# INSTRUCTION BOOK

FOR

# MODEL NC-100ASD RADIO RECEIVING EQUIPMENT

**Frequency Range: 200 to 400 Kilocycles and**
**1,300 to 30,000 Kilocycles**

**Power Supply: 115 volts, 50-60 Cycles or**
**115 volts, 25 Cycles**

*Manufactured by*

**NATIONAL COMPANY, INC.**
**61 SHERMAN STREET**
**MALDEN, MASS., U.S.A.**

## SECTION 1. DESCRIPTION

### 1.1 General

1.11 This Communications Radio Receiving Equipment is suitable for the reception of radio telephone and telegraph signals (either CW or MCW) by either headphone or loud speaker methods. Each equipment consists of a Radio Receiver, a Loud Speaker and Instruction Books.

1.12 The Radio Receiver is a ten tube, table mounting, superheterodyne covering a continuous frequency range of from 200 to 400 kilocycles and 1,300 to 30,000 kilocycles in five working bands as follows:

| | | | |
|---|---|---|---|
| 200 | to | 400 | Kilocycles |
| 1,300 | to | 2,800 | Kilocycles |
| 2,800 | to | 6,400 | Kilocycles |
| 6,400 | to | 14,000 | Kilocycles |
| 14,000 | to | 30,000 | Kilocycles |

1.13 All radio frequency transformers and their associated trimmer capacitors are mounted in a cast aluminum catacomb having fifteen shielding compartments. Each R.F. transformer and its associated trimmer capacitor is mounted on a low-loss bakelite base fitted with contact pins which protrude from the coil catacomb. Manipulation of the band change knob slides the coil catacomb across the width of the chassis causing the contact pins of each set of R.F. transformers to engage, in turn, with contact springs mounted on the receiver chassis.

1.14 The MAIN TUNING dial has five scales calibrated in accordance with the frequency response of the five bands. The particular band in use is indicated by the tip of the pointer, which moves radially as the BAND SELECTOR knob is turned. In addition to the frequency calibrated scales, an auxiliary numerical dial is employed. This dial has 100 divisions and makes 10 revolutions while the tuning capacitor rotates 180 degrees; it is direct reading to one part in one thousand.

1.15 The circuit of the receiver is shown in Dwg. No. 8.1. It consists of one stage of radio frequency amplification, first detector (or mixer), high frequency oscillator, two stages of intermediate frequency amplification operating at 456 kilocycles, an "infinite impedance" diode detector, a noise peak limiter and two resistance coupled audio stages. A CW oscillator is provided for beat note reception for

CW signals. An amplified and delayed automatic volume control system is provided. Associated with the automatic volume control system is a signal strength meter, calibrated in S-units from 1 to 9 and in db. above S-9 from 0 to 40 db. A built-in power supply designed for operation from a 115 volt (±10%) 50/60 cycle* AC power source supplies all voltages required by the receiver.

## 1.2 Output Circuit

1.21 Two audio output circuits are provided:

(I) A headphone jack is mounted on the front panel. The correct load impedance for the headphone output circuit is 600 ohms. Maximum audio power output at the headphone jack is approximately I2 milliwatts. The headphone jack is so wired that the loud speaker circuit is opened when the phone plug is inserted.

(2) A pair of loud speaker output terminals (pin jacks) are located at the rear of the chassis. The proper load impedance of the loud speaker output circuit is 500 ohms. The maximum undistorted audio power available is 2 watts.

## 1.3 Antenna Requirements

1.31 Antenna input terminals are located at the rear of the chassis near the center. The input circuit is suitable for use with a single wire antenna, a balanced feed-line or a low impedance concentric transmission line. The impedance of the antenna or transmission line at the receiver input terminals should not be less than 70 ohms.

1.32 Two insulated binding posts are provided together with a short length of flexible lead permanently attached to the receiver chassis. By means of this lead, either input terminal may be grounded to the chassis if required.

1.33 In an installation having a simple antenna-ground combination, connect the single wire lead-in to either of the two input terminals, and ground the other terminal to the chassis by means of the flexible lead, referred to in Par. 1.32. It is recommended that the equipment be permanently grounded; the ground lead may be attached directly to the input terminal which is connected to the chassis or the terminal E-104. The dimensions of the single wire antenna system are not at all critical: The recommended minimum overall length of antenna and lead-in is fifty feet; the recommended maximum overall length is two hundred feet.

I.34 In an installation having a balanced feed-line, connect the two leads directly to the two input terminals. The grounding lead, referred to in Par. 1.32, is not used.

*See Notice, Page ii.

1.35 In an installation having a concentric feed-line, connect the inner conductor to one of the input terminals and the outer conductor to the other input terminal. Connect the latter to the chassis by means of the flexible lead.

## 1.4 Power Supply

1.41 This Communications Radio Receiving Equipment is built for operation from a 115 volt (± 10%) 50/60 cycle* AC power source. Normal power consumption is approximately 70 watts. The power supply circuits provide 6.3 volts at 3.15 amperes for the heater circuit of the receiver and 240 volts at 70 milliamperes for the receiver B supply. A two-section filter is employed. A protective fuse F-101 is connected in one side of the AC line.

1.42 Connector plug P-102 should be inserted in "H" position for 115 to 126.5 volt power source, "L" position being used for 103.5 to 115 volt power source.

## 1.5 Tube Complement

1.51 The tubes employed in the Radio Receiver are as follows:

| SYMBOL | TYPE | FUNCTION |
|---|---|---|
| V-101 | 6K7 | R.F. Amplifier |
| V-102 | 6J7 | First Detector |
| V-103 | 6J7 | H.F. Oscillator |
| V-104 | 6K7 | First I.F.Amplifier |
| V-105 | 6K7 | Second I.F. Amplifier |
| V-106A | 6F8G | First Audio Amplifier |
| V-106B | | Automatic Volume Control |
| V-107A | 6C8G | Second Detector |
| V-107B | | Limiter |
| V-108 | 6J7 | C.W. Oscillator |
| V-109 | 6V6G | Second Audio Amplifier |
| V-110 | 5Z3 | Rectifier |

## 1.6 Loud Speaker

1.61 The Loud Speaker Chassis has a nominal diameter of eight inches. A coupling transformer having an input impedance of 500 ohms is provided to match the voice coil and receiver output impedances. A two wire shielded cable is used for connection to the receiver. The circuit is shown in Dwg. No. 8.1.

