for the detector while C202 provides r-f filtering.

4.2.10. NOISE LIMITER. - A series type noise limiter is used in the 51J receiver. This limiter employs one-half (pins 1, 2, and 3) of a type 12AX7 dual triode tube, V112. Refer to figure 4-4. Due to a-c loading of the second detector heavy noise impulses are automatically clipped from the positive audio peaks in the detector. The noise appearing on the negative side of the audio cycle is clipped by the noise limiter. In operation, a negative voltage produced by rectification of the carrier is developed across capacitor C210. This voltage cannot change rapidly due to the value of C210 and R152 through which C210 charged. This negative potential is placed upon the cathode of the noise limiter tube through R153. The cathode is then negative in respect to the plate of the noise limiter tube, due to the voltage divider action of R150 and R151, and current flows. This current is modulated by the audio which then appears on the noise limiter cathode to which the grid of the audio amplifier section of V112 is connected. The noise limiter diode will conduct as long as the cathode is negative in respect to the plate. However, should a heavy noise impulse be received, the plate would be driven negative faster than the cathode could follow due to the time constant of R152 and C210. If the plate is driven more negative than the cathode, the tube will cease to conduct and no audio will reach the grid of the following audio tube. The audio cannot reach the cathode of the limiter tube directly from the bottom of the detector transformer because of the filtering action of R152 and C210. The value of modulation at which the limiter clips can be adjusted by changing the value of some of the components in the circuit. In this receiver, limiting starts between 50 and 85.5 percent modulation. When receiving conditions do not require use of the noise limiter, switch S116 bypasses the signal around it.

4.2.11. AUTOMATIC VOLUME CONTROL. - The problem of blocking that is created by strong signals or heavy static is eliminated by use of an amplified avc system and a low impedance avc line. Refer to figure 4-5. The second triode section of V110 is used as an avc rectifier to produce control voltage for avc amplifier tube V111 which is a dual triode with both sections tied in parallel. The avc voltage that is applied to grids of the controlled tubes is produced when plate current flowing through avc amplifier tube V111 causes a voltage drop across resistor R146. Plate voltage for the avc amplifier tube is obtained from the voltage drop across resistors R164, R165 and R166, which are in series with the center tap of the power transformer to ground. However, tube V111 will not draw plate current when there is no signal input to the receiver because of approximately 11 volts of bias that is placed upon its grids by the voltage drop through R164. This bias voltage for V111 is taken from the end of R145 through which the rectified carrier flows in opposition to the bias voltage. Thus, when the rectified carrier becomes strong enough to overcome the bias voltage on V111, the tube will draw plate current and produce a voltage drop across R146, thereby producing avc voltage in proportion to the strength of the received signal. The bias on the grids of V111 is high enough to produce a delay in the generation of avc voltage and thus allows the receiver to function at full sensitivity on weak signals. Resistor R144 and capacitor C207 form the time constant in the avc circuit. R171, C208, and R167 are used in a degenerative circuit to prevent the avc amplifier tube from responding to low audio frequencies. Avc is turned off by opening the plate circuit of avc amplifier tube V111. Tubes controlled by avc bias include r-f amplifier V101, and the 500 kc i-f amplifier tubes, V107, V108, and V109.

4.2.12. AUDIO AMPLIFIER. - Two stages of audio amplification are employed in the 51J-2 receiver. The first stage utilizes the second triode section of V112, pins 6, 7, and 8, in a resistance-coupled amplifier circuit. A type 6AQ5 miniature

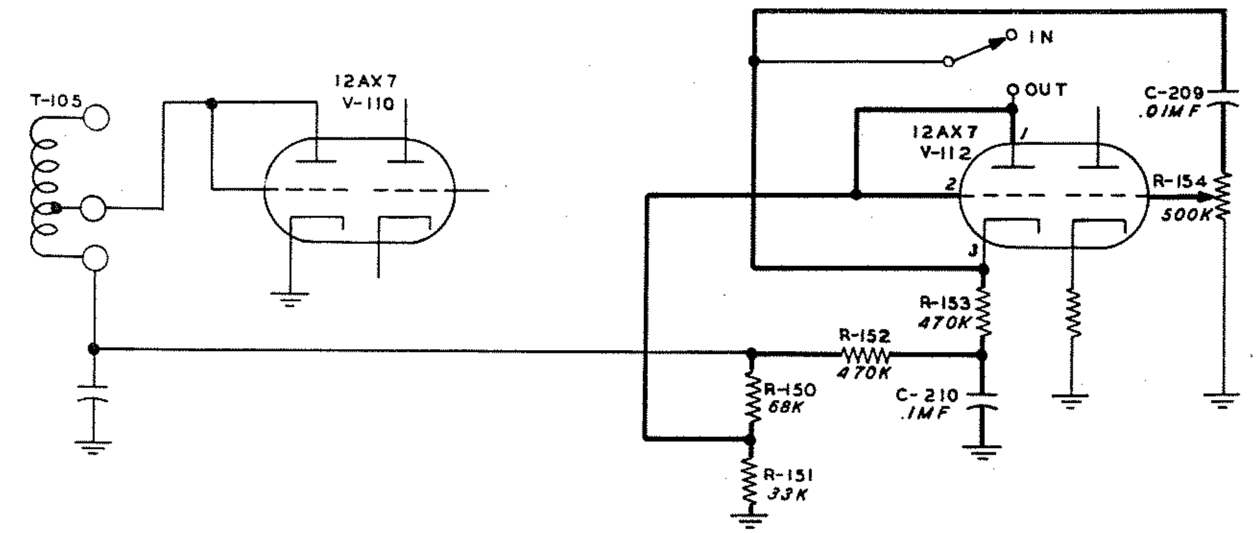


Figure 4-4. 51J-2 Noise Limiter Circuit

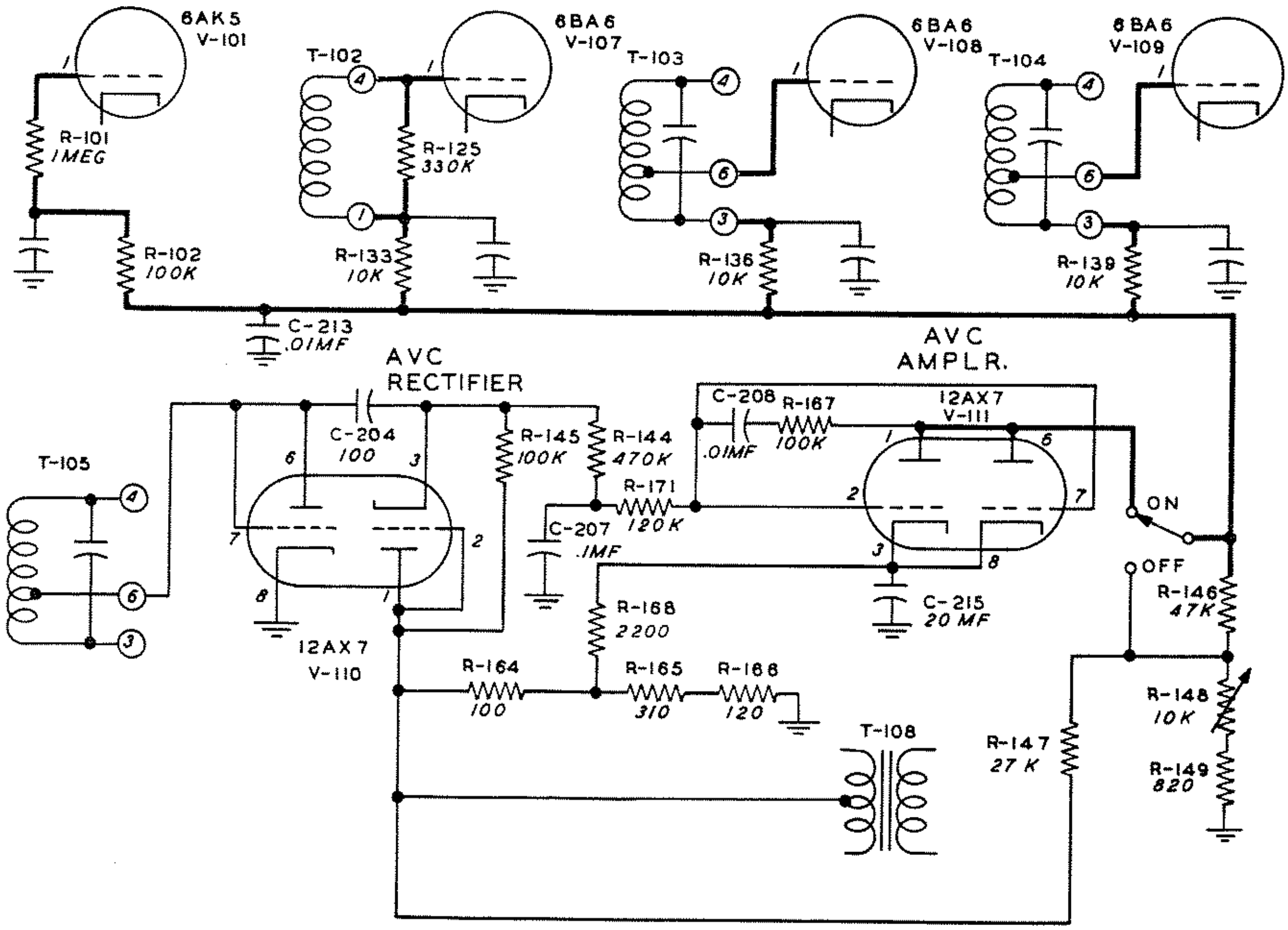


Figure 4-5. 51J-2 A.V.C. Circuit

pentode power amplifier tube, V113, is used in the audio output stage. This stage has fixed bias obtained from the voltage drop produced across R166 in the center tap lead of the high voltage transformer secondary. The 500-ohm secondary of the audio output transformer is tapped at 4 ohms to excite the voice coil winding of a speaker directly. Both the 500-ohm and the 4-ohm outputs are terminated on the rear of the chassis at terminal strip E103. Headphone connections on the front panel are also made to the 4-ohm tap. The plugging of headphones into phone jack J101 disconnects the speaker.

4.2.13. 100 KC CALIBRATOR. - This calibrator is included with the receiver for use when extreme accuracy of calibration in the order of 200 cycles is desired. It is coupled to the grid of r-f amplifier tube V101, and is made operable when CALIBRATOR ON-OFF switch S111 is turned on. The calibrator utilizes a 6BA6 tube in a Pierce circuit, a low drift 100-kc crystal between the control grid and screen, and a 5-25 uuf capacitor C169 between grid and ground. The capacitor permits the making of small frequency corrections that set the calibrator to zero beat with a primary frequency standard. Variable capacitor C224 on the front panel provides for fine adjustment of frequencies.

4.2.14. BEAT FREQUENCY OSCILLATOR. - The receiver is equipped with a bfo for cw reception. This oscillator is a modified Hartley circuit employing electron coupling. A type 6BA6 pentode tube is used. The output frequency is 500±3 kc which is beat against the 500-KC i.f. signal to produce an audio tone. Pitch is varied by the BFO PITCH control on the front panel. This control varies the capacitance in the oscillator control grid circuit and thus varies the frequency of oscillation. The BFO is turned off by grounding the screen grid.

4.2.15. POWER SUPPLY. - The receiver is equipped with a power transformer that is connected for a 115-volt source. However, as shown in figure 7-3, the transformer can be re-connected for a 230-volt source. The power supply is capable of producing 220 volts dc at 100 ma. A two-section choke input filter is used following a 5V4 high vacuum rectifier. The filter consists of a 3-henry input choke, a 5-henry output choke and two 35-mfd filter capacitors. B+ for the audio output is taken from the junction of the two chokes. The receiver's ON-OFF switch, and a 1-ampere fuse are located in the primary circuit of the power supply. Tube filaments and dial lights receive a 6.3 volt a-c power supply from a winding on the power transformer.

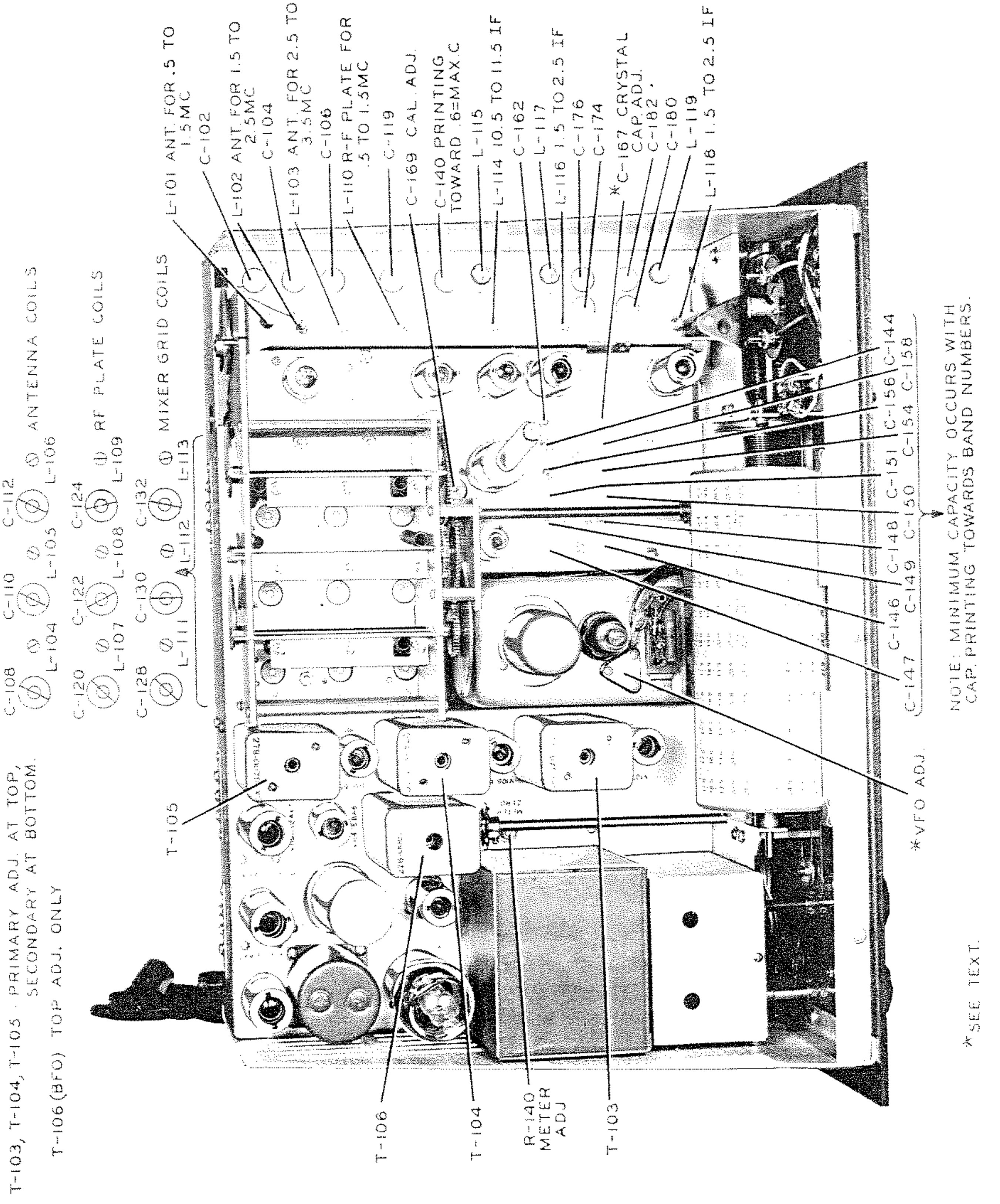


Figure 5-1 Alignment Adjustments

SECTION 5

MAINTENANCE

5.1. INSPECTION.

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

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

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

5.1.3. CLEANING. - The worst enemies of uninterrupted service in equipment of this type are dirt and corrosion. Dirt reduces efficiency and causes undue wear of rotating parts. Corrosion most seriously affects contacts such as those on tap switches, tubes, relays, and cables. Like salt laden air, dirt and moisture accelerate corrosion. The result may be equipment failure for no apparent reason.

Periodic dusting of accessible parts by means of a soft brush and a jet of dry, oil-free air removes foreign particles. Under certain conditions it is difficult or virtually impossible to prevent accumulation of moisture. Even so, frequent wiping of parts lessens danger of corrosion. If the atmosphere is corrosive, frequent inspection and wiping of parts is of special importance.

5.1.4. VACUUM TUBES. - Check the emission characteristics of all tubes; then examine all tube prongs to make sure they are free from corrosion. Straighten bent pins with a tube pin straightener. See that all tubes are firmly seated in their proper sockets and that a good electrical contact exists between tube prong and socket. Before discarding a tube be sure that it is at fault and that the trouble is not due to a loose or broken connection within the equipment. Keep an extra set of tested tubes on hand at all times. If an equipment's faulty performance seems due to tube failure, check the tubes by replacing them with the extras. Inspection will usually locate defective tubes that are overloading power circuits. Excessive heating or sputtering within a vacuum tube indicates a fault in the tube circuit.

5.1.5. TUBE REPLACEMENT PRECAUTIONS.

(a) Remove tubes by pulling them straight up.

(b) Before inserting a tube make certain that its pins are straight and that it is of the correct type for the socket into which it is to be placed.

5.1.6. TUBE TABLE.

RECEIVER:

Symbol	Type	Function
V101	6AK5	R-f amplifier
V102	6BE6	First mixer
V103	6BE6	Band 1 mixer
V104	6BA6	Calibration oscillator
V105	6AK5	Crystal h-f oscillator
V106	6BE6	Second mixer
V107	6BA6	First 500 kc i-f amplifier
V108	6BA6	Second 500 kc i-f amplifier
V109	6BA6	Third 500 kc i-f amplifier
V110	12AX7	Detector and avc rectifier
V111	12AX7	Avc amplifier
V112	12AX7	Noise limiter and first audio amplifier
V113	6AQ5	Audio power amplifier
V114	6BA6	Beat frequency oscillator
V115	5V4	Power rectifier
V001	6SJ-7	Variable frequency oscillator

5.2. TROUBLE SHOOTING.

5.2.1. GENERAL. - Improper performance of radio equipment is usually due to tube failure. Refer to paragraph 5.1.4. In general, the type of trouble encountered in radio apparatus can be ascertained by means of various tests and measurements. Components in the associated circuit may then be checked and the cause of trouble located.

Useful resistance and voltage measurements will be found in table 5-1.

NOTE

NO ONE BUT AN AUTHORIZED AND COMPETENT SERVICE MAN EQUIPPED WITH PROPER TEST FACILITIES SHOULD BE PERMITTED TO SERVICE THIS EQUIPMENT.

5.2.2. FUSES. - This equipment contains fuses of the correct rating. Replace blown fuses only after carefully examining affected circuits to make certain that no permanent fault exists. Use only one-ampere fuses.

5.3. ALIGNMENT.

5.3. ALIGNMENT. - Should the receiver get out of alignment, return it to satisfactory performance by means of the following procedure.

5.3.1. EQUIPMENT AND TOOLS USED FOR ALIGNMENT.

(a) 500-kc to 30.5-mc signal generator

(b) D-c vacuum tube voltmeter.

(c) Oscilloscope.

(d) Detuning network consisting of a .01-mf capacitor and 4700-ohm resistor in series with clip leads.

(e) Fiber or bakelite adjusting tool, 1/8-inch diameter with screwdriver type bit. (Supplied)

(f) Fiber or bakelite adjusting to 1, 5/16-inch diameter with screwdriver type bit. (Supplied)

(g) Small screwdriver.

NOTE

IF A SIGNAL GENERATOR IS NOT AVAILABLE, THE CALIBRATION OSCILLATOR MAY BE USED FOR ALIGNMENTS PARAGRAPHS 5.3.4. (a through h) AND 5.3.9. to 14. USE THE PROCEDURE OUTLINED BELOW BUT LEAVE THE CALIBRATION OSCILLATOR ON. SET THE BFO AT EXACTLY 500 KC AS IN PARAGRAPH 5.3.6. COUPLE THE OUTPUT OF

THE CALIBRATION OSCILLATOR, AT C173, TO PIN 7 OF V106 WITH CLIP LEAD. TUNE THE RECEIVER TO EACH ALIGNMENT FREQUENCY BY ZERO BEATING WITH THE BFO. THEN TUNE THE TRIMMERS AND CORES FOR MAXIMUM OUTPUT READINGS.

5.3.2. CRYSTAL OSCILLATOR TRIMMER ADJUSTMENT.

(a) By means of a "Q" meter or some other accurate device used in measuring capacitance, adjust trimmer C167, marked XTAL on chassis, to provide an input capacitance of 32 mmf across the crystal holders. This value will occur at or near minimum capacitance setting. If this capacitor is badly mistuned, the crystals will be off frequency and low in output.

(b) Connect a 470K-ohm resistor to pin 7 of tube V102. Connect VTVM between free end of 470K-ohm resistor and chassis. This resistor reduces the effect of the capacitance of the meter lead.

(c) In all of the following adjustments, peak the trimmers if the indicated voltage is not more than 2 volts. If it is more than 2 volts, detune trimmer toward minimum capacitance, until the voltage reads 2. See figure 5-1.

(1) Turn receiver on. Set bandswitch on band 30; then tune trimmer marked 30 according to the procedure in paragraph (c), above.

(2) Repeat, tuning trimmer marked 28, with bandswitch on band 28.

(3) Repeat on even bands from 26 through 14, tuning correspondingly marked trimmers.

(4) Repeat with bandswitch on band 1. Adjust trimmer labeled B.C. that is nearer V105.

(d) Remove 470K-ohm resistor from V102. Connect the resistor to pin 1 of V103. Connect VTVM between free end of resistor and chassis.

(e) Place bandswitch on band 1. Tune for maximum indication on VTVM the trimmer marked B.C. that was not previously tuned.

5.3.3. 100 KC CALIBRATION OSCILLATOR ALIGNMENT. - Calibrate the 100-kc calibration oscillator by means of the CAL trimmer, C169, located on the front panel, using a primary frequency standard. D-c grid voltage on V104, as indicated on a d-c VTVM should be a negative 15-30 volts minimum.

5.3.4. FIXED 500 KC I-F AMPLIFIER ALIGNMENT. - Connect signal generator between pin 7 of V106 and chassis. Connect one end of a clip lead to output of 100-kc calibration oscillator at C173. Hold the other end near grid of V106. Be sure BFO is in OFF position. Set signal generator to zero beat at 500 kc. Turn off 100-kc calibration oscillator and remove clip lead. Connect detuning network consisting of an .01-mf capacitor in series with a 4700-ohm resistor from the plate of V107 to the chassis. Connect VTVM from the diode load resistor R151 to chassis. Place SELECTIVITY switch in "O" position.

(a) Tune secondary of T103 by adjusting the bottom slug for maximum indication on VTVM. Keep diode load voltage below 3 volts by adjusting signal generator output.

(b) Connect detuning network from terminal 4 of T103 to chassis. Tune top slug, or primary, for maximum indication on VTVM.

(c) Connect detuning network from plate of V108 to chassis. Tune secondary of T104 for maximum indication on VTVM.

(d) Connect detuning network to terminal 4 of T104. Tune primary of T104 for maximum indication on VTVM.

(e) Connect detuning network to plate of V109. Tune secondary of T105 for maximum indication on VTVM.

(f) Connect detuning network to terminal 4 of T105. Tune primary of T105 for maximum indication on VTVM.

(g) Remove detuning network from terminal 4 of T105. Tune T101 for maximum indication on VTVM.

(h) If the BFO PITCH knob has never been off the shaft, align the bfo as follows. Turn BFO on. Set the line on the BFO PITCH knob at the fiducial mark on the panel. Adjust core in T106 (fig. 5.1) to zero beat.

If the BFO PITCH knob has been off the shaft, align the bfo as follows. Turn BFO on. Adjust core in T106 to produce a beat note. Line up the knob with the panel mark and with the mid-range point of the bfo pitch capacitor by turning the knob to either the right or the left of the fiducial panel mark until pitch of beat note rises to a maximum. Leave knob exactly at point of maximum pitch. BFO PITCH capacitor plates are now either all in or all out. Loosen set screws in BFO PITCH knob. Rotate knob on shaft until knob mark is 90° from panel mark. Tighten set screws. Set knob mark at fiducial mark on panel. BFO PITCH capacitor is now at mid-range. Adjust core of T106 to zero beat. (A method of aligning the BFO without a signal generator is given in paragraph 5.3.6.)

5.3.5. CRYSTAL PHASING ADJUSTMENT.

(a) A frequency-modulated frequency generator must be used in this adjustment. The carrier frequency should be set between 1.5 and 3.5 mc. Frequency excursion should be about 20 kc. The rate of excursion should be as rapid as possible without blocking the signal in the crystal filter. The rate will be low due to the inertia of the 100-kc crystal in the filter.

(b) Line up the crystal filter PHASING control knob with the panel mark and with the mid-range position of the phasing capacitor. To accomplish this, with the aid of a flashlight look into the right-hand hole in the top of the crystal filter cover in order to see the plates of the phasing capacitor. Turn the PHASING control until the rotor plates are straight down toward the bottom of the receiver, i. e., until the rotor plates completely engage the bottom set of stator plates. Loosen set screw in PHASING control knob. Set knob line 90° to the left of the panel mark. Tighten set screws. Turn knob to panel mark. Phasing capacitor is now at mid-range.

(c) Connect the frequency modulated signal generator lead to pin 7 of V106. Connect oscilloscope lead to junction of R150 and R152. (See fig. 4-4.) Turn on generator and oscilloscope and allow them to warm up.

(d) Turn SELECTIVITY switch to position 1. Turn AVC off, LIMITER off, BFO off, CALIBRATE off and AUDIO GAIN to position 0. Tune receiver to carrier frequency of signal generator which should lie in the range between 1.5 and 3.5 mc.

(e) Turn RF GAIN to position 5 and synchronize scope. Two fairly symmetrical peaks should appear on the scope screen. If they do not, adjust receiver tuning, RF GAIN and oscilloscope controls until they do appear. Each of these peaks is essentially an i-f response curve.

(f) Rotation of the PHASING control to the left should cause a rejection notch to appear at one side of each peak. If this notch does not appear, set the PHASING control about one-eighth turn to the left of center and adjust the core in top of T102 (accessible through the left-hand hole in the crystal filter cover) until it does appear and is well-defined on the scope screen. Adjust until no evidence of a damped oscillation remains.

(g) Turn PHASING control about one-eighth turn to the right of center. The rejection notch should appear at the other side of each peak and, without further adjustment, should be well-defined and without evidence of a damped oscillation. If this is not the case, adjust T102 core slightly.

(h) Repeat steps (f) and (g) until the notch obtained in one of the steps looks symmetrical with respect to the notch obtained in the other step and gives no evidence of a damped oscillation.

<u>5.3.6. ALTERNATE BFO ALIGNMENT METHOD.</u> - The following paragraphs describe how to align the BFO when a signal generator is not available. For the standard alignment procedure, which requires a signal generator, refer to paragraph 5.3.5. above for the set-up, and to 5.3.5.(h) for the procedure.

(a) Disconnect antenna from terminal at rear of chassis. Turn 100-kc crystal oscillator on and BFO on.

(b) Tune receiver to a 100-kc check point on bands 2 or 3. For example, tune receiver to 2.0 mc.

(c) Line up the knob with the panel mark and with the mid-range point of the BFO PITCH capacitor as follows:

(1) If the BFO PITCH knob has never been off the shaft during the life of the receiver, turn the knob until the knob mark lines up with the panel mark on the receiver and proceed as in paragraph (d)

(2) If the BFO PITCH knob has been off the shaft, set the BFO PITCH capacitor at mid-range as follows: Adjust the core in T106 to produce a beat note. Turn BFO PITCH knob either to the right or to the left of the panel mark until the beat note's pitch rises to a maximum. Leave knob exactly at point of maximum pitch. BFO PITCH capacitor plates are now either all in or all out. Loosen set screw in BFO PITCH knob. Rotate knob on shaft until knob mark is 90° from panel mark. Tighten set screw. Turn knob to mark on panel. BFO PITCH capacitor is now at mid-range.

(d) Tune receiver at least 10 kc off any 0.1 megacycle point on bands 2 or 3 and turn up AUDIO GAIN until a constant pitch beat note is audible. If the constant pitch beat note is not audible, adjust tuning core in top of T106 until it is. Make certain that this is the correct note by turning the KILOCYCLE dial ±10 kc and noting whether the pitch of the beat note remains constant. This constant pitch beat note, which occurs only on bands 2 and 3, is produced by a small amount of fifth harmonic from the 100-kc oscillator that leaks into the i-f strip through the second mixer stage and beats with the signal from the bfo. Because of the superior strength of the calibration beat note in the vicinity of a 100-kc check point, this constant pitch beat note is most audible about halfway between check points.

(e) Adjust tuning core of T106 for zero beat. The bfo frequency is now 500 kc when the BFO PITCH knob is set at the fiducial mark on the panel.

5.3.7. 500 KC I-F PERFORMANCE MEASUREMENTS.

(a) SENSITIVITY. - From the signal generator apply a 500-kc signal between pin 7 of V106 and chassis. (Check calibration of the signal generator as in paragraph 5.3.4.) Connect VTVM from diode load resistor R151 to chassis. The input to pin 7 of V106 at 500 kc should be within the range of 25 to 40 uv for a 4 volt reading at the diode load.

(b) SELECTIVITY.

(1) Adjust the output level of the signal generator for 4 volts at the diode load. Note the signal generator output reading at this setting. This voltage and the 4-volt diode load reading are the reference voltages.

(2) Increase the output level of the signal generator to twice the previously noted voltage (6db increase). Detune signal generator on either side of the initial 500-kc setting until the diode load voltage drops back to the 4-volt reference. The resulting change in input frequency is the measure of selectivity at 6 db down.

(3) Re-set the signal generator frequency to the 500-kc reference and adjust the output level for the 4-volt diode load reading as in step (1), above. Increase the output level of the signal generator 1000 times (60 db increase), and proceed as in step (2) to determine the selectivity at 60 db down.

(4) The overall selectivity specifications are:

a. Minimum selectivity

6 db	5.5 kc min.	6.5 kc max.
60 db	17.0 kc min.	20.0 kc max.

b. Maximum selectivity (crystal filter in)

6 db	0.2 kc min.	0.3 kc max.
60 db	0.2 kc min.	12.0 kc max.

5.3.8. ALIGNMENT OF DIALS WITH VFO.

(a) MEGACYCLE DIAL POINTER. - It is very unlikely that the pointer on the MEGACYCLE dial will become inaccurate through normal use of the receiver. However, if the dial pointer has accidently been slipped with respect to the cord, reset it as follows: Take off escutcheon plate; then rotate KILOCYCLE knob counterclockwise until it hits the mechanical stop. Then rotate it a fraction of a turn clockwise until the zero-zero mark lines up with the fiducial. From this point rotate KILOCYCLE knob exactly five turns clockwise. Grasp the dial cord and slide the MEGACYCLE pointer along it to the center frequency of the band. For example, if the receiver is set at band 2, set pointer exactly at 2.0 mc. Replace escutcheon plate.

(b) KILOCYCLE DIAL. - If the KILOCYCLE dial reading is incorrect, first determine the magnitude and direction of the errors; then correct them according to the procedures outlined below. To determine the nature of the errors, set the receiver on band 2 with the BAND CHANGE knob. Set receiver at 1.5 mc. Set KILOCYCLE fiducial line to center mark on escutcheon opening by turning ZERO ADJ knob. Turn on BFO. Set BFO exactly at 500 kc as in paragraph 5.3.6. Turn on the 100-kc oscillator with CALIBRATE switch. Turn KILOCYCLE knob to zero beat. Note the magnitude and direction of error in the KILOCYCLE dial reading. Set receiver at 2.5 mc. With BFO still set at exactly 500 kc, turn KILOCYCLE knob to zero beat. Again, note magnitude and direction of error in KILOCYCLE dial reading.

(1) If the KILOCYCLE dial reading is incorrect by less than 3 kc in the same direction by the same amount at both ends of the MEGACYCLE dial, correct as follows:

a. Be sure BFO is set at 500 kc as in paragraph 5.3.6.

b. Tune the receiver to zero beat at some 100-kc check point on the band.

c. Set KILOCYCLE fiducial line to zero-zero on the KILOCYCLE dial by turning the ZERO ADJ knob.

(2) If the KILOCYCLE dial reading is incorrect by more than 3 kc in the same direction by the same amount at both ends of the MEGACYCLE dial, correct as follows:

a. Be sure BFO is set at 500 kc as in paragraph 5.3.6.

b. Tune to zero beat at 1.5 mc.

c. Set KILOCYCLE fiducial line to center index mark on escutcheon opening by turning ZERO ADJ knob.

d. Loosen set screws in the circular KILOCYCLE dial and set to zero-zero. Be careful not to turn KILOCYCLE shaft when dial is loose. Tighten set screws.

(3) If the two errors in the KILOCYCLE dial reading are either opposite in direction or different in size, it indicates that the vfo end points have drifted. Correct as follows:

a. Be sure BFO is set at 500 kc as in paragraph 5.3.6. Tune receiver to zero beat at 1.5 mc on band 2.

b. If the zero-zero mark on the KILOCYCLE dial lies within the lines on the escutcheon opening, set KILOCYCLE fiducial line to zero-zero on the KILOCYCLE dial by turning the ZERO ADJ knob.

c. If the zero-zero mark lies outside the lines on the escutcheon opening, loosen set screws in the KILOCYCLE dial. Set fiducial to the center line in the escutcheon opening. Rotate KILOCYCLE dial until zero-zero mark lines up with the fiducial. Tighten set screws.

d. Rotate KILOCYCLE knob approximately ten turns to zero beat. This procedure tunes the receiver to 2.5 mc.

e. Now note the error in the KILOCYCLE dial reading.

f. If this error is less than $\pm$ 3 kc, set the fiducial to 2.5 mc by turning the ZERO ADJ knob. This procedure sets the point of maximum accuracy at 2.5 mc. If maximum accuracy is desired near some other check point in the band, tune the receiver to zero beat at the desired check point. Then adjust fiducial to zero-zero on the KILOCYCLE dial.

g. If this error is more than $\pm$ 3 kc, refer to paragraph 5.3.15. for instructions.