*See Notice, Page ii.

## SECTION 2. INSTALLATION

### 2.1 General

2.11 The complete Radio Receiving Equipment is carefully packed in a wooden box. After unpacking, make interconnections between the Radio Receiver and the Loud Speaker in accordance with Dwg. No. 8.1. Connect the shielded leads W-201 of the loud speaker to the speaker terminals E-102 of the receiver; screw the shield grounding lug to the chassis terminal E-104. Connect the power supply plug P-101 to a 115 volt 50/60* cycle AC power source. See Section 1.4. Make antenna connections in accordance with Section 1.3 "Antenna Requirements".

2.12 Before putting the receiver in operation, remove machine screw at the left-hand end of the chassis to release the band changing mechanism. This screw clamps the coil catacomb to the end of the chassis during shipment and should be saved if the equipment is to be repacked and reshipped.

2.13 A pair of terminals E-103 at the rear of the receiver chassis is wired to the B+ switch S-101B. These terminals provide a convenient means of connecting a relay or switch for remote control.

2.14 Angle brackets and suitable hardware are supplied which provide a convenient means for mounting the receiver in a relay rack.

### 2.2 Loud Speaker Mounting

2.21 If the installation is such that the Loud Speaker, cabinet mounted, will be placed close to the receiver, the most desirable position is at the left-hand side. Placing the Loud Speaker on top of the receiver cabinet is the least desirable position since vibration from the speaker may introduce microphonic noises which would not otherwise be noticeable. In a rack mounted installation, the Loud Speaker, mounted on its panel, may be placed directly above the Receiver.

2.22 Microphonic noise or "mechanical feed-back" can often be eliminated by reversing the speaker leads at the speaker output terminals of the receiver.

## SECTION 3. OPERATING INSTRUCTIONS

### 3.1 Controls

3.101 All switches and controls (with the exception of the MAIN TUNING dial and the BAND SELECTOR knob) of the Radio Receiver are identified by etched panel plates or dial scales. The symbol numbers in the following paragraphs of this Section refer to Dwg. No. 8.1 and to the Parts List.

*See Notice, Page ii.

3.102 The MAIN TUNING dial is located at the center of the front panel of the receiver. The dial scale and pointer arrangement are described in Par. 1.14. The dial drive is so arranged that the frequency to which the receiver tunes increases with clockwise rotation of the tuning knob. The accuracy of calibration can be relied upon to plus or minus 2%.

3.103 The BAND SELECTOR knob is located near the bottom of the front panel at the center. The knob must be rotated approximately one turn to change from one band to an adjacent band. In addition to the radial movement of the dial pointer (see Par. 1.14) a positive detent is provided to insure proper positioning of the coil contact pins in the contact springs.

3.104 The LIMITER control R-144, at the left-hand side of the receiver panel, is used to adjust the DC potential applied to the elements of the limiter tube V-107B. The limiter circuit is thus provided with an adjustable threshold at which limiting action starts. Any audio voltages, or peaks, in excess of this threshold are prevented from reaching the audio amplifier. With the LIMITER control set at 0, the limiter circuits will pass all but the strongest audio peak voltages; when the control is set at 10, the threshold is lowered to a point where the audio signal will be distorted due to suppression of the positive peaks.

3.105 The TONE control R-115, at the lower left-hand corner of the front panel, is used to vary the frequency characteristic of the audio amplifier. When the control is set at the position marked "N", the full audio frequency range of the receiver is available; in the HIGH position, audio frequencies below 100 cycles are attenuated; as the control is turned clockwise towards the LOW position, audio frequencies above 1000 cycles are increasingly attenuated.

3.106 The POWER SUPPLY switch S-101A-S-101B is located at the left of the dial scale. In the counterclockwise position, OFF, the receiver is turned off, the primary circuit being opened by switch S-101A; in the mid-position, B+ OFF, switch S-101A is turned on but the B supply circuits are incomplete since switch S-101B is open; in the clockwise position, B+ ON, switch S-101B is closed, completing the B supply circuit. The B+ OFF position may thus be used for rendering the receiver inoperative, as may be required during periods of transmission, unless the B supply circuits are completed through terminals E-103.

3.107 The R.F. GAIN control R-121 is located below the POWER SUPPLY switch near the MAIN TUNING dial. It controls the amplification of R.F. Amplifier tube V-101 and the two I.F. amplifier tubes V-104 and V-105. Amplification increases as the control is turned clockwise towards 10 on the scale.

3.108 A three-position CONTROL SWITCH S-102A-S-102B is located at the upper right-hand corner of the MAIN TUNING dial. In the AVC position, the automatic volume control circuits are in operation; in the MVC position, automatic volume control is turned off; in the CWO position, the CW oscillator is turned on and automatic volume control turned off.

3.109 The A.F. GAIN control R-116 is located at the lower right-hand corner of the main dial. It is used to control the audio amplification of the receiver. Audio amplification increases as the control is turned clockwise towards 10 on the scale.

3.110 The C.W. OSC. control C-129, located at the right-hand side of the front panel, is used for varying the frequency of the CW oscillator. The CW oscillator is tuned to the intermediate frequency at 0 on the C.W. OSC. scale.

3.111 At the upper left-hand side of the front panel is located the S-METER switch S-103. This switch must be pushed in when S-meter readings are to be made, as explained in Par. 3.41. At all other times, the S-meter should be disconnected by pulling the switch button out.

## 3.2 MCW or Phone Reception

3.21 After the Equipment is properly installed, in accordance with Section 2, it is put into operation by turning the POWER SUPPLY switch to the B+ ON position. The LIMITER control should be set at 0; the TONE control set at "N"; the R.F. GAIN control should be advanced to some position between 8 and 10, depending upon receiving conditions; the A.F. GAIN control should be set at the point providing the desired audio volume; the CONTROL SWITCH should be set at the AVC position. The receiver is now adjusted for the reception of MCW signals and will tune to the approximate frequency indicated by the MAIN TUNING dial.

3.22 With the CONTROL SWITCH in the AVC position, the R.F. GAIN control should be advanced as far as receiving conditions permit, or until background noise becomes objectionably loud. Audio output should be adjusted entirely by means of the A.F. GAIN control. The operator must remember that automatic volume control action will be restricted unless the R.F. GAIN control is fully advanced.