(c) VFO SHAFT. - Check the vfo frequency against a known source to determine whether the vfo shaft has been displaced a full turn, and thereby has shifted

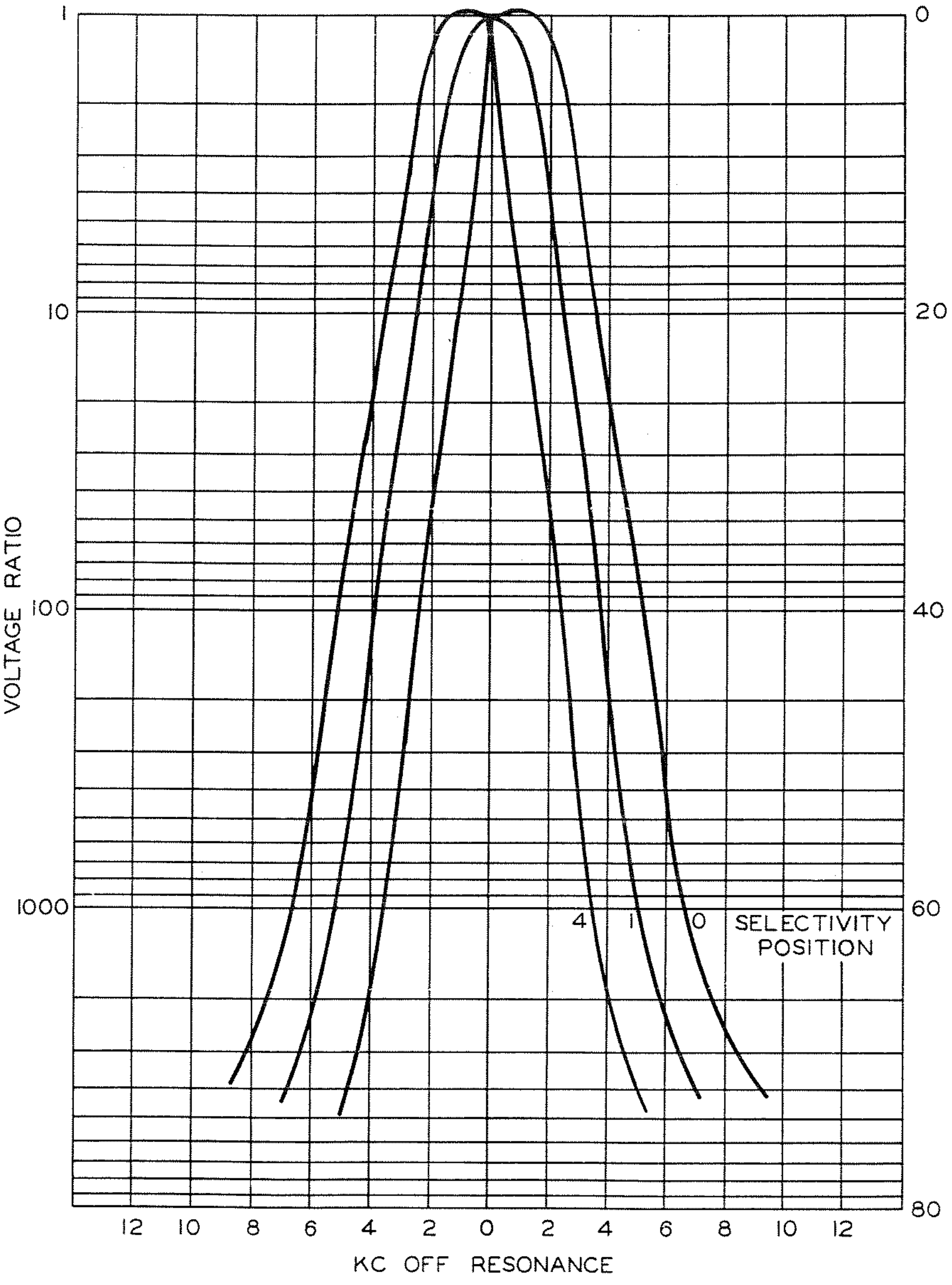


Figure 5-2 Selectivity Curve

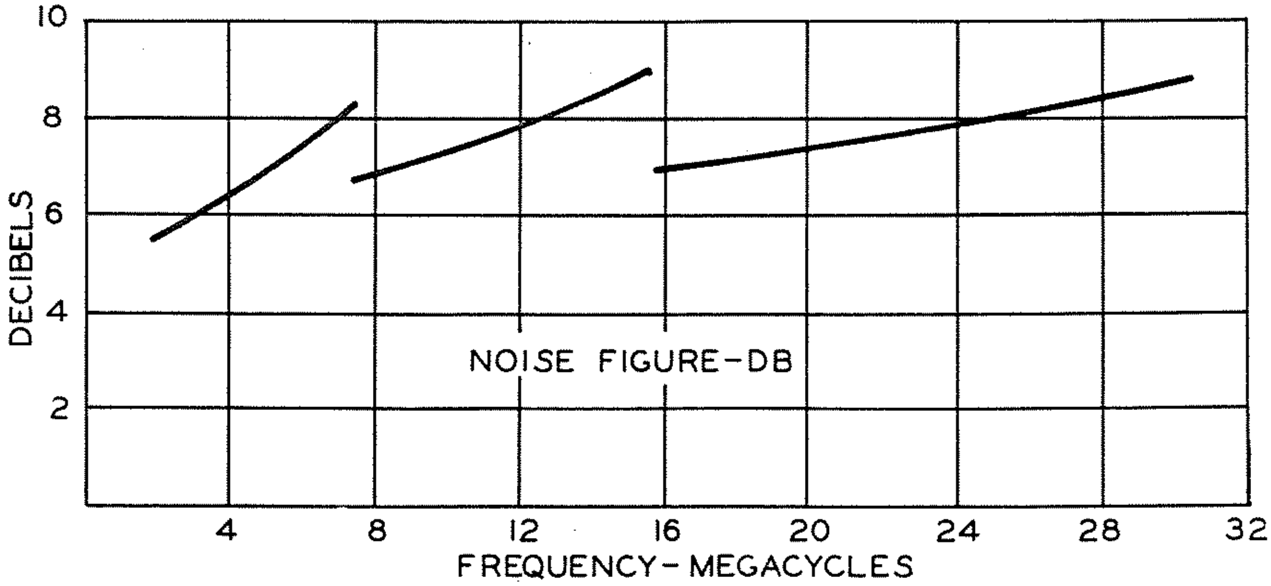


Figure 5-3 Noise Figure Curve

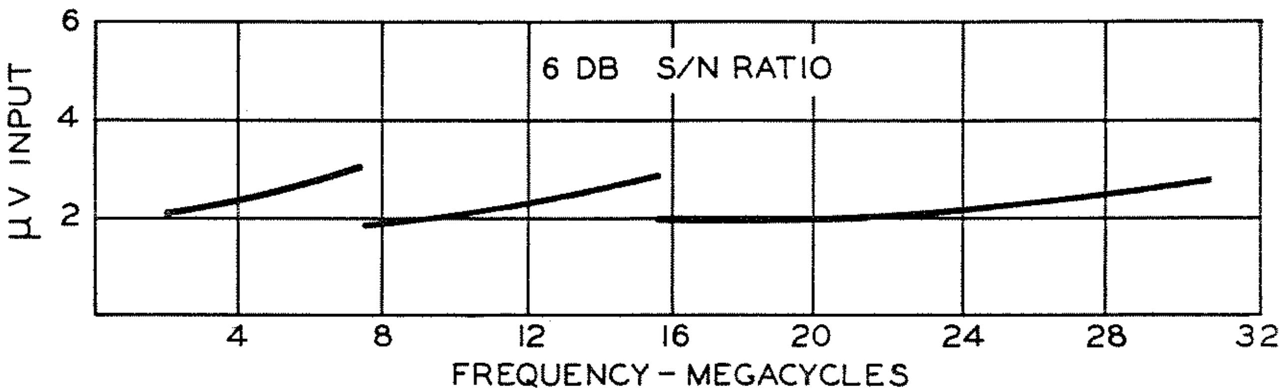


Figure 5-4 Sensitivity Curve

the vfo frequency exactly 100 kc. Using a signal generator having an accuracy of $\pm$ 1 percent or $\pm$ 20 kc or another 51J-2 known to be properly aligned, check as follows.

(1) If a signal generator is used, set the receiver bfo at exactly at 500 kc as in paragraph 5.3.6. Turn the 100-kc oscillator off. Connect the output of the signal generator to pin 7 of V106 with a clip lead. Set generator at 2.0 mc. Tune the receiver to zero beat with the bfo at about 2.0 mc. (The vfo is now set at approximately 2.5 mc.) If the vfo shaft is displaced a full turn, zero beat will occur at approximately 1.9 mc or 2.1 mc instead of 2.0 mc. For exact setting of receiver, remove the signal generator and connect a clip lead from pin 7 of V106 to the 100-kc oscillator output at C173. Turn on the 100-kc oscillator and tune receiver to zero beat with the bfo.

(2) If an accurately aligned 51J-2 (hereafter called the test receiver) is used, couple the antenna jack of the test receiver to the output of the vfo that is being checked. Set the bfo of the test receiver at 500 kc using the 100-kc oscillator in the test receiver as in paragraph 5.3.6. Tune the test receiver dials to 2.5 mc and check this setting by zero beating the bfo with the 100-kc oscillator as in (1), above. Turn test receiver 100-kc oscillator off.

Tune the receiver containing the vfo being checked to where zero beat is observed in the test receiver output. If the shaft of the vfo being checked has been displaced one full turn, zero beat will occur at 1.9 mc or 2.1 mc instead of 2.0 mc.

(3) If steps (1) or (2) reveal that the vfo shaft is displaced a full turn, correct as follows.

a. Note whether zero beat observed in steps (1) or (2) was above or below the 2.0-mc dial position.

b. Loosen the set screws in the vfo coupler. (A Bristo wrench with extended handle is recommended.)

NOTE

The KILOCYCLE dial must be rotated to various positions to provide access to the two coupling set screws. Loosen one screw and turn the shaft to a position where the second screw can be loosened. IMPORTANT--note the dial reading at this point before completely uncoupling the vfo. The 100-kc correction will use this dial setting as reference.

c. Hold the vfo shaft rigid at this position, and set the receiver dials to read 100 kc higher than the reference setting if zero beat occurred at 1.9 mc in steps (1) or (2), or 100 kc lower than the reference setting if zero beat occurred at 2.1 mc.

d. Tighten the coupling set screw which is accessible at this shaft position. Turn the KILOCYCLE dial until the second coupling set screw can be tightened. Tune the receiver dials for zero beat at the 2.0-mc reading.

e. Additional fine adjustment can be made by moving the KILOCYCLE dial on the shaft or by moving the fiducial line on the KILOCYCLE dial opening.

5.3.9. VARIABLE I-F ALIGNMENT AND R-F ALIGNMENT BAND 2.

(a) Connect signal generator in series with a 270 ohm resistor between terminal 2 on the ANTENNA terminal board and the chassis. Jumper terminal 1 to ground on terminal board. Connect VTVM between diode load resistor R151 and chassis. Switch receiver to band 2. Set dial to read 1.6 mc.

(b) Turn bfo on and set to 500 kc as in paragraph 5.3.6. Set signal generator to zero beat at 1.6 mc. Turn bfo off. Adjust output of signal generator to give some value of diode load voltage below 5 volts. Tune slugs marked 1.6 (in L116, L118 and L102) for a maximum indication while adjusting the signal generator to keep diode load voltage below 5 volts.

(c) Set dial to read 2.4 mc. Turn bfo on and set at 500 kc. Set generator to zero beat at 2.4 mc with bfo. Turn off bfo. Tune adjustments marked 2.4 (trimmer capacitors C174, C180 and C104) for a maximum indication, keeping diode load voltage below 5 volts.

(d) Repeat tuning procedures at 1.6 and 2.4 mc until no further increase in output can be obtained.

NOTE

IN THE FOLLOWING R-F ALIGNMENT PROCEDURES KEEP DIODE LOAD VOLTAGE BELOW 5 VOLTS AS IN PARAGRAPH 5.3.9.(b) ABOVE, AND HAVE BFO SET AT EXACTLY 500 KC AS IN PARAGRAPH 5.3.6.

5.3.10. VARIABLE I-F ALIGNMENT AND R-F ALIGNMENT BAND 3.

(a) Connect the signal generator and VTVM as in step 5.3.9.(a). Set band switch to band 3.

(b) Set dial to read 2.6 mc. Turn BFO on. Set signal generator to zero beat at 2.6 mc with bfo. Turn BFO off. Adjust tuning cores marked 2.6 (in L117, L119 and L103) for a maximum indication.

(c) Set dial to read 3.4 mc. Turn BFO on. Set signal generator to zero beat at 3.4 mc with bfo. Turn BFO off. Adjust trimmer capacitors marked 3.4 (C176, C182 and C106) for a maximum indication.

(d) Repeat tuning procedures at 2.6 and 3.4 until no further increase in output can be obtained.

5.3.11. RF ALIGNMENT BANDS 4-7.

(a) Connect signal generator and VTVM as in step 5.3.9.(a). Set bandswitch to band 4.

(b) Set dial to read 4.0 mc. Turn BFO on. Set signal generator to zero beat at 4.0 mc with bfo. Turn BFO off. Adjust tuning cores marked 4.0 (in L104, L107 and L111) for maximum indication.

(c) Set bandswitch to band 7. Set dial to read 7.0 mc. Turn BFO on. Set signal generator to zero beat at 7.0 mc with bfo. Turn BFO off. Turn trimmer capacitors marked 7.0 (C108, C120 and C128) for maximum indication.

(d) Repeat tuning procedures at 4.0 mc and 7.0 mc until no further increase in output can be obtained.

5.3.12. RF ALIGNMENT BANDS 8-15.

(a) Connect signal generator and VTVM as in paragraph 5.8.9.(a).

(b) Set bandswitch to band 8. Set dial to 8.0 mc. Turn BFO on. Set signal generator to zero beat with bfo at 8.0 mc. Turn BFO off. Adjust tuning cores marked 8 (L105, L108, and L112) for maximum indication.

(c) Set bandswitch to band 15. Set dial to read 15.0 mc. Turn BFO on. Set signal generator to zero beat with bfo at 15.0 mc. Turn BFO off. Tune trimmer capacitors marked 15 (C110, C122 and C130) for maximum indication.

(d) Repeat tuning procedures at 8.0 mc and 15.0 mc until no further increase in output can be obtained.

5.3.13. RF ALIGNMENT BANDS 16-30.

(a) Connect signal generator and VTVM as in step 5.3.9.(a).

(b) Set bandswitch to band 16. Set dial to 16.0 mc. Turn BFO on. Set signal generator to zero beat with bfo at 16.0 mc. Turn BFO off. Adjust tuning cores marked 16 (in L106, L109 and L113) for a maximum indication.

(c) Set bandswitch to band 30. Set dial to 30.0 mc. Turn BFO on. Set signal generator to zero beat with bfo at 30.0 mc. Turn BFO off. Adjust trimmer capacitors marked 30.0 (C112, C124, and C132) for a maximum indication.

(d) Repeat tuning procedures at 16.0 and 30.0 mc until no further increase in output can be obtained.

5.3.14. RF ALIGNMENT BAND 1.

(a) Connect signal generator and VTVM as in step 5.3.9.(a).

(b) Set bandswitch to band 1. Set dial to 0.6 mc. Turn BFO on. Set generator to zero beat with bfo at 0.6 mc. Turn BFO off. Adjust core in L114 so that it is in approximately the same position in the inductor as are the cores in L116 and L118. Adjust cores marked 0.6 (in L101 and L110) for a maximum indication. Adjust trimmer capacitor marked 0.6 (C140) for a maximum indication.

NOTE

TWO PEAKS MAY BE FOUND WHEN TUNING C140. USE THE PEAK THAT REQUIRES THE HIGHER VALUE OF CAPACITANCE. Refer to C140 in figure 5-1.

(c) Set dial to 1.4 mc. Turn BFO on. Set signal generator to zero beat with bfo at 1.4 mc. Turn BFO off. Tune trimmers marked 1.4 (C102 and C119) for a maximum indication. Adjust core marked 1.4 (in L115) for a maximum indication.

(d) Repeat tuning procedures at 0.6 and 1.4 mc until no further increase in output can be obtained.

5.3.15. VFO ALIGNMENT.

(a) GENERAL. - During manufacture of the vfo the frequency-determining elements are hermetically sealed within the outer cylindrical cover while they are being held at a high temperature. This drives out practically all moisture and creates a partial vacuum within the sealed compartment. Because of the method of fabrication and the efficiency of design, it is quite unlikely that the vfo will become misaligned through normal use of treatment. However, if it does become noticeably misaligned, as indicated by the procedure outlined in paragraph 5.3.8.(b)(3), it must be returned to the factory for permanent alignment. Because alignment procedure involves breaking of the hermetic seal by removal of a small plug, the future stability of the vfo will be seriously impaired if conditions under which it was manufactured are not duplicated during alignment. Therefore, it is possible to align the vfo only temporarily without sending it back to the factory. If the vfo is to be sent back to the factory refer to paragraph 5.4. for instructions on removal and replacement. This temporary alignment can be performed by a qualified and properly equipped service technician, but should be attempted only in case of emergency. All components not contained within the sealed cover can be maintained in the field.

WARNING

DO NOT, UNDER ANY CIRCUMSTANCES, ATTEMPT TO REMOVE THE OUTER CYLINDRICAL COVER. THIS NOT ONLY BREAKS THE HERMETIC SEAL BUT EXPOSES THE FREQUENCY CORRECTOR MECHANISM AND THE CAREFULLY COMPENSATED FREQUENCY-DETERMINING ELEMENTS.

(b) PROCEDURE.

(1) Before aligning the vfo be sure that the bfo is set at 500 kc as in paragraph 5.3.6. that the 500 kc i-f channel is aligned and that the 100-kc oscillator is turned off.

(2) Use a signal generator having an output of 1.5 mc with better than ±25 kc accuracy.

(3) Turn on the receiver and short the antenna terminal to chassis.

(4) Couple the 1.5-mc output from the signal generator to pin 1 of V106.

(5) Find the low frequency endpoint (2.0 mc) of the vfo by turning the KILOCYCLE tuning knob <u>clockwise</u> to the last zero beat obtainable in that direction.