3.23 The CONTROL SWITCH may be set at MVC, in which case the operator must be careful not to advance the R.F. GAIN control to a point where I.F. or audio amplifier overload occurs. Such overload is indicated by excessive distortion. In general, it is recommended that the A.F. GAIN control be set about halfway on, i.e., at 5 and audio output adjusted by means of the R.F. GAIN control.

3.24 If a signal is weak and partially obscured by background noise and static, best signal-to-noise ratio will be obtained by turning the TONE control towards the LOW position. The most effective setting must be determined by trial as too much attenuation of high audio frequencies will impair the intelligibility of speech.

3.25 When a signal is accompanied by static peaks or noise pulses of high intensity and short duration, the best signal-to-noise ratio will be obtained by advancing the LIMITER control towards 10. The best setting must be determined by trial as too much limiter action will impair audio quality. If static peaks and noise pulses are extremely strong or if they are of fairly long duration, the effectiveness of the limiter will be best with the CONTROL SWITCH in the MVC position. In such cases both R.F. GAIN and LIMITER controls must be carefully adjusted for optimum signal-to-noise ratio.

## 3.3. CW Reception

3.31 The initial adjustment of the receiver for CW reception is as described in Par. 3.21, except that the CONTROL SWITCH must be in the CWO position. The C.W. OSC. control should be set at mid-scale.

3.32 The sensitivity of the receiver should be adjusted by means of the R.F. GAIN control, care being taken not to advance the control to the point where strong signals will cause I.F. or audio amplifier overload.

3.33 The action of the TONE and LIMITER controls will be similar to that described under Par. 3.24 and 3.25. When receiving CW signals, it will be possible to advance both TONE and LIMITER controls considerably further than is possible in MCW reception, since audio distortion is relatively unimportant.

3.34 Turning the C.W. OSC. control will change the characteristic pitch of the receiver background noise. The pitch will become higher as the CW oscillator is detuned from the I.F. amplifier. With the C.W. OSC. control set at 2 or 3,(on either side of 0) the characteristic pitch of the receiver background noise will be in the neighborhood of 2000 cycles. Under these conditions, the audio beat note of any CW signal will show a broad peak at approximately 2000 cycles. This peak will appear on "one side of the carrier" only and the other side, where the audio beat note is around 2000 cycles, will be considerably weaker. This characteristic is helpful in receiving weak signals through interference.

## 3.4 Measurement of Signal Strength

3.41 To make a measurement of signal strength by means of the S-meter, the R.F.GAIN control must be fully advanced, the CONTROL SWITCH in the AVC position and the S-meter

switch S-103 depressed to complete the meter circuit. The adjustment of the TONE, LIMITER and A.F. GAIN controls is unimportant.

3.42 With no R.F. input to the receiver, or with the antenna disconnected, the S-meter should read 0, plus or minus 1 S-unit. If it does not, the S-meter circuit requires adjustment. See Section 4.6.

3.43 Measurement of the signal strength of CW signals cannot be made with the CW oscillator in operation.

## SECTION 4. ALIGNMENT

### 4.1 General

4.11 All circuits are carefully aligned before shipment, using precision crystal oscillators which insure close conformability to dial calibration. No readjustment will be required, therefore, unless the receiver is subjected to extremely rough handling.

4.12 The SENSITIVITY vs. FREQUENCY curves of Dwg. No. 9.1 indicate the overall sensitivity of the average Radio Receiving Equipment. These curves, together with the MAXIMUM NOISE LEVEL curves of Dwg. No. 9.2, provide data for definitely checking the Radio Receiver to determine if repairs or realignment are necessary, since the majority of circuit element failures, or any misalignment, will reduce both sensitivity and maximum noise level of the Equipment. The data referred to above will, therefore, also serve to show the efficacy of repairs or realignment.

4.13 The SELECTIVITY, IMAGE ATTENUATION, FIDELITY and AVC characteristics of Dwg. Nos. 9.3 to 9.6 inclusive are necessary where a particular performance check is desired, but are of secondary importance in most cases, since an Equipment having normal SENSITIVITY and MAXIMUM NOISE characteristics will, in all probability, be normal in all other respects.

4.14 Should realignment of the Radio Receiver become necessary, the following alignment data should be carefully studied before making any circuit adjustments. The operator is cautioned against making any adjustments indiscriminately and he should not realign any circuit unless tests definitely indicate that realignment is necessary. It is important that the operator understand the function of each circuit element so that correct alignment may be obtained quickly and accurately.

4.15 Before proceeding with the alignment of any circuit of the Radio Receiver, the Equipment must be set up as specified in Section 2, "Installation", except that the an-

tenna lead-in or transmission line must be disconnected. An output meter having a 600 ohm resistive load should be connected to the phone output jack J-101. In this case, the speaker remains connected to terminals E-102. Alternatively, an output meter having a 500 ohm resistive load may be connected to the speaker output terminals E-102 with the speaker disconnected. The R.F. GAIN control should be fully advanced and the POWER SUPPLY switch in the B+ ON position. The band selector knob must be set to connect one of the radio frequency bands: either the band upon which realignment is desired, or the band specified in any of the data in Sections 5 and 9. The TONE control should be set at "N" and the LIMITER at 0.

4.16 The complete alignment of the Radio Receiver may be divided into four steps:

(1) Intermediate Frequency Amplifier Alignment.

(2) H.F. Oscillator Alignment.

(3) First Detector and R.F. Amplifier Alignment.

(4) Tracking of H.F. Oscillator, First Detector and R.F. Amplifier circuits.

The circuits MUST be checked in the above order when complete alignment is necessary.

## 4.2 I.F. Amplifier Alignment

4.21 The intermediate frequency of the Radio Receiver is 456 kilocycles, plus or minus 2 kilocycles.

4.22 Tuning adjustments are provided on each I.F. transformer. These adjustments are designated by symbol numbers C-149 to C-154 inclusive on Photo No. 7.3 and Dwg. No. 8.1.

4.23 To align the I.F. amplifier, the high output lead of an accurately calibrated signal generator should be connected to the grid terminal of the first detector tube V-102, and the grounded lead to any convenient point on the chassis. The flexible grid lead must be disconnected from the grid of tube V-102. Connection is made directly from the output jack of the signal generator, the dummy antenna being omitted. Certain types of signal generators may not have a complete D.C. path between the two output leads; in such cases, a resistor having a value between 5,000 and 50,000 ohms should be connected between the grid of tube V-102 and chassis to provide a grid return path. The CONTROL SWITCH of the receiver should be in the MVC position and the modulation of the signal generator turned on to provide a test signal, modulated 30%, 400 cycles. The A.F. GAIN control should be fully advanced.

4.24 The signal generator should be tuned to 456 kilocycles and the output attenuator adjusted to provide a signal of approximately 100 microvolts. The I. F. tuning adjustments referred to in Par. 4.22 should each be carefully adjusted to give a maximum reading on the output meter. The order in which the adjustments are made is not important. While making these adjustments, it will be necessary to retard the attenuator of the signal generator if the readjustment increases I.F. amplifier gain to the point where overload occurs.

4.25 The performance of the I.F. amplifier and audio circuits may be checked against the stage gain data in Section 5.3, after alignment has been completed. Selectivity may be checked against the data in Dwg. No. 9.3.

4.26 After alignment of the I.F. amplifier has been completed, the modulation of the signal generator should be turned off; the CONTROL SWITCH should be set at CWO; and the C.W. OSC. control should be set at 0, at which setting the CW oscillator should be at zero beat with the test signal. If zero beat does not occur at 0, readjust capacitor C-157 of transformer T-104, as shown on Photo No. 7.3.

### 4.3 H.F. Oscillator Alignment

4.31 If, after I.F. alignment is completed, tests compared with the data in Section 9 indicate that alignment of any high frequency circuit is necessary, the procedure is as outlined in the following paragraphs.

4.32 The coil group which is plugged into the circuit at any time is the one directly underneath the three-gang tuning capacitor at the center of the chassis. The coil nearest the front of the receiver is in the high frequency oscillator circuit, the middle coil is in the first detector circuit, and the coil nearest the antenna-ground binding post strip E-101 is in the R.F. amplifier circuit. As shown in the photographs, there are two holes in each coil compartment; of each pair, the one nearest the front of the receiver is directly over the trimmer capacitor.

4.33 Set the tuning dial near the high frequency end of the range and check the dial reading against the calibration curve by means of an accurate signal generator or a signal of known frequency. Readjustment should be made if the dial reading is in error by more than plus or minus 2 per cent.

4.34 Errors in frequency calibration at the high frequency end of the dial scale are corrected by adjustment of the H.F. oscillator trimmer capacitor of the band in question. The five H.F. oscillator trimmer capacitors carry symbol numbers from C-161 to

C-165 inclusive, as shown in Photo. No. 7.5. A screw driver having a metal shaft may be used to make the adjustment but the shaft should not touch any part of the aluminum coil catacomb. If the dial reading of the receiver is too high, the capacity of the H.F. oscillator trimmer must be decreased to make correction. Conversely, low dial readings are corrected by increasing the capacity of the H.F. oscillator trimmer capacitor.

4.35 It is imperative that the high frequency oscillator circuits operate at a higher frequency than that of the R.F. amplifier circuits. This can be checked by tuning in the image signal, which should appear at a dial reading approximately 912 kilocycles below that of the real signal. The image signal should be considerably weaker (see Dwg. No. 9.4) if the R.F. amplifier is correctly aligned and a stronger test signal may be required before the image can be found. If the image does not appear at the lower frequency dial setting, the H.F. oscillator circuit is incorrectly adjusted and the capacity of the H.F. oscillator trimmer capacitor in question must be decreased until the real signal and image signal appear at the proper points on the dial.

## 4.4 First Detector and R.F. Amplifier Alignment

4.41 With the test signal from the signal generator adjusted to provide a modulated signal near the high frequency limit of the band to be checked, tune the receiver to give maximum output, as indicated by the output meter. The first detector and R.F. trimmer capacitors of the band in question may now be adjusted to give maximum output meter readings. On the highest frequency bands, adjustment of the first detector and R.F. trimmers may change the calibration of the high frequency oscillator, necessitating readjustment of the tuning dial to keep the receiver in tune with the test signal. If these trimmers should require considerable realignment, it may be necessary to readjust the high frequency oscillator trimmer in order to maintain correct calibration.

4.42 A very simple and quick method of first detector and R.F. trimmer alignment may be used if a signal generator is not available. This method consists of setting the trimmers at the adjustment which provides maximum circuit or background noise. It will be found that trimmer settings under this method are sufficiently sharp to provide good alignment, although the adjustment must be made with care to avoid alignment to the image frequency.

## 4.5 Tracking of High Frequency Circuits

4.51 After the H.F. oscillator and R.F. amplifier trimmers have been checked in accordance with Sections 4.3 and 4.4, near the high frequency limit of the band under

test, the receiver should be tuned to a frequency near the low frequency end of the band. Tracking and calibration at any point up to the low frequency limit may be checked by adjusting the signal generator to the proper frequency and testing the settings of high frequency circuit trimmers. After such a test, all trimmers checked should be reset at the high frequency end of the band. A simpler and quicker tracking check may be made by bending the outside rotor plates of each section of the main tuning capacitor C-105 in turn so that the maximum capacity of each circuit may be increased or decreased by a small amount. The rotor plates must not be bent so much that they will not return to their original positions when pressure is removed. Any change in capacity in any section of this capacitor should decrease the sensitivity of the receiver.

4.52 Series padding capacitor C-147 is used to obtain correct calibration at the low frequency end of the 200 to 400 kilocycle range. If the dial reading is too low, the capacity of C-147 should be increased, and vice versa.

4.53 In order to determine if one or more sections of the main tuning capacitor C-105 are the cause of any mistracking present, it is necessary to make the check described in Par. 4.51 on two or more different bands. If the same tracking error appears on all bands, the main tuning capacitor is definitely at fault. The error should be corrected by permanently bending the rotor or stator plates to provide the proper capacity.

4.54 If the tracking error appears only in the H.F. oscillator, first detector or R.F. amplifier stage and on only one band, the inductance of the tuned circuit of that stage is incorrect. If the tracking check of Par. 4.51 shows that more capacity is needed for correct alignment, the inductance in question is too low and vice versa. After any adjustment of inductance, the associated trimmer capacitor must be readjusted at the high frequency end of the band, as explained under Par. 4.41. Tracking should then be checked again at the low frequency end of the band.

4.55 After alignment has been completed, the antenna feed-line should be connected to the receiver and final adjustment of the R.F. amplifier trimmer should then be made.