CAUTION

DO NOT FORCE THE VFO SHAFT BY ATTEMPTING TO TURN IT FARTHER WHEN IT REACHES THE STOP AT EITHER END OF THE RANGE.

(6) The vfo setting is now within 20 kc of 2.0 mc and must be adjusted more accurately as follows. Uncouple signal generator from pin 1 of V106. Connect a clip lead from the 100-kc oscillator at C173 to pin 1 of V106. Turn the 100-kc oscillator on. Carefully adjust the KILOCYCLE dial to the nearest zero beat. Vfo setting is now exactly 2.0 mc. Note the reading on the KILOCYCLE dial at this setting.

(7) Rotate the KILOCYCLE dial exactly 10 turns in a <u>counterclockwise</u> direction from the above KILOCYCLE dial reading. Find zero beat by turning the KILOCYCLE dial a few divisions toward either side of the 10-turn mark.

(8) If zero beat occurs on either side of the 10-turn mark, note the magnitude and direction of error by counting divisions between the actual zero beat reading and the reading where it should have appeared. Multiply the number of error divisions by three.

(9) If zero beat occurs at less than 10 turns, rotate the KILOCYCLE dial <u>counterclockwise</u> by the number of divisions arrived at in step (8) (3 times the error divisions).

(10) If zero beat occurs at more than 10 turns, rotate the KILOCYCLE dial <u>clockwise</u> by the number of divisions arrived at in step (8) (3 times the error divisions).

(11) Remove the clip plug in the top of the vfo container (See figure 5-1 for location) to gain access to the variable capacitor. Adjust this capacitor until zero beat is again reached.

(12) The high and low end (2.0 and 3.0 mc) zero beat positions should now be exactly ten turns apart. If this is not the case, repeat the above procedure until they are, remembering that a new reference point at the full clockwise end of the KILOCYCLE dial will likely be necessary each time the procedure is repeated. Be careful not to lose the endpoints by counting incorrectly or forgetting the count. If endpoints are lost, turn off the 100-kc oscillator and start the procedure over at step (4).

(13) EXAMPLES. - The following examples illustrate the procedure outlined in paragraph (5) above.

NOTE

DO NOT ATTEMPT TO FOLLOW THESE EXAMPLES AS INSTRUCTIONS. THEY ARE PURELY HYPOTHETICAL AND ARE INCLUDED FOR ILLUSTRATIVE PURPOSES ONLY.

a. (Example) Turn KILOCYCLE dial clockwise to the low frequency endpoint (2.0 mc) of the vfo. Note dial reading at this point. Rotate the KILOCYCLE dial exactly 10 turns counterclockwise to the same KILOCYCLE dial reading. A beat note is audible at this setting. Find zero beat by turning the KILOCYCLE dial 4 divisions clockwise. This indicates that the endpoints are 4 divisions less than 10 turns apart. Multiply the 4 error divisions by 3 to arrive at 12. Rotate the KILOCYCLE dial counterclockwise by twelve divisions since zero beat occurs at less than 10 turns. Adjust trimmer capacitor to zero beat at this position. Rotate the KILOCYCLE dial exactly 10 turns clockwise to check whether the endpoints are now exactly 10 turns apart. If they are not, repeat procedure in paragraph (b) until they are.

b. (Example) Turn KILOCYCLE dial clockwise to the low frequency endpoint (2.0 mc) of the vfo. Note dial reading at this point. Rotate the KILOCYCLE dial exactly 10 turns counterclockwise to the same KILOCYCLE dial reading. A beat note is audible at this setting. Find zero beat by turning the KILOCYCLE dial 3 divisions counterclockwise. This indicates that the endpoints are 3 divisions more than 10 turns apart. Multiply the 3 error divisions by 3 to arrive at 9. Rotate the KILOCYCLE dial clockwise by 9 divisions since zero beat occurs at more than 10 turns. Adjust trimmer capacitor to zero beat at this position. Rotate KILOCYCLE dial exactly 10 turns clockwise to check whether the endpoints are now exactly 10 turns apart. If they are not, repeat procedure in paragraph (b) until they are.

(c) After separating the 2.0 and 3.0 mc endpoints of the vfo exactly 10 turns, replace the clip plug on the oscillator container. If the receiver dials do not exactly read 1.5 and 2.5 mc at the beat notes after the above procedure, correct the KILOCYCLE dial setting by adjustment of the fiducial line or by turning the KILOCYCLE dial with respect to the vfo shaft. It is not necessary to readjust the r-f and i-f amplifiers for small changes in the vfo adjustment.

5.3.16. ADJUSTMENT OF L-124. - Reach L-124 from the bottom of the chassis. Adjust as follows:

(a) Turn BFO ON and tune in the spurious signal at 1250 kc.

(b) Adjust L-124 for the greatest attenuation of the spurious signal.

5.4. COMPLETE VFO REMOVAL AND REPLACEMENT.

(a) REMOVAL. - If the vfo has to be completely removed from the receiver for servicing, proceed as follows.

(1) Remove the front panel and allow it to swing forward on the wires. (See paragraph 5.6.2. for detailed instructions on removing the front panel.)

(2) Loosen set screws on the vfo coupler. Pull coupler apart and remove the center disc.

(3) Remove the three screws that hold the vfo to the gear mounting plate. The upper right screw, as viewed from front of plate, is accessible throu a hole in gear by turning the KILOCYCLE shaft to align the hole over the screw.

(4) Slide the vfo back and tip the rear downward.

(5) Remove the connector plug and pull vfo from the receiver.

(b) REPLACEMENT. - To replace a vfo in the receiver, reverse the above procedure. Replace the front panel and knobs; reassemble the vfo coupler, but do not tighten set screws in the vfo coupler. The procedure used in aligning the vfo with the receiver tuning dials is as follows.

(1) Carefully turn the oscillator shaft in a <u>clockwise</u> direction until the stop in the oscillator is reached. (DO NOT FORCE THE SHAFT BEYOND THIS STOP.) Back off one turn.

(2) Set the receiver dials at 1.5 mc (low end of band 2).

(3) Tighten the set screws in the vfo coupler.

(4) Proceed as in 5.3.8.(c) (VFO SHAFT). The procedure outlined in 5.3.8.(c) implies correct KILOCYCLE dial readings but a full turn (100 kc) error. However, this procedure is applicable to correction of any errors between the dial readings and the vfo shaft position. An example of this follows.

a. Suppose in 5.3.8.(c)(1 or 2), zero beat occurs at a reading of 2.1 on the MEGACYCLE dial and 53 on the KILOCYCLE dial rather than at 2.0 and 0-0 (0.153 mc high). At this setting the vfo shaft set screws are not accessible for loosening. Turn the KILOCYCLE dial until the screws can be reached. At the position where the second screw is loosened, the dial readings are 2.0 and 22 (2.022 mc). Since a correction of minus 0.153 mc was indicated by the zero beat dial readings, hold the vfo shaft stationary and turn the KILOCYCLE dial until the reading is 2.022 mc minus 0.153 mc or 1.869 mc. This is represented by readings of 1.8 on the MEGACYCLE dial and 69 on the KILOCYCLE dial.

Tighten one vfo coupling screw without moving the vfo shaft, and turn the shaft to a position where the second screw is accessible for tightening. Then turn the dials to a 2.0 reading and listen for a zero beat at or very near this point. Make fine corrections by adjusting the KILOCYCLE dial position on the shaft or by moving the fiducial line.

5.5. DIAL BULB REPLACEMENT. - Lights for the slide rule dial are mounted in sockets that are clipped to the metal structure above the dial. To replace light bulbs slide the clips off the metal structure and pull out the sockets. Press down on the bulb slightly and turn it a fraction of a turn counterclockwise. When replacing the sockets, press the wires up into the channel. Remove the KILOCYCLE dial light, also mounted in a clip type socket, by reaching under the drum of the MEGACYCLE dial and grasping the frame of the dial light socket. Press lightly on the sides of the frame to release it from the receiver structure, and then pull it back far enough to replace the bulb.

5.6. DIAL AND BAND CHANGE GEAR MAINTENANCE.

5.6.1. GENERAL. - The replacing and synchronizing of gears in the dial and band change mechanism of this receiver can be a difficult job. It is recommended that the unit be sent to the factory for servicing should any major repairs be required.

WARNING

IF DISASSEMBLY OF THE GEAR UNIT IS CONTEMPLATED, INSTRUCTIONS IN PARAGRAPHS 5.6.2 AND 5.6.3. MUST BE FOLLOWED CLOSELY OR IT WILL BE IMPOSSIBLE TO SYNCHRONIZE THE GEARS UPON REASSEMBLY.

5.6.2. DISASSEMBLY OF GEAR BOX.

(a) If the gear box is to be returned to the factory for servicing, proceed as follows.

(1) Set the receiver on its back. Remove the following knobs: SELECTIVITY, PHASING, BFO PITCH, BAND CHANGE, KILOCYCLE tuning, ZERO ADJ and ANT TRIM. Remove the collar, tension washer and flat washer from the KILOCYCLE shaft. Remove the screws that fasten the front panel to the chassis. Lift the panel off and allow it to hang to one side on the cable wires.

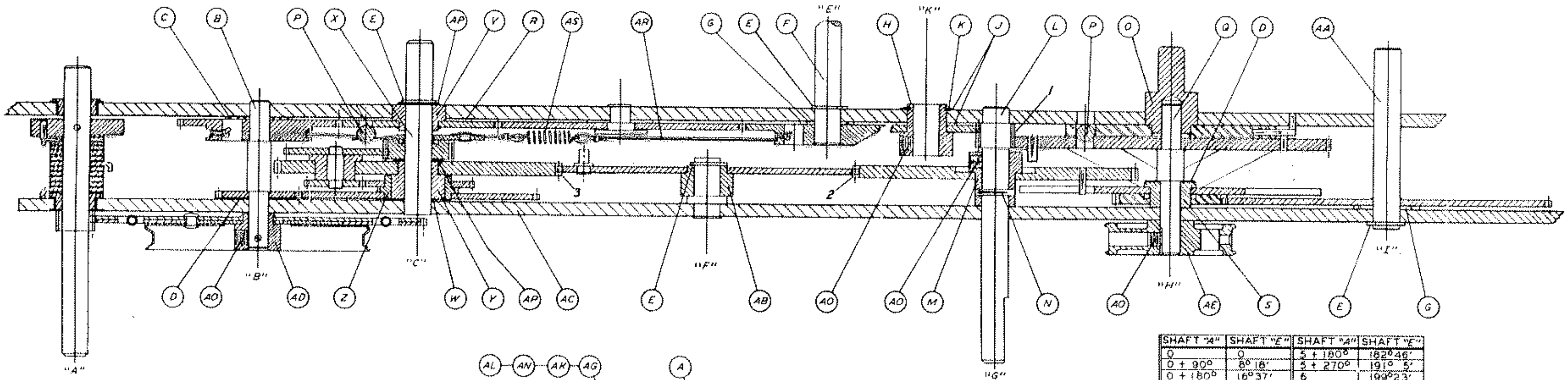
(2) Remove the right-hand end bracket from the chassis.

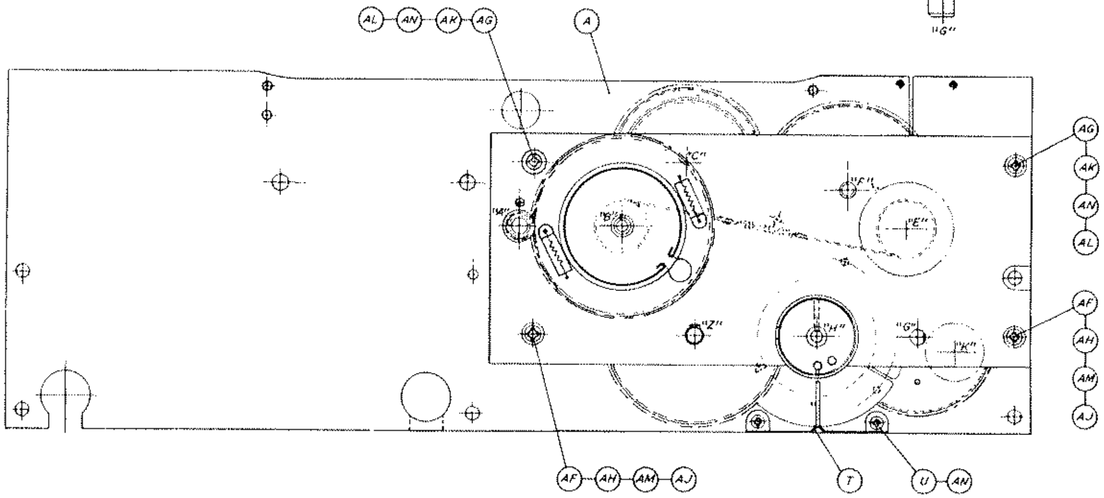
(3) Loosen set screws in the following couplers: vfo, r-f slug rack and i-f slug rack shafts, all accessible from the top of the receiver, and two band change shafts, accessible from the bottom.

(4) Remove the vfo mounting screws and the gear box mounting screws.

(5) Lift the gear box from the receiver.

ITEM NO.	QUANTITY	PART NO.	PART NAME
A	1	504 3142 003	BACK GEAR PANEL ASSY
B	1	504 3111 002	REV. GEARS & SHAFT ASSY
C	1	504 2973 001	WASHER
D	2	500 2112 002	WASHER
E	4	340 0025 00	RETAINING RING
F	1	504 3014 001	I.F. DRIVER GEAR & SHAFT ASSY
G	2	500 1081 003	WASHER
H	1	504 3004 001	GEAR ASSY - SWITCH, I.F.
J	2	500 1109 003	WASHER
K	1	340 0013 00	RETAINING RING
L	1	504 2956 001	MC KNOB SHAFT
M	1	504 3013 001	KNOB GEAR & HUB ASSY
N	1	311 1122 30	GROOVE PIN
O	1	504 3006 001	SHAFT ASSY - BAND SWITCH
P	2	309 5200 00	BALL - 3/16 DIA
Q	1	504 3012 001	SHAFT ASSY - GENEVA WHEEL
R	1	504 2972 001	THRUST BEARING
S	1	504 3015 001	HUB ASSY - GENEVA WHEEL
T	1	504 2932 001	CENTERING SPRING
U	2	343 0165 00	6-32 X 1/8 PBH SCREW
V	1	504 3018 001	HUB ASSY - DETENT GEAR
W	1	504 2974 001	WASHER
X	1	504 3025 001	DETENT SPRING ASSY
Y	1	504 3020 001	CENTER PLANET-GEAR & HUB ASSY
Z	1	504 3016 001	HUB ASSY - FLOATING
AA	1	504 3005 001	SHAFT & GEAR ASSY
AB	1	504 3009 001	STOP IDLER GEAR HUB ASSY
AC	1	504 3141 003	FRONT GEAR PANEL ASSY
AD	1	504 3024 001	POINTER PULLEY ASSY
AE	1	504 2954 001	PULLEY - DRUM
AF	2	504 2960 001	STANDOFF - LOWER
AG	2	504 2991 001	STANDOFF - UPPER
AH	4	343 0186 00	8-32 X 5/16 SCREW
AJ	4	310 6380 00	WASHER #8 FLAT
AK	4	343 0167 00	6-32 X 1/4 SCREW
AL	4	310 6360 00	WASHER #6 FLAT
AM	4	373 0003 00	WASHER #8 SHAKE
AN	6	373 0001 00	WASHER #6 SHAKE
AO	6	328 0002 00	6-40 X 1/8 SET SCREW
AP	4	500 1112 003	WASHER
AR	1	432 1009 00	LOADING CORD FT
AS	1	502 1158 002	SPRING

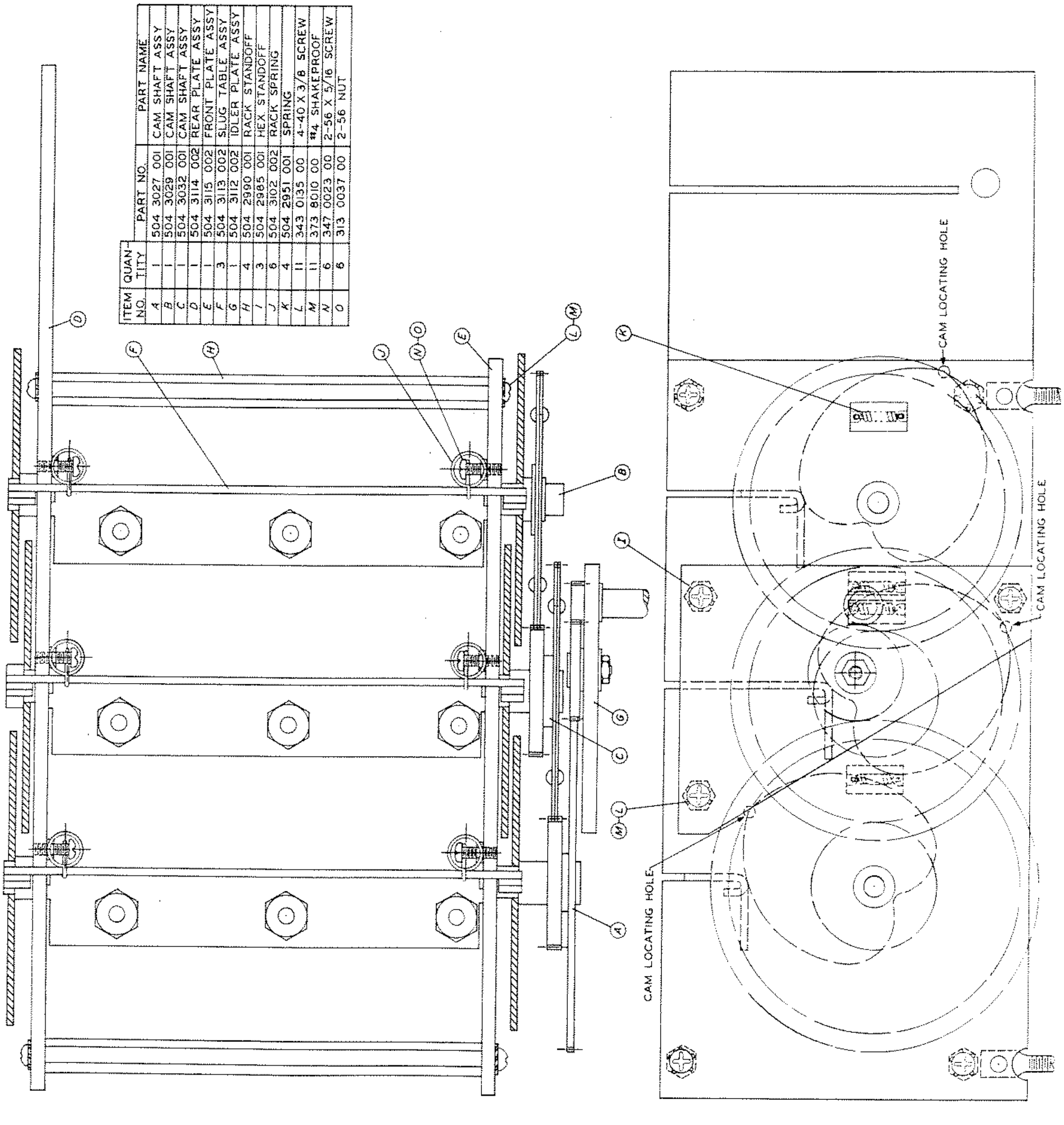




SHAFT "A"	SHAFT "E"	SHAFT "A"	SHAFT "E"
0	0	5 + 180°	182°46′
0 + 90°	8° 18′	5 + 270°	191° 5′
0 + 180°	16°37′	6	199°23′
0 + 270°	24°55′	6 + 90°	207°42′
1	33°14′	6 + 180°	216°
1 + 90°	41°32′	6 + 270°	224° 18′
1 + 180°	49°51′	7	232°37′
1 + 270°	58° 9′	7 + 90°	240°55′
2	66°28′	7 + 180°	249° 14′
2 + 90°	74°46′	7 + 270°	257°32′
2 + 180°	83° 5′	8	265°51′
2 + 270°	91°23′	8 + 90°	274° 9′
3	99°42′	8 + 180°	282°28′
3 + 90°	108°	8 + 270°	290°46′
3 + 180°	116°18′	9	299° 5′
3 + 270°	124°37′	9 + 90°	307°23′
4	132°55′	9 + 180°	315°42′
4 + 90°	141° 14′	9 + 270°	324°
4 + 180°	149°32′	10	332°18′
4 + 270°	157°51′	10 + 90°	340°37′
5	166° 9′	10 + 180°	348°55′
5 + 90°	174° 28′	10 + 270°	357° 14′

POSITION OF SHAFT "A" GIVEN IN NO. OF TURNS PLUS DEGREES FROM CCW STOP. SHAFT "E" MUST POSITION WITHIN 27′ OF ITS SPECIFIED FIGURE FOR EACH INCREMENT OF ROTATION ON SHAFT "A". SETTINGS ON "A" (EXCEPT END POSITIONS) TO BE APPROACHED IN BOTH CW & CCW DIRECTIONS.

Figure 5-5 Dial and Bandswitch Gear Box



ITEM NO.	QUANTITY	PART NO.	PART NAME
A	1	504 3027 001	CAM SHAFT ASSY
B	1	504 3029 001	CAM SHAFT ASSY
C	1	504 3032 001	CAM SHAFT ASSY
D	1	504 3114 002	REAR PLATE ASSY
E	1	504 3115 002	FRONT PLATE ASSY
F	3	504 3113 002	SLUG TABLE ASSY
G	1	504 3112 002	IDLER PLATE ASSY
H	4	504 2990 001	RACK STANDOFF
I	3	504 2985 001	HEX STANDOFF
J	6	504 3102 002	RACK SPRING
K	4	504 2951 001	SPRING
L	11	343 0135 00	4-40 X 3/8 SCREW
M	11	373 8010 00	#4 SHAKEPROOF
N	6	347 0023 00	2-56 X 5/16 SCREW
O	6	313 0037 00	2-56 NUT

Figure 5-6 R-F Slug Rack Drawing

(b) If repairs are to be made in the field, the gear box may either be removed from the receiver or left in, depending on the extent of repairs. If the box is to be removed, turn the MEGACYCLE knob to its clockwise stop and the KILOCYCLE knob to its counterclockwise stop, and follow the instructions in paragraph 5.6.2.(a); then proceed according to the following steps. If the box is to be left in the receiver, perform steps (1) and (2) under paragraph 5.6.2.(a); then proceed according to the following steps. Refer to figures 4-2 and 5-5 for location of gears and shafts.

(1) Turn shaft G (BAND CHANGE) clockwise to the stop below band 1. Turn shaft A counterclockwise to the stop.

(2) Scribe a mark across the 85-tooth spider gear that carries the planetary gears, and across the 90-tooth stop-pin gear, using the top of the front gear panel as a guide.

(3) Scribe a radial mark, precisely under the Geneva wheel spring detent, on the 144-tooth gear that has two stop pins attached.

(4) Using the circumference of the Geneva wheel as a guide, scribe a mark on the 85-tooth gear that drives the Geneva wheel.

(5) Scribe a mark through the edge of the small dial cord pulley and the front gear panel.

(6) Remove pin from hub of large dial cord pulley.

(7) Remove large dial cord pulley and gear.

(8) Remove small dial cord pulley.

(9) Remove retaining ring from shaft I (shown as shaft Z in the front view of gear plate in figure 5-5).

(10) Using a pair of right angle TRUARC pliers or two bent (right angle) scribes, remove retaining ring from shaft F.

(11) Measure and record the length of loading spring, using a pair of dividers.

(12) Remove four mounting screws from front gear panel.

(13) Remove front gear panel, being careful not to let shafts ride up with plate. <u>While removing this panel, do not allow gears to unmesh or rotate.</u>

(14) Keep shim washers with respective gears or shafts.

(15) Before moving or disengaging any gears other than the 90-tooth gear on shaft F, scribe a line through detent spring, 48-tooth detent gear, and rear gear panel, and another line through the 52-tooth gear on shaft E and rear gear panel.

(16) Mark all gears being removed in such a manner that they may be identified later for reassembly.

(17) If the overtravel coupler is removed, note that the disc and gear are detented. Do note lose detent ball.

(18) Make all necessary repairs. If any parts that have been scribed are to be replaced, be sure to scribe the new parts in exactly the same manner as the old before placing them in the equipment. If the loading cord is to be replaced, form a small loop at one end of each of the two pieces to provide anchors for the spring. Push free ends of the cords through the proper pulley-holes. Knot the free ends after allowing for five-inch lengths of cord between the loops and knots. Coat the knots with Duco cement.

5.6.3. REASSEMBLY OF GEAR BOX. - The following procedure assumes that all gears have been removed, that all repairs have been made, and that the gear and shaft assemblies have been reassembled after repairs were made.

(a) Use AN-G-25 grease on all bearing surfaces during assembly.

(b) If the 74-tooth idler gear whose shaft is riveted to the rear gear panel was removed, replace it first.

(c) Replace 48-tooth gear and shaft K assembly and shim washers, item J. Replace retaining ring.

(d) Replace 52-tooth gear and shaft E assembly and washer, item G. Line up scribe marks on gear and rear plate. Replace retaining ring.

(e) Replace 48-tooth detent gear, shaft C, detent, and 16-tooth gear assembly. Line up marks on rear panel, 48-tooth gear, and detent spring.

(f) Replace 85-tooth spider gear, 45-tooth, and 25-tooth planetary gear assembly, and shim washer, item AP, on shaft C. Do not move other gears already lined up with the scribe marks.

(g) Replace 48-tooth gear, shaft B, 24-tooth gear assembly, and washers, items C and D, as follows:

Wind the loading cord about 1-1/2 turns clockwise on the pulley that is attached to the 52-tooth gear on shaft E. Do not move gears while doing this. Hook spring onto both halves of the loading cord. Insert shaft B into hole on rear plate, but do not yet engage the 48-tooth gear with the detent gear. While holding the 52-tooth gear and shaft E assembly and the detent gear at their respective scribe marks, rotate shaft B counterclockwise until loading spring stretches to the length measured before disassembly. Engage 48-tooth gear with detent gear while maintaining tension on the loading spring.

(h) Replace the 72-tooth gear and 50-tooth sun gear assembly and shim washer, item W, while holding 85-tooth spider gear so that the scribe mark on it is horizontal (parallel with the top and bottom edges of the gear panels). Keep all other gears set at the scribe marks.

(i) Reassemble overtravel disc with the 144-tooth overtravel gear. Detent the two together with detent ball. Use AN-G-25 grease to hold ball in place.

(j) Replace overtravel assembly, lining up mark on overtravel gear with notch on Geneva detent spring.

(k) Replace 85-tooth gear, shaft G, and 16-tooth gear assembly, lining up arcuate scribe mark with circumference of overtravel gear. (This mark will later line up with the Geneva wheel, but at present it is concentric with the overtravel gear. Make sure that alignment described in step (h) is maintained.

(l) Replace Geneva wheel and 33-tooth gear assembly and shim washer, item D. Be sure Geneva drive pin is engaged with slot in the Geneva wheel while the Geneva wheel detent is engaged, and that the arcuate scribe mark on the 85-tooth drive gear lines up with the circumference of the Geneva wheel.

(m) Replace 99-tooth gear and shaft I assembly, and washer, item G. Position is not critical.

(n) Lay the 90-tooth stop-pin gear in position with the scribe mark horizontal across the top, and collinear with scribe mark on the 85-tooth spider gear (parallel to the top and bottom edges of the gear panels).

(o) Replace front gear panel as follows: While sliding the panel into position, slide the 90-tooth stop-pin gear on its shaft which is attached to the front panel, being careful to keep scribe mark lined up with the mark on the 85-tooth spider gear. Also keep arcuate mark on the 85-tooth Geneva drive gear lined up with the circumference of the Geneva wheel. Further, keep the mark on the 144-tooth overtravel coupler gear lined up with notch in the Geneva wheel detent. Replace screws in front gear panel.

(p) Check operation of the BAND CHANGE gear. If the gear box has been removed from the receiver, make the check while holding the gear box in a horizontal plane with the front gear panel facing down, so that the 90-tooth stop pin gear will not fall off during the check. If the gear box has not been removed from the receiver, replace the retaining ring on the 90-tooth stop-pin gear shaft before making the check. In either case, proceed as follows:

(1) Shaft G should now be against the clockwise stop, and should detent when turned counterclockwise approximately 45°. The ball on shaft C will now detent shaft G every 180°.

(2) When shaft G is turned counterclockwise 7-1/2 revolutions, or 15 detent positions from the first detent position, the pin in the 144-tooth gear

on shaft H (figure 5-5), and the radial pin on the overtravel disc rotate clockwise until the radial pin just touches or is about to touch the pin in the rear gear panel. Further rotation of shaft G causes the pin in the gear to leave the radial pin that was stopped by the pin in the rear gear panel. Thus the overtravel coupler output shaft, which drives r-f band switches S101 through S106 (figure 4-2), rotates 300° for the first 16 detent positions of shaft G and remains at that setting for further counterclockwise rotation of shaft G.

(3) Shaft G should rotate 14 more detent positions or 7 revolutions from the sixteenth detent position, and should hit the counterclockwise stop approximately 45° past the thirtieth detent position. If the stop pins intersect before this, adjust them by changing phase relations of the gears at points 1, 2, and 3, shown in figure 5-5. Before deciding to change the relative positions of these gears, double check the conditions in steps (1), (2) and (3). If instructions in paragraphs 5.6.2. and 5.6.3. were followed precisely, operation of the BAND CHANGE gear train should meet the conditions set forth in these steps.

(4) The Geneva wheel should turn one notch when shaft G turns counterclockwise from an even-numbered to an odd-numbered detent position. (Count the first detent position from the clockwise stop as number 1.) Thus shaft I should rotate through 14 positions, or 280°, for 30 detent positions, or 14-1/2 turns, of shaft G. The initial position of shaft I should correspond to detent positions 1 and 2 of shaft G, the second shaft I position should correspond to detent positions 3 and 4 of shaft G, and so on through to the thirtieth detent position of shaft G.

(q) After accomplishing proper operation of the BAND CHANGE gear train, replace the retaining ring on the 90-tooth stop-pin gear shaft.

(r) Replace large dial cord pulley and gear assembly as follows: Turn shaft A to counterclockwise stop. Make sure that the 52-tooth gear on shaft E and the 48-tooth detent gear on shaft C are still set at their respective scribe marks. Place pulley and gear assembly far enough on shaft B to engage the rear section of the split gear with the 15-tooth gear on shaft A. Be sure that groove-pin holes in shaft and hub are lined up and that the pulley slot is within 45° of the position shown in figure 5-5. Rotate front section of split gear so that springs stretch to 3/4 of an inch. Engage front section with 15-tooth gear on shaft A. Replace groove pin and tighten set screw.

(s) Check operation of loading cord by turning shaft A clockwise. Be sure that the loading spring travels from the drum on shaft E to the same relative position at the drum on shaft B when shaft A hits the clockwise stop. The loading spring should not touch either drum at either end of its travel.

(t) Replace small dial cord pulley. Line up with scribe mark and tighten set screw.

(u) Rotate shaft A to its counterclockwise stop, and shaft G to its clockwise stop; then replace the gear box in the receiver. Reconnect couplers; then replace dial cords, front panel and right-hand end bracket. Replace flat washer, tension washer and collar on KILOCYCLE shaft. Push collar against tension washer until tension washer is almost flat; then tighten set screws. Replace knobs.

5.7. R-F TUNER ASSEMBLY MAINTENANCE.

5.7.1. GENERAL. - The r-f tuner assembly will require very little maintenance. However, should it be taken apart for any reason, the following information will indicate the correct positions of the cams.

5.7.2. POSITIONS OF CAMS. - The front plate of the slug rack assembly contains three alignment holes as indicated in figure 5-6. If the cams are correctly synchronized, the tips of the front cams will be directly opposite these holes. Use a dental mirror to accurately inspect the position of the cam tips in relation to the alignment holes. If a dental mirror is not available, check positions and operation of the cams in the following manner.

(a) Turn BAND CHANGE knob to band 30. Turn KILOCYCLE knob clockwise to stop.

(b) Viewing the right-hand slug-moving cam from the front, the slug table cam rider should be approximately 1/16 of an inch to the right of the cam tip. The cam rider should descend this same right-hand edge when step (c) is performed.

(c) Turn BAND CHANGE knob to band 16. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (b), and not bottomed in the low spot of the cam.

(d) Turn BAND CHANGE knob to band 15. Turn KILOCYCLE knob clockwise to stop.

(e) Viewing the center cam from the front, the cam rider should be approximately 1/32 of an inch to the left of the cam tip. The cam rider should descend this same left-hand edge when step (f) is performed.

(f) Turn BAND CHANGE knob to band 8. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (e) and not bottomed in the low spot of the cam.

(g) Turn BAND CHANGE knob to band 7. Turn KILOCYCLE knob clockwise to stop.

(h) Viewing the left-hand cam from the front, the cam rider should be approximately 1/32 of an inch to the right of the cam tip. The cam rider should descend this same right-hand edge when step (i) is performed.

(i) Turn BAND CHANGE knob to band 4. Turn KILOCYCLE knob counterclockwise to stop. The cam rider should still be on the same side of the cam as in step (h) and not bottomed in the low spot of the cam.