## 4.6 S-Meter Adjustment

4.61 The S-meter balancing resistor R-135 is used to obtain zero meter reading in the absence of signal input to the receiver. The adjustment is as follows: Set the R.F. GAIN at 10, CONTROL SWITCH at MVC, and disconnect the antenna leads; adjust R-135 until the S-meter reads zero.

## SECTION 5. SERVICE AND TEST DATA

### 5.1 General

5.11 Even though all component parts of the receiver have an ample factor of safety, failure may occur in certain individual cases. Of these failures, the most common will probably be due to some defect in one of the tubes. Measurement of voltages and cathode currents, in accordance with the data of Par. 5.23, will show which tube is bad. If the failure is a short in either the plate or screen circuits, the filter resistors associated with the circuit in question should be checked for possible burnout. Similarly, should any by-pass capacitor fail, any filter or voltage divider resistors which are connected in series with it should be checked for any change in resistance which may result from the overload.

5.12 Other possible failures, such as open circuits caused by poor connections, can likewise be located by current and voltage tests, in accordance with the tabulation of Par. 5.23. Open by-pass capacitors are apt to cause either a loss of sensitivity or oscillation in some portion of the circuit. In such cases, the fault can be easily located by temporarily connecting a good capacitor in parallel with each unit that is under suspicion.

5.13 Intermittent or noisy operation of the receiver is usually caused by a poor connection in either the wiring or in one of the tubes. Such a fault is often rather difficult to find but can usually be located by lightly tapping each circuit element or component with a piece of insulating material.

### 5.2 Tube Socket Voltages and Cathode Currents

5.21 The TUBE SOCKET VOLTAGES AND CATHODE CURRENTS table 5.23 must not be considered as a list of the actual operating voltages and currents in the various circuits of the Radio Receiver. The resistance of the measuring instruments, together with capacitive and resistive loading effects, will disturb many of the circuits to such an extent that they become inoperative, thus altering normal voltage and current distribution.

5.22 The only currents listed in table 5.23 are those in the various cathode circuits. This listing is a desirable simplification, inasmuch as measurement of cathode current constitutes a definite check on all circuits directly associated with the vacuum tube in question.

## 5.23 TUBE SOCKET VOLTAGES AND CATHODE CURRENTS

| TERMINAL | VARIABLE | | VOLTAGE D.C.VOLTS | | CURRENT D.C.MA. | |
|---|---|---|---|---|---|---|
| | SYMBOL | SETTING | R-121 AT 0 | R-121 AT 10 | R-121 AT 0 | R-121 AT 10 |
| V-101 Grid | None | | 0 | 0 | | |
| V-101 Cathode | None | | A 20 | A 2.1 | 4.2 | .8 |
| V-101 Screen | None | | B 90 | B 68 | | |
| V-101 Plate | None | | B 215 | B 195 | | |
| V-102 Grid | None | | 0 | 0 | | |
| V-102 Cathode | See # | | A 3.0 | A 2.8 | .6 | .55 |
| V-102 Screen | See # | | B 37 | B 34 | | |
| V-102 Plate | See # | | B 200 | B 185 | | |
| V-103 Grid | See # | | --* | --* | | |
| V-103 Cathode | See # | | 0 | 0 | --* | --* |
| V-103 Screen | See # | | B 58 | B 53 | | |
| V-103 Plate | See # | | B 200 | B 185 | | |
| V-104 Grid | None | | 0 | 0 | | |
| V-104 Cathode | None | | A 20 | A 3.5 | 2.3 | .7 |
| V-104 Screen | None | | B 90 | B 68 | | |
| V-104 Plate | None | | B 210 | B 190 | | |
| V-105 Grid | None | | 0 | 0 | | |
| V-105 Cathode | None | | A 20 | A 6.5 | 2.5 | .9 |
| V-105 Screen | None | | B 110 | B 87 | | |
| V-105 Plate | None | | B 215 | B 190 | | |
| V-106A Grid | None | | 0 | 0 | | |
| V-106A Cathode | None | | A 4.4 | A 4.0 | 2.2 | 2.0 |
| V-106A Plate | None | | B 110 | B 100 | | |
| V-106B Grid | See o | | 0 | 0 | | |
| V-106B Cathode | None | | A -33 | A -44 | 0 | 0 |
| V-106B Cathode | See o | | A 6.5 | A 9.0 | 0 | 0 |
| V-106B Plate | See o | | B 35 | B 45 | | |
| V-106B Plate | S-102B | MVC | 0 | 0 | | |
| V-106B Plate | S-102B# | CWO | 0 | B -10* | | |
| V-107A Grid | None | | 0 | 0 | | |
| V-107A Cathode | S-102B | MVC | A 6.0 | A 6.5 | .1 | .1 |
| V-107A Cathode | S-102B | CWO | A 9 | A 12 | .2 | .2 |

## 5.23 TUBE SOCKET VOLTAGES AND CATHODE CURRENTS
(Continued)

| TERMINAL | | VARIABLE | | VOLTAGE D.C.VOLTS | | CURRENT D.C.MA. | |
|---|---|---|---|---|---|---|---|
| | | SYMBOL | SETTING | R-121 AT 0 | R-121 AT 10 | R-121 AT 0 | R-121 AT 10 |
| V-107A | Plate | None | | B 215 | B 195 | | |
| V-107B | Grid | R-144 | 0 | A -2* | A -3* | | |
| V-107B | Grid | R-144 | 10 | 0 | 0 | | |
| V-107B | Cathode | R-144 | 0 | A -3* | A -4* | -- | -- |
| V-107B | Cathode | R-144 | 10 | A .3* | A .5* | -- | -- |
| V-107B | Plate | None | | 0 | 0 | | |
| V-108 | Grid | See * | | -- | -- | | |
| V-108 | Cathode | None | | 0 | 0 | --* | --* |
| V-108 | Screen | S-102B | MVC | 0 | 0 | | |
| V-108 | Screen | S-102B | CWO | B 15* | B 13* | | |
| V-108 | Plate | S-102B | MVC | 0 | 0 | | |
| V-108 | Plate | S-102B | CWO | B 40* | B 35* | | |
| V-109 | Grid | See ° | | 0 | 0 | | |
| V-109 | Cathode | See ° | | A 13 | A 12 | 52 | 47 |
| V-109 | Screen | None | | B 215 | B 195 | | |
| V-109 | Plate | None | | B 190 | B 175 | | |
| V-110 | Plate | S-101B | B+ OFF | 0 | 0 | | |
| V-110 | Plate | S-101B | B+ ON | B 42 | B 55 | | |
| V-110 | Fil. | S-101B | B+ OFF | B 255 | B 255 | | |
| V-110 | Fil. | S-101B | B+ ON | B 260 | B 240 | | |
| Chassis | | See ° | | B 38 | B 45 | | |

All measurements made with equipment connected for normal operation.