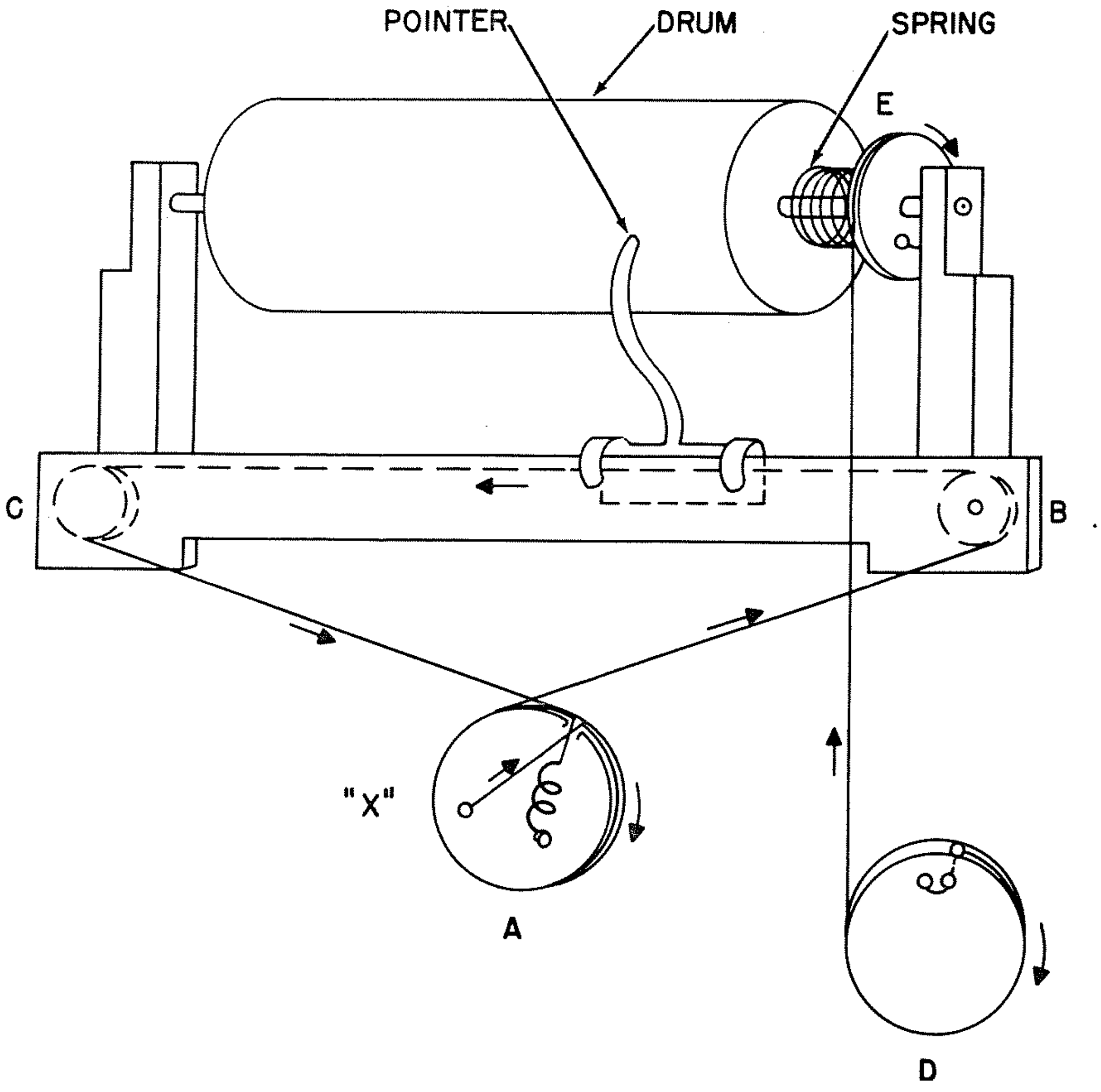


Figure 5-7. 51J-2 Dial Cord Arrangement

(j) Before putting the receiver into operation again, investigate the electrical alignment of the stages affected by any repair operations, and the synchronization of the slug rack with the BAND CHANGE mechanism.

5.8. DIAL CORDS.

5.8.1. MEGACYCLE POINTER CORD. - Refer to figure 5-7. Remove the front panel according to directions in paragraph 5.6.2. If the cord is to be replaced, use 36-5/8 inches of Collins number 432 1009 00 nylon-covered cord.

(a) Turn kilocycle control shaft counterclockwise to stop.

(b) Tie a loop in the cord. Loop the cord over the tab at point X in figure 5-7.

(c) Wind cord about one-half turn clockwise on pulley A, continue to pulley B, pointer, pulley C, and back to pulley A.

(d) Wind cord about 1-1/2 turns clockwise around pulley A. Fasten cord to the spring on pulley A with spring at full tension.

(e) Replace front panel, kilocycle control shaft flat washer, tension washer, collar, and knobs.

5.8.2. DRUM CORD. - If the drum cord has jumped the pulleys, restring it without removing the front panel. If the cord is broken, remove the front panel as in paragraph 5.6.2. Use 27 inches of Collins 432 1009 00 nylon-covered cord for replacement.

(a) Turn BAND CHANGE knob to band 30.

(b) Turn pulley E, figure 5-7, about one-half turn and hold tension of spring.

(c) Insert cord in pulley D and knot it. Wind cord about three-quarters of a turn on pulley D; extend to pulley E, and wind it one and one-half turns or more around pulley E as needed. Insert cord in hole and knot it.

(d) Replace panel and knobs.

(e) Loosen set screw in drum hub and turn drum until 30-mc band is centered in the escutcheon opening; then tighten set screw.

TABLE 5-1

51J-2 TUBE SOCKET RESISTANCE AND VOLTAGE MEASUREMENTS

All measurements taken from socket pins to ground, resistance measurements taken with no a-c input, power on, gain controls on full, AVC on, all other switches off unless otherwise noted.

Voltage measurements taken with 115-volt a-c input, power on, no input signal, r-f gain full on, audio gain off, AVC on, all other switches off unless otherwise noted. Voltages measured with vacuum tube voltmeter, 11 megohms input resistance.

TUBE	PIN	RESISTANCE	VOLTAGE
V101	1	1,150,000	-1.35
	2,7	GND	0
6AK5	3	GND	0
	4	FIL	6.3 AC
	5	58,000	63 BAND 1 (165 ALL OTHERS)
	6	79,000	90
V102	1	2	0
	2	470	+1.5
6BE6	3	GND	0
	4	FIL	6.3 AC
	5	40,000	160
	6	90,000	50
	7	330,000	VARIES WITH XTAL INJECTION (0 to -2V)
V103	1	100,000	0
	2	1,500	+4.8
6BE6	3	GND	0
	4	FIL	6.3 AC
	5	40,000	175 BAND 1 (0 ON ALL OTHERS)
	6	70,000	90
	7	.1	0
V104	1	680,000	-15 WITH XTAL CALIBRATOR ON +46 WITH CALIBRATOR OFF
6BA6	2,7	4700 WITH 100 Kc OSC. ON	+6.5 WITH CALIBRATOR ON
	3	FIL	6.3 AC
	4	GND	0
	5	270,000	70 WITH CALIBRATOR ON 180 WITH CALIBRATOR OFF
	6	150,000	55 WITH CALIBRATOR ON 180 WITH CALIBRATOR OFF

TUBE	PIN	RESISTANCE	VOLTAGE
V105 6AK5	1 2,7 3 4 5 6	100,000 9 GND FIL 90,000 BAND 2 40,000 BAND 3 75,000	VARIES WITH XTAL (-3 to -10V) +.1 0 6.3 AC 18 BAND 2 160 BAND 3 98 BAND 3 / 92 BAND 2
V106 6BE6	1 2 3 4 5 6 7	100,000 470 GND FIL 38,000 70,000 .3 BAND 3 .4 BAND 2	-.1 +2.0 0 6.3 AC 200 60 0
V107 6BA6	1 2,7 3 4 5 6	58,000 GND GND FIL 35,000 24,000	-1.5 0 0 6.3 AC 190 52
V108 6BA6	1 2,7 3 4 5 6	58,000 GND GND FIL 35,000 22,000	-1.5 0 0 6.3 AC 190 55
V109 6BA6	1 2,7 3 4 5 6	58,000 38 GND FIL 35,000 85,000	-1.5 +.3 0 6.3 AC 190 85
V110 12AX7	1 2 3 4 5 6 7 8 9	500 500 100,000 FIL FIL 100,000 100,000 GND GND	-52 -52 -50 6.3 AC 6.3 AC -4.0 -4.0 0 0

TUBE	PIN	RESISTANCE	VOLTAGE
V111 12AX7	1	47,000	-1.5 AVC ON
	2	700,000	-45
	3	2700	-42
	4	FIL	6.3 AC
	5	FIL	6.3 AC
	6	47,000	-1.5 AVC ON
	7	700,000	-45
	8	2700	-42
	9	GND	0
V112 12AX7	1	33,000	-.4
	2	33,000	-.4
	3	33,000 LIMITER OUT	-.8 LIMITER OUT
		1 meg. LIMITER IN	-.3 LIMITER IN
	4	FIL	6.3 AC
	5	FIL	6.3 AC
	6	25,000	150
	7	500,000	0
	8	3,300	+1.8
	9	GND	0
V113 6AQ5	1	NC	0
	2	GND	0
	3	GND	0
	4	FIL	6.3 AC
	5	35,000	210
	6	35,000	210
	7	100,000	-12
V114 6BA6	1	90,000	-.5
	2	GND	0
	3	GND	0
	4	FIL	6.3 AC
	5	150,000	200
	6	GND BFO OFF	0
		370,000 BFO ON	33
	7	.1	0
V115 5V4G	1	NC	NC
	2	35,000	240
	3	NC	NC
	4	600	400 AC
	5	NC	NC
	6	600	400 AC
	7	NC	NC
	8	35,000	240

PARTS LIST

SECTION 6

51J-2 RECEIVER

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-101	L-101 padding	CAPACITOR: mica, 910 mmf ±1%, 500WV	912 0547 00
C-102	L-101 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-103	L-102 padding	CAPACITOR: mica, 510 mmf ±2%, 300WV	912 0544 00
C-104	L-102 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-105	L-103 padding	CAPACITOR: mica, 300 mmf ±2%, 500WV	912 0526 00
C-106	L-103 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-107	L-104 padding	CAPACITOR: mica, 220 mmf ±2%; 500WV	912 0517 00
C-108	L-104 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-109	L-105 padding	CAPACITOR: mica, 75 mmf ±5%, 500WV	912 0485 00
C-110	L-105 trimming	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-111	L-106 padding	CAPACITOR: Not used	
C-112	L-106 trimming	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-113	V-101 grid coupling	CAPACITOR: mica, 100 mmf ±5%, 500WV	912 0494 00
C-114	V-101 grid decoupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	912 0566 00
C-115	V-101 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-116	V-102 grid coupling	CAPACITOR: ceramic, 1.0 mmf ±1/4 mmf, 500 WV	916 4368 00
C-117	V-101 plate coupling band 1	CAPACITOR: ceramic, 2.0 mmf ±1/4 mmf, 500 WV	916 4373 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-118	L-110 padding	CAPACITOR: mica, 910 mmf ±1%, 300WV	935 5015 00
C-119	L-110 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-120	L-107 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-121	L-107 padding	CAPACITOR: mica, 220 mmf, ±2%, 500WV	912 0517 00
C-122	L-108 trimming	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-123	L-108 padding	CAPACITOR: mica, 75 mmf ±5%, 500WV	912 0485 00
C-124	L-109 trimming	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-125		CAPACITOR: Not used	
C-126	V-101 plate by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-127	L-111 padding	CAPACITOR: mica, 220 mmf, ±2%, 500 WV	912 0517 00
C-128	L-111 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-129	L-112 padding	CAPACITOR: mica, 75 mmf ±5%, 500 WV	912 0485 00
C-130	L-112 trimming	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-131	L-113 padding	CAPACITOR: Not used	
C-132	L-113 trimming	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-133	V-102 grid coupling, band 4-7	CAPACITOR: ceramic, 1.5 mmf ±1/4 mmf, 500 WV	916 4370 00
C-134	V-102 cathode by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-135	V-102 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-136	V-102 injection coupling	CAPACITOR: ceramic, 100 mmf, 350 WV	912 0494 00
C-137	L-114 to L-115 coupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-138	V-102 plate by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-139	L-115 padding	CAPACITOR: ceramic, 20 mmf, ±5%	916 4420 00
C-140	L-115 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-141	V-103 cathode by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-142	V-103 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-143	V-103 injection coupling	CAPACITOR: mica, 100 mmf ±5%, 500 WV	912 0494 00
C-144	L-121 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-145	L-121 padding	CAPACITOR: mica, 150 mmf ±5%, 500WV	912 0506 00
C-146	Bands 29, 30 harmonic tuning	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-147	Bands 27, 28 harmonic tuning	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-148	Bands 25, 26 harmonic tuning	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-149	Bands 23, 24 harmonic tuning	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-150	Bands 21, 22 harmonic tuning	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-151	Bands 19, 20 harmonic tuning	CAPACITOR: ceramic, 15 mmf ±5%, 500 WV	916 4412 00
C-152	Bands 19, 20 harmonic	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-153	Bands 17, 18 harmonic tuning	CAPACITOR: ceramic, 36 mmf ±5%, 500 WV	916 4448 00
C-154	Bands 17, 18 harmonic tuning	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-155	Bands 15, 16 harmonic tuning	CAPACITOR: ceramic, 47 mmf ±5%, 500 WV	916 4463 00
C-156	Bands 15, 16 harmonic tuning	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-157	Bands 13, 14 harmonic tuning	CAPACITOR: ceramic, 68 mmf ±5%, 500 WV	916 4309 00
C-158	Bands 13, 14 harmonic tuning	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-159	Spurious filter tuning	CAPACITOR: mica, 150 mmf p/m 5%, 500 WV (p/o L-124)	912 0506 00
C-160		CAPACITOR: Not used	
C-161	Bands 1, 2 harmonic tuning	CAPACITOR: mica, 200 mmf ±2%, 500WV	912 0514 00
C-162	Bands 1, 2 harmonic tuning	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-163	V-105 plate by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-164	V-105 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-165	Osc. feedback network	CAPACITOR: ceramic, 15 mmf ±5%, 500 WV	916 4412 00
C-166	Osc. feedback network	CAPACITOR: mica, 100 mmf ±5%, 500 WV	912 0494 00
C-167	Osc. grid circuit capacity trimmer	CAPACITOR: variable ceramic, 3-12 mmf, 350 WV	917 1035 00
C-168		CAPACITOR: Not used	
C-169	Freq. standard adjusting	CAPACITOR: variable ceramic, 5-25 mmf, 350 WV	917 1036 00
C-170	V-104 cathode by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-171	V-104 screen by-pass	CAPACITOR: mica, 100 mmf ±5%, 500 WV	912 0494 00
C-172	V-104 plate decoupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-173	Freq. standard coupling	CAPACITOR: ceramic, 10 mmf ±1 mmf, 500 WV	916 4406 00
C-174	L-116 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-175	L-116 padding	CAPACITOR: mica, 180 mmf ±2%, 500 WV	912 0511 00
C-176	L-117 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-177	L-117 padding	CAPACITOR: mica, 300 mmf ±2%, 500 WV	912 0526 00
C-178	V-3 plate by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-179	L-118 padding	CAPACITOR: mica, 180 mmf ±2%, 500 WV	912 0511 00
C-180	L-118 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-181	L-119 padding	CAPACITOR: mica, 300 mmf ±2%, 500 WV	912 0526 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-182	L-119 trimming	CAPACITOR: variable ceramic, 8-50 mmf, 350 WV	917 1038 00
C-183	V-106 cathode by-pass	CAPACITOR: ceramic 10,000 mmf, 350 WV	913 0566 00
C-184	V-106 grid by-pass	CAPACITOR: mica, 100 mmf ±5%, 500 WV	912 0494 00
C-185	V-106 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-186	V-106 plate by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-187	Filter crystal parallel	CAPACITOR: ceramic, 2.0 mmf ±1/4 mmf, 500 WV	916 4373 00
C-188	Filter crystal phasing	CAPACITOR: variable air, midget, dual section, 10 mmf ±1 mmf max per section	504 7338 001
C-189	V-107 grid decoupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-190	V-107 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-191	V-107 plate by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-192		CAPACITOR: Not used	
C-193	V-108 grid decoupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-194	V-108 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-195	V-108 plate by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-196		CAPACITOR: Not used	
C-197	V-109 grid decoupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-198	V-109 cathode by-pass	CAPACITOR: paper, .1 mf ±10%, 150 WV	931 0333 00
C-199	V-109 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-200	V-109 plate by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-201		CAPACITOR: Not used	
C-202	Detector Filter	CAPACITOR: mica, 330 mmf ±2%, 500 WV	912 0529 00
C-203		CAPACITOR: Not used	
C-204	AVC rectifier coupling	CAPACITOR: mica, 100 mmf ±5%, 500 WV	912 0494 00
C-205	Back bias r-f filter	CAPACITOR: paper, .1 mf ±10%, 150 WV	931 0333 00
C-206	BFO coupling	CAPACITOR: mica, 5 mmf ±5%, 500 WV	912 0428 00
C-207	AVC amp. stabilizing	CAPACITOR: paper, .1 mf ±10%, 150 WV	931 0333 00
C-208	AVC amp. stabilizing	CAPACITOR: paper, .1 mf ±10%, 150 WV	931 0333 00
C-209	Audio coupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-210	Noise limiter filter	CAPACITOR: paper, .1 mf ±10%, 150 WV	931 0333 00
C-211	Audio coupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-212	Audio output equalizer	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-213	AVC time constant	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-214	HF oscillator B+ filter	CAPACITOR: ceramic, 10,000 mmf, 350 WV	931 0566 00
C-215	V-111 cathode by-pass	CAPACITOR: dry electrolytic, 20 mf, 150 WV	184 6509 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
C-216	Back bias filter	CAPACITOR: dry electrolytic, 20 mf, 150 WV	184 6509 00
C-217	C-217A and C-217B	CAPACITOR: dry electrolytic, dual section, -10% +250%, 450 WV	184 5000 00
C-217A	Power supply filter	CAPACITOR: 35 mmf, section of C-217	
C-217B	Power supply filter	CAPACITOR: 35 mf, section of C-217	
C-218	V-114 screen by-pass	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-219	V-114 screen decoupling	CAPACITOR: ceramic, 10,000 mmf, 350 WV	913 0566 00
C-220	Variable i-f coupling	CAPACITOR: ceramic, 4.0 mmf ±1/4 mmf, 500 WV	916 4380 00
C-221	Variable i-f coupling	CAPACITOR: ceramic, 2.0 mmf ±1/4 mmf, 500 WV	916 4373 00
C-222	Power supply r-f filter	CAPACITOR: paper, .1 mf ±10%, 400 WV	931 0299 00
C-223	B+ isolation capacitor	CAPACITOR: dry electrolytic, 8 mf, 350 WV	184 6515 00
C-224	Calibration osc. panel adj.	CAPACITOR: variable air, 6-100.5 mmf	922 0024 00
CR-101	Audio level meter rectifier	RECTIFIER: dry disc, instrument type	353 3000 00
E-101	Antenna input connector	BOARD: terminal, 3 solder lug term	306 0158 00
E-102	Relay terminal	BOARD: terminal, 3 solder lug term	306 0158 00
E-103	Audio output connector	BOARD: terminal, 3 solder lug term	306 0158 00
F-101	Primary power fuse	FUSE: cartridge, 1-amp slow-blow	264 4280 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
I-101	Dial illuminating	LAMP: pilot light, miniature bayonet base bulb, T-3-1/4 bulb	262 3240 00
I-102	Dial illuminating	LAMP: pilot light, miniature bayonet base bulb, T-3-1/4 bulb	262 3240 00
I-103	Dial illuminating	LAMP: pilot light, miniature bayonet base bulb, T-3-1/4 bulb	262 3240 00
I-104	Meter illuminating	LAMP: dial light, 6-8 v, miniature bayonet base bulb, (part of M-101)	
J-101	Headphone output	JACK: phone, 2 circuit, for use with 0.250" diam plug	360 0025 00
L-101	Band 1 antenna	COIL ASSEMBLY: 2 windings, 1st wind. asymmetrically wound, 75 turns, secd winding close spaced, 15 turns	504 3038 001
L-102	Band 2 antenna	COIL ASSEMBLY: 2 windings, 1st wind. asymmetrically wound, 48 turns, secd winding close spaced 7 turns	504 3042 001
L-103	Band 3 antenna	COIL ASSEMBLY: 2 windings, 1st wind. asymmetrically wound, 42.9 turns, second winding close spaced, 5 turns	504 3045 001
L-104	Band 4 to 7 antenna	COIL ASSEMBLY: 2 windings, 1st wind. asymmetrically wound, 20 turns; second winding close spaced, 3 turns	504 3049 001
L-105	Band 8 to 16 antenna	COIL ASSEMBLY: 2 windings, 1st wind. asymmetrically spaced, 20 turns second winding close spaced 1-5/6 turns	504 3053 001
L-106	Band 17 to 30 antenna	COIL ASSEMBLY: 2 windings, 1st wind. asymmetrically wound, 20 turns, second winding close spaced, 1-5/6 turns	504 3054 001

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
L-107	Band 4 to 7 mixer primary	COIL ASSEMBLY: RF, single winding, 27 turns asymmetrically wound	504 3060 001
L-108	Band 8 to 16 mixer primary	COIL ASSEMBLY: RF single winding, 20 turns, asymmetrically wound	504 3061 001
L-109	Band 17 to 30 mixer	COIL ASSEMBLY: RF, single winding, 20 turns, asymmetrically wound	504 3062 001
L-110	Band 1 mixer	COIL ASSEMBLY: RF, single winding, 75 turns, asymmetrically wound	504 3056 001
L-111	Band 4 to 7 mixer secondary	COIL ASSEMBLY: RF, single winding 75 turns asymmetrically wound	504 3060 001
L-112	Band 8 to 16 mixer secondary	COIL ASSEMBLY: RF, single winding, 20 turns asymmetrically wound	504 3061 00
L-113	Band 17 to 30 mixer secondary	COIL ASSEMBLY: RF, single winding, 20 turns asymmetrically wound	504 3062 001
L-114	Band 1, 11.5 to 10.5 mc i-f coil	COIL ASSEMBLY: IF, single winding, 48 turns, asymmetrically wound	504 3064 001
L-115	Band 1, 11.5 to 10.5 mc i-f coil	COIL ASSEMBLY: IF, single winding 16 turns	504 3057 00
L-116	Variable i-f coil primary	COIL ASSEMBLY: IF, single winding 48 turns, asymmetrically wound	504 3064 001
L-117	Variable i-f coil primary	COIL ASSEMBLY: single winding, 46 turns	504 3066 001
L-118	Variable i-f coil secondary	COIL ASSEMBLY: IF, single winding 48 turns, asymmetrically wound	504 5347 001
L-119	Variable i-f coil secondary	COIL ASSEMBLY: single winding, 46 turns	504 3066 001
L-120	Crystal oscillator cathode choke	COIL ASSEMBLY: 500 uh, 3 sections of 112 turns each	503 4535 001
L-121	Crystal oscillator harmonic selector	COIL ASSEMBLY: oscillator plate, single winding, 46 turns	504 3074 001

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
L-122	Input choke	REACTOR: filter, 3.0 hy 0.120 amp, 100 ohm, 90/140 cps	678 0324 00
L-123	Output choke	REACTOR: filter, 5.0 hy 0.080 amp, 300 ohm max, 90/140 cps	678 0323 00
L-124	Spurious filter	COIL: 46 turns #28 wire	504 6646 002
M-101	Signal level and db meter	METER: Signal level, 1 ma, 46 ohm (includes I-104)	458 0192 00
P-001	VFO Power connector	BOARD: oscillator terminal, 5 solder lug term	504 5010 00
P-101	AC plug and cord	CORD: 6 ft lg, with 2 conductor AC plug	426 1003 00
R-101	V-101 grid return	RESISTOR: 1 megohm ±10%, 1/2 w	745 1212 00
R-102	V-101 grid decoupling	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-103		RESISTOR: Not used	
R-104	V-101 screen dropping	RESISTOR: 33,000 ohm ±10%, 1/2 w	745 1149 00
R-105	V-101 plate load, band 1	RESISTOR: 10,000 ohm ±10%, 1/2 w	745 1128 00
R-106	V-101 plate decoupling	RESISTOR: 6800 ohm ±10%, 1/2 w	745 1121 00
R-107	V-102 cathode	RESISTOR: 470 ohm ±10%, 1/2 w	745 1072 00
R-108	V-102 grid 1 return	RESISTOR: .33 megohm ±10%, 1/2 w	745 1191 00
R-109	V-102 screen dropping	RESISTOR: 47,000 ohm ±10%, 1/2 w	745 1156 00
R-110	V-102 plate decoupling	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-111	V-103 cathode	RESISTOR: 1500 ohm ±10%, 1/2 w	745 1093 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R-112	V-103 grid 1 return	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-113	V-103 screen dropping	RESISTOR: 33,000 ohm ±10%, 1/2 w	745 1149 00
R-114	V-105 screen dropping	RESISTOR: 33,000 ohm ±10%, 1/2 w	745 1149 00
R-115	V-105 grid leak	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-116	V-103 plate load	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-117	V-103 plate load	RESISTOR: 47,000 ohm ±10%, 1/2 w	745 1156 00
R-118	V-104 grid leak	RESISTOR: .68 megohm ±10%, 1/2 w	745 1205 00
R-119	V-104 cathode	RESISTOR: 4700 ohm ±10%, 1/2 w	745 1114 00
R-120	V-104 screen dropping	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-121	V-104 plate dropping	RESISTOR: .22 megohm ±10%, 1/2 w	745 1184 00
R-122	V-104 plate, screen decoupling	RESISTOR: 10,000 ohm ±10%, 1/2 w	745 1128 00
R-123	VFO plate, screen decoupling	RESISTOR: 3300 ohm ±10%, 1/2 w	745 1107 00
R-124	V-103 plate decoupling	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-125	V-107 grid load	RESISTOR: .33 megohm ±10%, 1/2 w	745 1191 00
R-126	V-107 screen dropping	RESISTOR: 27,000 ohm ±10%, 1/2 w	745 1146 00
R-127	V-106 cathode	RESISTOR: 470 ohm ±10%, 1/2 w	745 1072 00
R-128	V-106 screen dropping	RESISTOR: 33,000 ohm ±10%, 1/2 w	745 1149 00
R-129	V-106 plate decoupling	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-130	Crystal filter selectivity	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R-131	Crystal filter selectivity	RESISTOR: 22,000 ohm ±10%, 1/2 w	745 1142 00
R-132	Crystal filter selectivity	RESISTOR: 4700 ohm ±10%, 1/2 w	745 1114 00
R-133	V-107 grid decoupling	RESISTOR: 10,000 ohm ±10%, 1/2 w	745 1128 00
R-134	V-107 screen bleeder	RESISTOR: 47,000 ohm ±10%, 1/2 w	745 1156 00
R-135	V-107 plate decoupling	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-136	V-108 grid decoupling	RESISTOR: 10,000 ohm ±10%, 1/2 w	745 1128 00
R-137	V-108 screen bleeder	RESISTOR: 47,000 ohm ±10%, 1/2 w	745 1156 00
R-138	V-108 plate decoupling	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-139	V-109 grid decoupling	RESISTOR: 10,000 ohm ±10%, 1/2 w	745 1128 00
R-140	"S" meter zero adjust	RESISTOR: variable wire-wound, 100 ohm ±10%, 2 w	377 0104 00
R-141	V-109 screen dropping	RESISTOR: 47,000 ohm ±10%, 1/2 w	745 1156 00
R-142	V-109 plate decoupling	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-143	BFO injection load	RESISTOR: 10 ohm ±10%, 1/2 w	745 1002 00
R-144	AVC amp. stabilizing	RESISTOR: .47 megohm ±10%, 1/2 w	745 1198 00
R-145	AVC rectifier load	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-146	AVC amp load	RESISTOR: 47,000 ohm ±10%, 1/2 w	745 1156 00
R-147	AVC amp plate dropping	RESISTOR: 27,000 ohm ±10%, 1/2 w	745 1146 00
R-148	R-F gain control	RESISTOR: variable, 10,000 ohm ±20%, 1/2 w	376 3522 00
R-149	R-F gain control, fixed	RESISTOR: 820 ohm ±10%, 1/2 w	745 1083 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R-150	Detector load	RESISTOR: 68,000 ohm ±10%, 1/2 w	745 1163 00
R-151	Detector load	RESISTOR: 33,000 ohm ±10%, 1/2 w	745 1149 00
R-152	Limiter filter	RESISTOR: .47 megohm ±10%, 1/2 w	745 1198 00
R-153	Limiter filter	RESISTOR: .47 megohm ±10%, 1/2 w	745 1198 00
R-154	Audio gain control	RESISTOR: variable, .50 megohm ±20%, 1/4 w	376 4499 00
R-155	V-112 cathode, audio section	RESISTOR: 3300 ohm ±10%, 1/2 w	745 1107 00
R-156	V-112 plate load, audio section	RESISTOR: .22 megohm ±10%, 1/2 w	745 1184 00
R-157	V-113 grid load	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-158		RESISTOR: Not used	
R-159		RESISTOR: Not used	
R-160	V-114 screen dropping	RESISTOR: .33 megohm ±10%, 1/2 w	745 1191 00
R-161	V-114 plate load	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-162	V-114 plate dropping	RESISTOR: 10,000 ohm ±10%, 1/2 w	745 1128 00
R-163	"S" meter series	RESISTOR: 160 ohm ±5%, 1/2 w	745 1053 00
R-164	Back bias dropping	RESISTOR: wire-wound, 100 ohm ±5%, 8w	747 0031 00
R-165	Back bias dropping	RESISTOR: wire-wound, 310 ohm ±5%, 8w	747 0036 00
R-166	Back bias dropping	RESISTOR: wire-wound, 120 ohm ±5%, 8w	747 0032 00
R-167	AVC amp stabilizing	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-168	V-111 cathode	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-169	V-108 screen dropping	RESISTOR: 27,000 ohm ±10%, 1/2 w	745 1146 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
R-170	"S" meter bridge	RESISTOR: 100 ohm ±10%, 1/2 w	745 1044 00
R-171	AVC amp stabilizing	RESISTOR: 120,000 ohm ±10%, 1/2 w	745 1174 00
R-172	Static drain	RESISTOR: .10 megohm ±10%, 1/2 w	745 1170 00
R-173	Audio voltage dropping	RESISTOR: 2200 ohm ±10%, 1/2 w	745 1100 00
R-174	B+ isolation resistor	RESISTOR: 1000 ohm ±10%, 2 w	745 5086 00
S-101	Antenna coil selecting	SWITCH: rotary, 1 circuit, 18 position	269 1273 00
S-102	R-F coil selecting	SWITCH: rotary, 1 circuit, 17 position	269 1271 00
S-103	R-F amp plate coil selecting	SWITCH: rotary, 1 circuit, 17 position	269 1271 00
S-104	Mixer grid coil selecting	SWITCH: rotary, 1 circuit, 17 position	269 1271 00
S-105	Mixer plate circuit selecting	SWITCH: rotary, 1 circuit, 18 position	269 1273 00
S-106	Mixer plate circuit selecting	SWITCH: rotary, 1 circuit, 18 position	269 1273 00
S-107	Crystal osc harmonic selecting	SWITCH: rotary, 2 circuit, 15 position	269 1272 00
S-108	Crystal selecting	SWITCH: rotary, 1 circuit, 17 position	269 1271 00
S-109	Variable i-f selecting	SWITCH: rotary, 1 circuit, 2 position	269 1270 00
S-110	Variable i-f selecting	SWITCH: rotary, 1 circuit, 2 position	269 1270 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
S-111	Calibrator ON-OFF	SWITCH: rotary, 2 circuit, 2 position	259 0380 00
S-112	BFO ON-OFF	SWITCH: rotary, 2 circuit, 2 position	259 0380 00
S-113	Receiver ON-Standby-OFF	SWITCH: band change, 2 circuit, shorting, 3 position	259 0381 00
S-114	Selectivity Switch	SWITCH: band change, 1 circuit, shorting, 5 position	259 0379 00
S-115	AVC ON-OFF	SWITCH: rotary, 2 circuit, 2 position	259 0380 00
S-116	Noise limiter IN-OUT	SWITCH: rotary, 2 circuit, 2 position	259 0380 00
S-117	Meter Switch	SWITCH: toggle; DPDT, 30 amp continuous	266 3062 00
T-101	Crystal filter input	TRANSFORMER: crystal filter, frequency range 490-510 kc	278 0080 00
T-102	Crystal filter output	COIL ASSEMBLY: crystal filter grid, frequency range 490-510 kc	278 0078 00
T-103	First I-F	TRANSFORMER: IF diode, frequency range 490-510 kc	278 0079 00
T-104	Second I-F	TRANSFORMER: IF diode, frequency range 490-510 kc	278 0079 00
T-105	Third I-F	TRANSFORMER: IF diode, frequency range 490-510 kc	278 0079 00
T-106	BFO	TRANSFORMER: BFO, for use with 500 kc IF amplifier	278 0081 00
T-107	Audio output transformer	TRANSFORMER: Audio, pri 5000 ohms, secd 500 ohm tapped at 4 ohm, 1500 TV, 3 w max	677 0325 00
T-108	Power Transformer	TRANSFORMER: pri 115 v, secd #1: 5.0 v, secd #2: 6.3 v, secd #3: 700 v CT, 2500 TV, 45/70 cps	672 0326 00

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ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
V-101	R-F Amp.	TUBE: Type 6AK5, pentode JAN COMMERCIAL	254 0121 00 257 0040 00
V-102	First mixer	TUBE: Type 6BE6, pentagrid JAN COMMERCIAL	254 0799 00 257 0048 00
V-103	Third mixer	TUBE: Type 6BE6, pentagrid JAN COMMERCIAL	254 0799 00 257 0048 00
V-104	Crystal calibrator	TUBE: Type 6BA6, pentode JAN COMMERCIAL	254 0787 00 255 0185 00
V-105	Crystal oscillator	TUBE: Type 6BA6, pentode JAN COMMERCIAL	254 0787 00 255 0185 00
V-106	Second mixer	TUBE: Type 6BE6, pentagrid JAN converter COMMERCIAL	254 0799 00 257 0048 00
V-107	First I-F	TUBE: Type 6BA6, pentode JAN COMMERCIAL	254 0787 00 255 0185 00
V-108	Second I-F	TUBE: Type 6BA6, pentode JAN COMMERCIAL	254 0787 00 255 0185 00
V-109	Third I-F	TUBE: Type 6BA6, pentode JAN COMMERCIAL	254 0787 00 255 0185 00
V-110	Detector and AVC rectifier	TUBE: Type 12AX7, twin triode JAN COMMERCIAL	254 0790 00 255 0201 00
V-111	AVC amplifier	TUBE: Type 12AX7, twin triode JAN COMMERCIAL	254 0790 00 255 0201 00
V-112	Noise limiter - first audio	TUBE: Type 12AX7, twin triode JAN COMMERCIAL	254 0790 00 255 0201 00
V-113	Audio output	TUBE: Type 6AQ5, pentode JAN COMMERCIAL	254 0788 00 255 0195 00
V-114	BFO	TUBE: Type 6BA6, pentode JAN COMMERCIAL	254 0787 00 255 0185 00
V-115	Power supply recti-fier	TUBE: Type 5V4G, rectifier JAN COMMERCIAL	254 0102 00 255 0081 00

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
XC-217	Socket for C-217	SOCKET: tube, octal, mtg plate molded in	220 1850 00
XF-101	Holder for F-101	HOLDER: fuse, extractor post, for single 3AG fuse	265 1002 00
XI-101 XI-102	Holders for I-101, I-102	SOCKET: lamp, pilot light bracket, miniature bayonet base	262 1210 00
XI-103	Holder for I-103	SOCKET: lamp, pilot light assembly, miniature bayonet base	262 0150 00
XV-101 XV-102 XV-103 XV-104 XV-105 XV-106 XV-107 XV-108 XV-109	Socket for V-101 V-102, V-103, V-104, V-105, V-106, V-107, V-108, V-109	SOCKET: tube, 7 contact miniature shielded	220 1069 00
XV-110 XV-111 XV-112	Socket for V-110 V-111, V-112	SOCKET: tube, 9 contact shielded	220 1087 00
XV-113	Socket for V-113	SOCKET: tube, 7 cont miniature shielded	220 1069 00
XV-114	Socket for V-114	SOCKET: tube, 7 contact minature shielded	220 1069 00
XV-115	Socket for V-115	SOCKET: tube octal, mtg plate molded in	220 1850 00
XY-101 thru XY-110	Socket for Y-101 thru Y-110	BOARD: crystal, accom. 10 type CR-18/U crystals	504 5009 001

ITEM	CIRCUIT FUNCTION	DESCRIPTION	COLLINS PART NUMBER
XY-111	Socket for Y-111	SOCKET: crystal, for 100 kc crystal	292 0055 00
Y-101	Bands 29 and 30 crystal	CRYSTAL: Type CR-18/U, 10.67 mc	291 6608 00
Y-102	Bands 23 and 24 crystal	CRYSTAL: Type CR-18/U, 13.00 mc	291 6613 00
Y-103	Bands 19 and 20 crystal	CRYSTAL: Type CR-18/U, 11.00 mc	291 6609 00
Y-104	Bands 15 and 16 crystal	CRYSTAL: Type CR-18/U, 9.00 mc	291 6612 00
Y-105	Bands 11 and 12, 25 and 26 crystal	CRYSTAL: Type CR-18/U, 14.00 mc	291 6611 00
Y-106	Bands 9 and 10, 21 and 22 crystal	CRYSTAL: Type CR-18/U, 12.00 mc	291 6610 00
Y-107	Bands 7 and 8, 17 18, 27 and 28 crystal	CRYSTAL: Type CR-18/U, 10.00 mc	291 6607 00
Y-108	Bands 5 and 6, 13 14 crystal	CRYSTAL: Type CR-18/U, 8.00 mc	291 6605 00
Y-109	Bands 3 and 4 crystal	CRYSTAL: Type CR-18/U, 6.00 mc	291 6602 00
Y-110	Bands 1 and 2 crystal	CRYSTAL: Type CR-18/U, 4.00 mc	291 6601 00
Y-111	Calibration crystal	CRYSTAL: special, 100 kc	291 5954 00
Y-112	Filter crystal	CRYSTAL: Type CR-7, 500 kc	291 5175 00
70E-7A	Variable frequency oscillator, 2-3 mc	This unit has been dehydrated and hermetically sealed, and should be returned to the Collins Radio Company if servicing is required.	

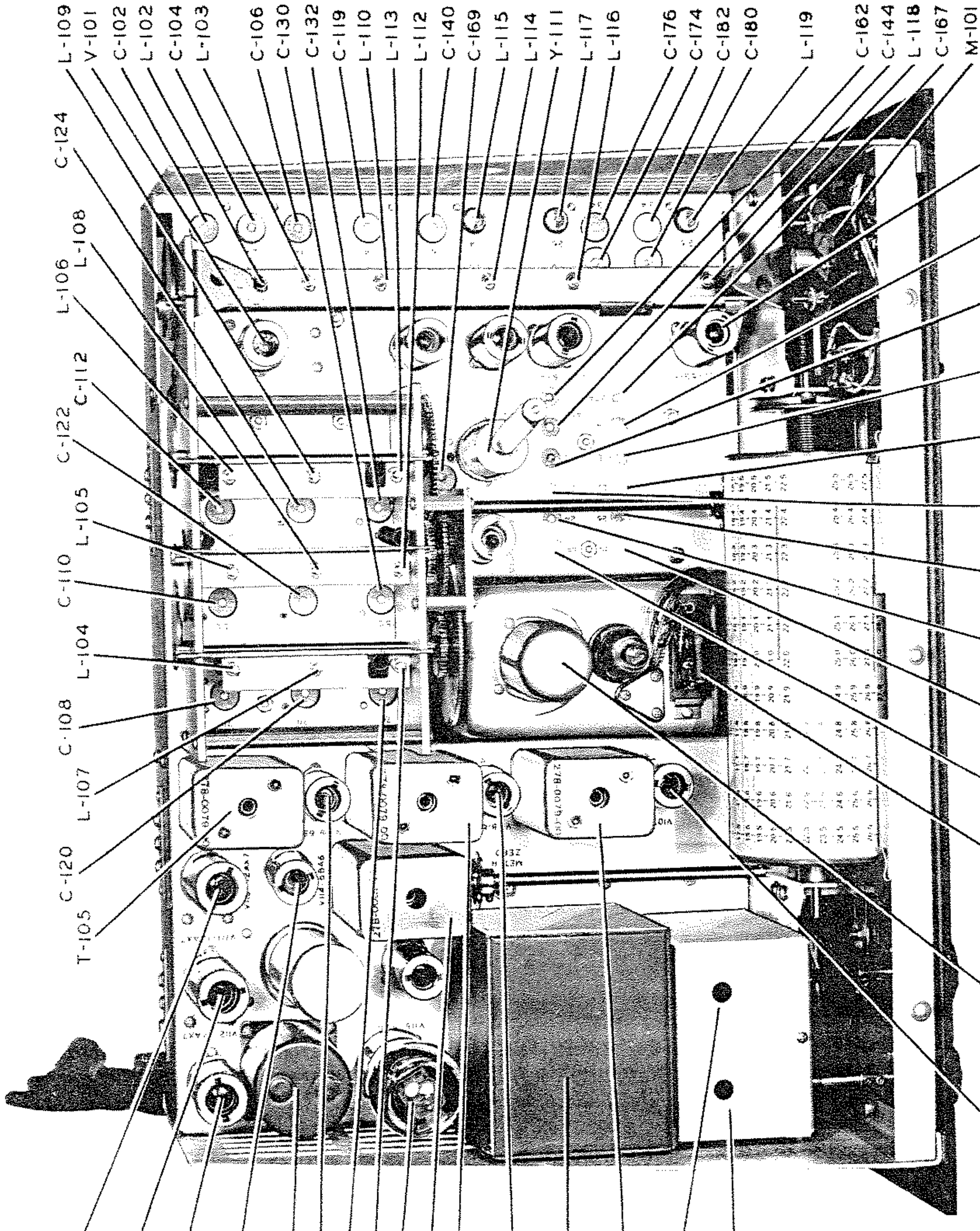

Figure 7-1 51J, Top View

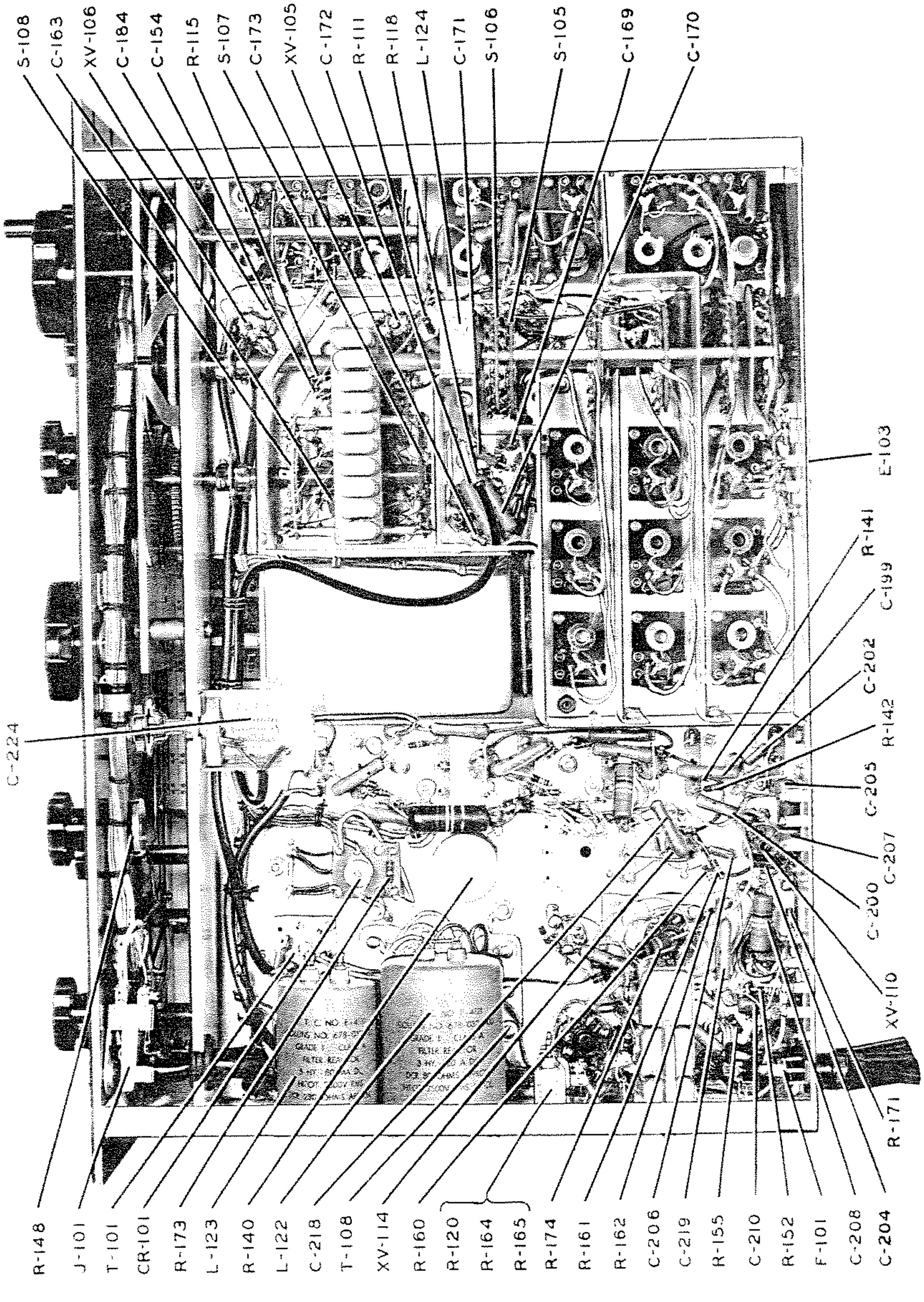

Figure 7-2 51J, Bottom View (Page 1 of 2 Pages)

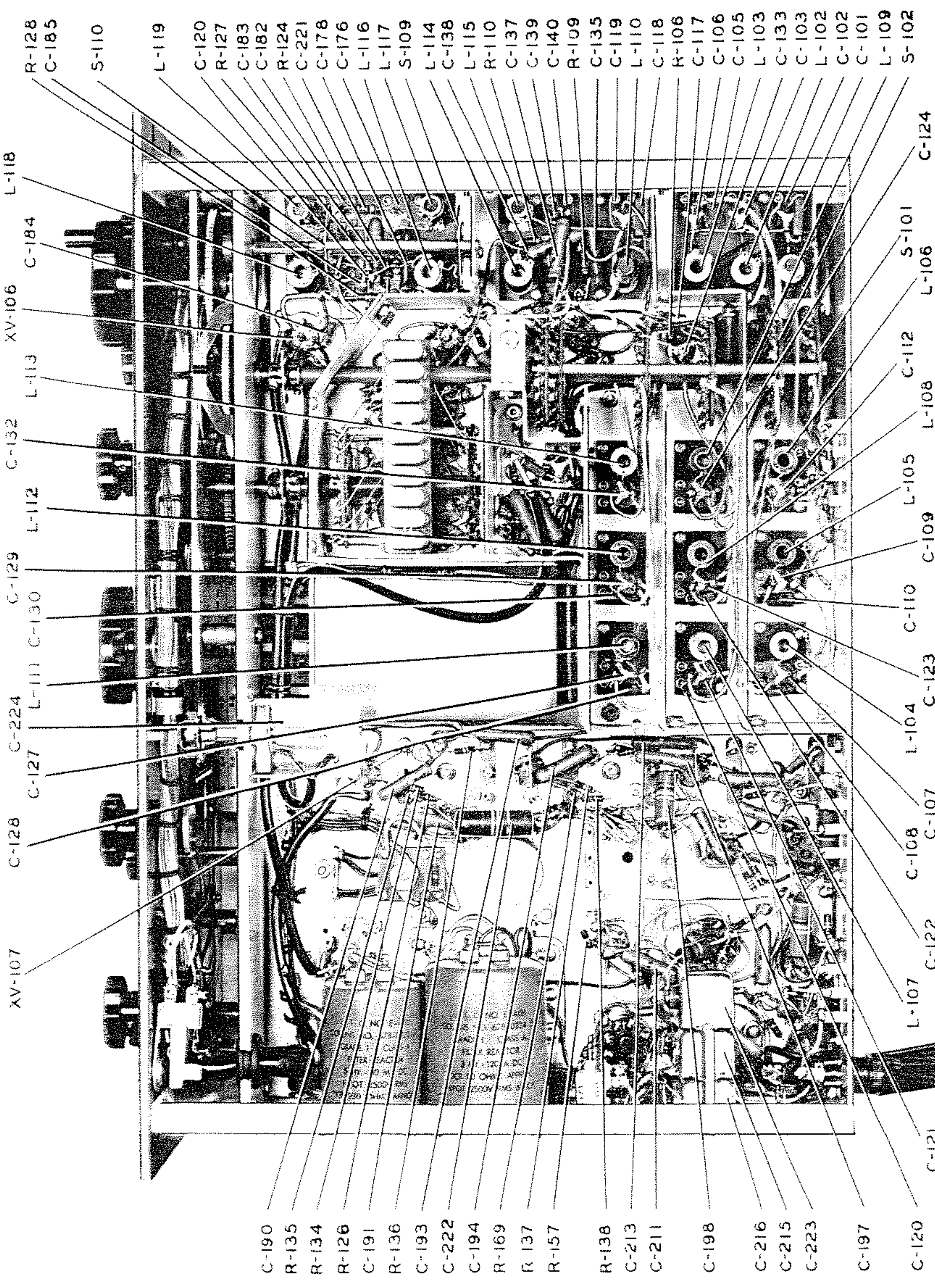

Figure 7-2 5LJ, Bottom View (Page 2 of 2 Pages)

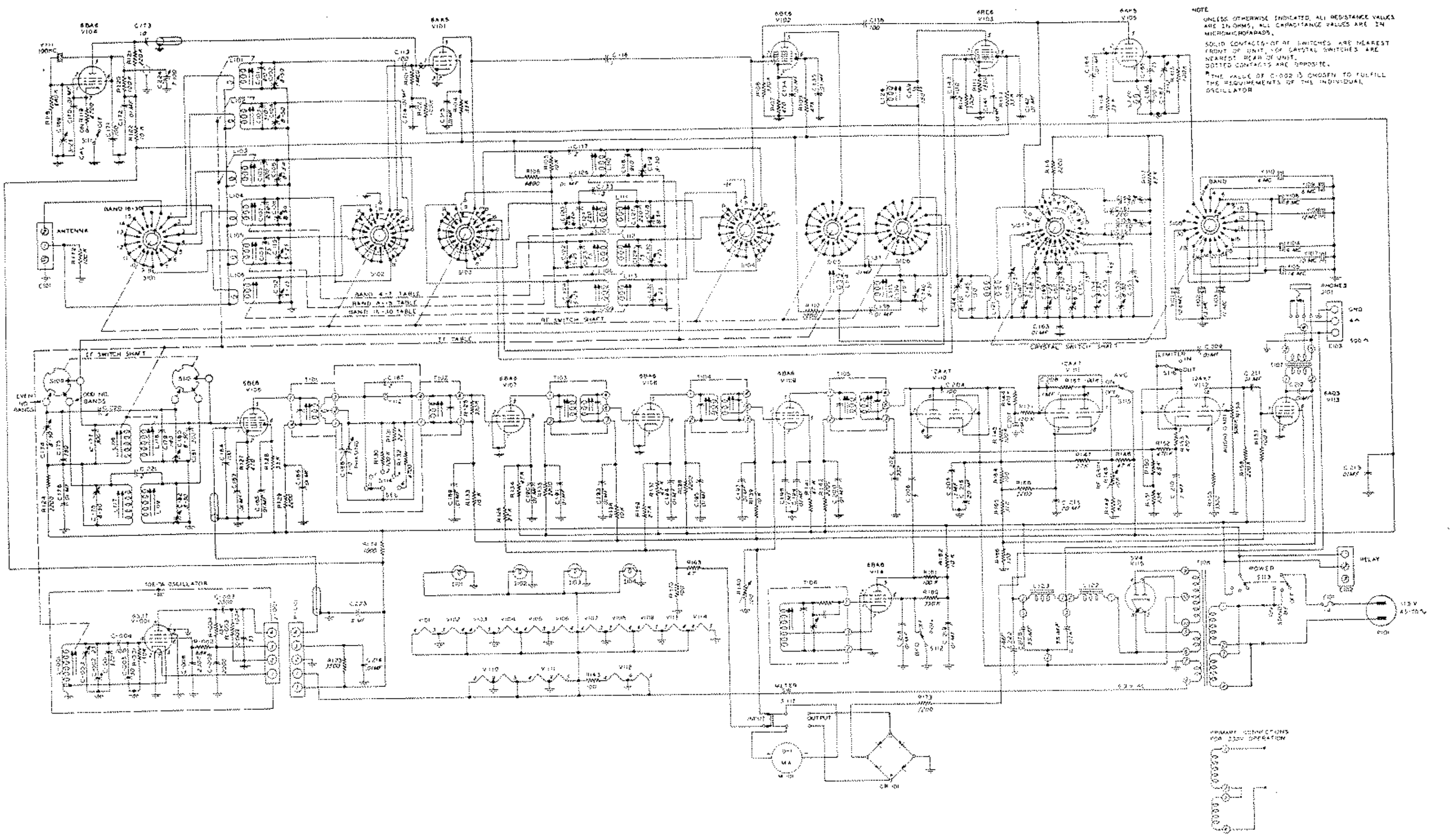

Figure 7-3 51J-2 Schematic Diagram