A.C. Supply Voltage 115 volts 60 cycles.**

Voltage measurements made with a D.C. voltmeter, 1000 ohms per volt. "A" readings taken on 0-50 volt scale, i.e., meter resistance is 50,000 ohms. "B" readings taken on 0-250 volt scale, i.e., meter resistance is 250,000 ohms. Unless otherwise specified, voltage

**See Notice, Page ii.

is measured between terminal and receiver chassis (negative).

All readings will depend (in varying degree) upon the resistance of the meter. Readings not marked with an asterisk are subject to a variation of plus or minus 15%.

\# Voltages and currents in this circuit are influenced by the setting of the tuning capacitor C-105, and by the radio frequency band in use. Measurement (if any) taken at 2500 kilocycles.

* Accurate measurement of voltage and/or current in this circuit cannot be made with an "analyzer" due to loading effects.

o This voltage measurement is made between terminal and B minus. Negative terminal of voltmeter to B minus.

## 5.3 Stage Gain Measurements

5.31 The sensitivity measurements listed below are made under the following conditions. The Equipment to be tested is set up in accordance with Par. 4.15 with the 1300 to 2800 kilocycle band in operation. A signal generator is connected in accordance with Par. 4.23, except that the high output lead is attached to the grid of the tube specified in the list below, and the test signal is 456 ± 2 Kc. modulated 30%, 400 cycles. Both R.F. GAIN and A.F. GAIN controls of the receiver must be fully advanced; the CONTROL SWITCH must be in the MVC position.

5.32 With 6 milliwatt output at the phone jack, the test signal should be within the limits specified below. The same data will apply with 480 milliwatt output at speaker terminals E-102.

| TERMINAL | TEST SIGNAL |
|---|---|
| V-102 Grid | 22 ± 8 Microvolts |
| V-104 Grid | 750 ± 200 Microvolts |
| V-105 Grid | 60,000 ± 15,000 Microvolts |
| V-107A Grid | Over 1. Volt |

## 5.4 RMA Color Code for Resistors

5.41 Body color denotes first numeral in resistance value. End color denotes second numeral. Dot color denotes number of ciphers following first two numerals. Gold color end dip indicates 5% tolerance. Silver color end dip indicates 10% tolerance. Other resistors 20% tolerance.

| COLOR | BODY | END | DOT |
|---|---|---|---|
| Black | -- | 0 | .0 |
| Brown | 1 | 1 | 0 |
| Red | 2 | 2 | 00 |
| Orange | 3 | 3 | 000 |
| Yellow | 4 | 4 | 0000 |
| Green | 5 | 5 | 00000 |
| Blue | 6 | 6 | 000000 |
| Purple | 7 | 7 | 0000000 |
| Gray | 8 | 8 | 00000000 |
| White | 9 | 9 | --- |

# SECTION 6. PARTS LIST

## 6.1 List of Manufacturers

| | | |
|---|---|---|
| 1 | Aerovox Corporation | New Bedford, Mass. |
| 2 | Central Radio Laboratories | Milwaukee, Wisconsin |
| 3 | Cornell-Dubilier Electric Corp. | So. Plainfield, New Jersey |
| 4 | General Electric (Mazda) | Cleveland, Ohio |
| 5 | Arrow-Hart & Hegeman | Hartford, Connecticut |
| 6 | Littelfuse Laboratories | Chicago, Illinois |
| 7 | Clarostat Mfg. Co. Inc. | Brooklyn, New York |
| 8 | National Company, Inc. | Malden, Massachusetts |
| 9 | RCA Mfg. Company (Tubes) | Harrison, New Jersey |
| 10 | Yaxley Div. of P.R.Mallory & Co. Inc. | Indianapolis, Indiana |
| 11 | Sprague Products Company | North Adams, Massachusetts |
| 12 | Jenson Radio Manufacturing Co. | Chicago, Illinois |
| 13 | Marion Electrical Instrument Co. | Manchester, New Hampshire |
| 14 | Cinch Manufacturing Corporation | Chicago, Illinois |
| 15 | Cornish Wire Company | New York, N.Y. |
| 16 | E. F. Johnson | Waseca, Minnesota |

6.2 Radio Receiver

| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | CAPACITORS | | |
| C-101 | V-109 Cathode By-pass | Paper: .25 mfd. 200 V DC W | 11 | 0252AA |
| C-102 | V-106A to V-109 Coupling | Paper: .1 mfd. 600 V DC W | 11 | G016AB |
| C-103 | V-106A Cathode By-pass | Elect: 25 mfd. 50 V DC W | 3 | FA10062 |
| C-104 | Tone Control | Mica: .001 mfd. 500 V DC W | 1 | 1467 |
| C-105 | Main Tuning | Variable Air: 3 gang, 12 to 225 mmf. per section | 8 | NPW3-225 |
| C-106 | V-107B Output By-Pass | Mica: .00025 mfd. 500 V DC W | 1 | 1468 |
| C-107 | Tone Control | Paper: .01 mfd. 600 V DC W | 11 | G116AB |
| C-108 | V-107A to V-107B Coupling | Paper: 1 mfd. 200 V DC W | 1 | 284 |
| C-109 | V-107A Cathode By-pass | Same as C-106 | | |
| C-110 | V-106A Plate By-pass | Same as C-106 | | |
| C-111 | V-105 B+ By-pass | Same as C-102 | | |
| C-112 | V-105 Screen By-pass | Paper: .1 mfd. 400 V DC W | 11 | 014AB |
| C-113 | V-105 Cathode By-pass | Same as C-112 | | |
| C-114 | V-105 Grid Filter | Same as C-107 | | |
| C-115 | V-104 B+ By-pass | Same as C-102 | | |
| C-116 | V-104 Cathode By-pass | Same as C-112 | | |
| C-117 | V-104 Grid Filter | Same as C-107 | | |
| C-118 | V-102 and V-103 B+ By-pass | Same as C-102 | | |
| C-119 | V-102 Cathode By-pass | Same as C-112 | | |
| C-120 | V-101 and V-104 B+ By-pass | Same as C-102 | | |
| C-121 | V-101 Screen By-pass | Same as C-112 | | |
| C-122 | V-101 Cathode By-pass | Same as C-112 | | |
| C-123 | V-101 Grid Filter | Mica: .005 mfd. 300 V DC W | 1 | 1467 |
| C-124 | V-101 Grid Filter | Same as C-107 | | |
| C-125 | V-103 Grid | Mica: .0001 mfd. 500 V DC W | 1 | 1468 |
| C-126 | V-103 Heater By-pass | Same as C-107 | | |
| C-127 | V-103 Screen By-pass | Same as C-112 | | |
| C-128 | V-103 to V-102 Coupling | Same as C-107 | | |
| C-129 | CW Osc. Vernier | Variable Air: 3 to 10 mmf. | 8 | CWV-100 |
| C-130 | V-108 Grid | Mica: .001 mfd. 500 V DC W | 1 | 1460 |

| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | CAPACITORS (CONT'D) | | |
| C-131 | V-108 Heater By-pass | Same as C-112 | | |
| C-132 | V-108 Screen By-pass | Same as C-112 | | |
| C-133 | V-106B Cathode By-pass | Same as C-112 | | |
| C-134 | Power Supply Filter | Oil: 4 mfd. 600 V DC W | 3 | TLAD-6040 |
| C-135 | Power Supply Filter | Same as C-134 | | |
| C-136 | Power Supply Filter | Same as C-134 | | |
| C-137 | Power Supply Filter | Same as C-134 | | |
| C-138 | V-107B to V-106A Coupling | Same as C-107 | | |
| C-139 | V-106B Plate By-pass | Same as C-112 | | |
| C-140 | V-108 to V-107A Coupling | Bakelite: 1 mmf. 400 V DC W | 8 | B22 |
| C-141 | V-107A to V-106B Coupling | Mica: .00005 mfd. 500 V DC W | 1 | 1468 |
| C-142 | H.F.Osc. pad.,200 to 400 kcs. | Mica: .000175 mfd. 500 V DC W | 1 | 1467 |
| C-143 | H.F.Osc. pad.,1.3 to 2.8 mcs. | Mica: .0008 mfd. 500 V DC W | 1 | 1467 |
| C-144 | H.F.Osc. pad.,2.8 to 6.4 mcs. | Mica: .00136 mfd. 500 V DC W | 1 | 1467 |
| C-145 | H.F.Osc. pad.,6.4 to 14. mcs. | Mica: .0031 mfd. 300 V DC W | 1 | 1467 |
| C-146 | H.F.Osc. pad.,14. to 30. mcs. | Mica: .00098 mfd. 500 V DC W | 1 | 1467 |
| C-147 | H.F.Osc. pad.,200 to 400 kcs. | Variable Air: 3 to 30 mmf. | 8 | M30 |
| C-148 | Not Used | | | |
| C-149 | T-121 Pri. Tuning | Variable Air: 6 to 85 mmf. | 8 | |
| C-150 | T-121 Sec. Tuning | Same as C-149 | | |
| C-151 | T-103 Pri. Tuning | Same as C-149 | | |
| C-152 | T-103 Sec. Tuning | Same as C-149 | | |
| C-153 | T-102 Pri. Tuning | Same as C-149 | | |
| C-154 | T-102 Sec. Tuning | Same as C-149 | | |
| C-155 | Not Used | | | |
| C-156 | Not Used | | | |
| C-157 | T-104 Tuning | Same as C-151 | | |
| C-158 | V-109 Plate By-pass | Mica: .0085 mfd. 300 V DC W | 1 | 1467 |
| C-159 | V-107A Plate By-pass | Paper: .05 mfd. 600 V DC W | 11 | G156AB |
| C-160 | R.F.Amp.Pad.,14 to 30 mcs. | Same as C-146 | | |
| C-161 | H.F.Osc.Trim. 200 to 400 kcs. | Variable Air: 8 to 75 mmf. | 8 | |
| C-162 | H.F.Osc.Trim. 1.3 to 2.8 mcs. | Variable Air: 4 to 23 mmf. | 8 | |
| C-163 | H.F.Osc.Trim. 2.8 to 6.4 mcs. | Variable Air: 3.5 to 19 mmf. | 8 | |
| C-164 | H.F.Osc.Trim, 6.4 to 14. mcs. | Same as C-163 | | |

N O T I C E

This Equipment is also built for operation from a 115 volt (±10%), 25 cycle power source. When it is so furnished, this manual is applicable, but all references to "115 volt (±10%), 50/60 cycle" are understood to mean "115 volt (±10%), 25 cycle".

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| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | CAPACITORS (CONT'D) | | |
| C-165 | H.F.Osc.Trim, 14. to 30. mcs. | Variable Air: 3 to 11 mmf. | 8 | |
| C-166 | 1st Det.Trim, 200 to 400 kcs. | Variable Air: 6 to 45 mmf. | 8 | |
| C-167 | 1st Det.Trim, 1.3 to 2.8 mcs. | Same as C-163 | | |
| C-168 | 1st Det.Trim, 2.8 to 6.4 mcs. | Same as C-163 | | |
| C-169 | 1st Det.Trim, 6.4 to 14. mcs. | Same as C-165 | | |
| C-170 | 1st Det.Trim, 14. to 30. mcs. | Same as C-163 | | |
| C-171 | R.F.Amp.Trim, 200 to 400 kcs. | Variable Air: 5 to 35 mmf. | 8 | |
| C-172 | R.F.Amp.Trim, 1.3 to 2.8 mcs. | Same as C-163 | | |
| C-173 | R.F.Amp.Trim, 2.8 to 6.4 mcs. | Same as C-162 | | |
| C-174 | R.F.Amp.Trim, 6.4 to 14. mcs. | Same as C-162 | | |
| C-175 | R.F.Amp.Trim, 14. to 30. mcs. | Same as C-162 | | |
| | | MISCELLANEOUS EIECTRICAL PARTS | | |
| E-101 | Antenna Input Terminals | Insulated Binding Posts | 8 | FWK |
| E-102 | Loud Speaker Output | Insulated Tip Jacks | 14 | 1720 |
| E-103 | S-101B Terminals | Insulated Screw Terminals | 14 | 1720 |
| E-104 | W-201 Shield Ground | Screw Terminal | 8 | HC-LUG |
| E-105 | S-101 Knob | Bakelite Knob with Pointer | 8 | HRP-P |
| E-106 | S-102 Knob | Same as E-105 | | |
| E-107 | R-144 Knob | Same as E-105 | | |
| E-108 | R-115 Knob | Same as E-105 | | |
| E-109 | Not used | | | |
| E-110 | Not used | | | |
| E-111 | C-129 Knob | Same as E-105 | | |
| E-112 | R-116 Knob | Same as E-105 | | |
| E-113 | Band Changing Knob | Bakelite Knob, 1/4" Shaft | 8 | HRK |
| E-114 | Main Tuning Knob | Bakelite Knob, 3/16" Shaft | 8 | HRK |
| E-115 | V-104 Grid Shield | Metal Tube Cap | 14 | 6011 |
| | | FUSES | | |
| F-101 | AC Line Fuse | 1 Amp. Glass Enclosed | 6 | 3AG |
| | | INDICATING DEVICES | | |
| I-101 | "S" Meter Lamp | 6.3 V, .25 A Screw Base | 4 | 46 |

| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | INDICATING DEVICES (Cont'd) | | |
| I-102 | Main Dial Lamp | Same as I-101 | | |
| I-103 | Main Dial Lamp | Same as I-101 | | |
| | | JACKS | | |
| J-101 | Headphone Output | Multi-Circuit Jack | 10 | 705 |
| J-102 | Coil Catacomb Grounding | Prong Clip | 16 | 247 |
| | | INDUCTORS | | |
| L-101 | B+ Filter | 5000 Turns #31 D.C. Resistance 300 Ohms | 8 | 80 |
| L-102 | B+ Filter | Same as L-101 | | |
| | | METERS | | |
| M-101 | Signal Strength Meter | 0 to 1 Milliammeter | 13 | RMB-52 |
| | | DIALS | | |
| N-101 | Not used | | | |
| N-102 | Not used | | | |
| N-103 | Main Calibration | Etched Scale | 8 | MDS-100BR |
| N-104 | Auxiliary Logging | Etched Dial | 8 | VDS-100 |
| | | MECHANICAL PARTS | | |
| O-101 | Pinion Gear | 12 Tooth Gear | 8 | CBP-100 |
| O-102 | Gear Rack | 9" Gear Rack | 8 | CBR-100 |
| O-103 | Catacomb Rod | 7/16" Diam., 16-7/8" Length | 8 | ROD-100 |
| | | PLUGS | | |
| P-101 | AC Connector | 2 prong, 660 W, 250 V | 15 | 150 |
| P-102 | Primary Tap Connector | 1/4" diam., Brass | 8 | TP-100 |
| P-103 | Coil Catacomb | 1/4" diam., Brass | 8 | CCP-100 |
| | | RESISTORS | | |
| R-101 | V-101 Grid Filter | 500,000 ohm $\frac{1}{2}$ Watt | 2 | 310 |
| R-102 | V-101 Cathode Bias | 500 ohm $\frac{1}{2}$ Watt | 2 | 310 |
| R-103 | V-102 Cathode Bias | 5,000 ohm $\frac{1}{2}$ Watt | 2 | 310 |

| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | RESISTORS (CONT'D) | | |
| R-104 | B+ Voltage Divider | 20,000 ohm, 2 Watt | 2 | 316 |
| R-105 | V-104 Grid Filter | Same as R-101 | | |
| R-106 | V-104 Cathode Bias | 300 to 5,000 Ohm, ½ Watt | 2 | 310 |
| R-107 | V-105 Grid Filter | Same as R-101 | | |
| R-108 | V-105 Cathode Bias | 300 to 5,000 Ohm, ½ Watt | 2 | 310 |
| R-109 | V-105 Screen | 70,000 Ohm, ½ Watt | 2 | 310 |
| R-110 | V-105 Screen Bleeder | 100,000 Ohm ½ Watt | 2 | 310 |
| R-111 | V-104 Plate Filter | 2,000 Ohm ½ Watt | 2 | 310 |
| R-112 | V-107A I.F. Filter | Same as R-103 | | |
| R-113 | V-107A Load | 50,000 Ohm, ½ Watt | 2 | 310 |
| R-114 | V-107B Input | Same as R-110 | | |
| R-115 | Tone Control | 500,000 Ohm 1 Watt Comp. Var. | 2 | 62-106 |
| R-116 | Audio Gain Control | 500,000 Ohm 1 Watt Comp. Var. | 2 | 72-105 |
| R-117 | V-106A Cathode Bias | Same as R-111 | | |
| R-118 | V-109 Cathode Bias | 250 Ohm, 2 Watt | 2 | 316 |
| R-119 | Audio Voltage Divider | 450 Ohm, 5 Watt | 11 | 5K |
| R-120 | Audio Voltage Divider | 50 Ohm, ½ Watt | 2 | 310 |
| R-121 | R.F.Gain Control | 10,000 Ohm, 1.5 Watt, W.W.Variable | 7 | P58-10,000U |
| R-122 | R.F.Gain Control Bleeder | Same as R-113 | | |
| R-123 | V-101 Grid Filter | Same as R-101 | | |
| R-124 | B+ Voltage Divider | Same as R-104 | | |
| R-125 | V-103 Grid Leak | 20,000 Ohm, ½ Watt | 2 | 310 |
| R-126 | V-103 and V-102 Plate Filter | Same as R-111 | | |
| R-127 | V-102 Screen | Same as R-110 | | |
| R-128 | V-103 Screen Bleeder | Same as R-110 | | |
| R-129 | V-103 Screen | 50,000 Ohm, 1 Watt | 2 | 314 |
| R-130 | V-108 Plate | 250,000 Ohm, ½ Watt | 2 | 310 |
| R-131 | V-108 Grid Leak | Same as R-113 | | |
| R-132 | V-108 Screen Bleeder | Same as R-110 | | |
| R-133 | AVC Filter | Same as R-101 | | |
| R-134 | "S" Meter Bridge | 1,000 Ohm, ½ Watt | 2 | 310 |
| R-135 | "S" Meter Adjustment | 1,000 Ohm, W.W. Variable | 7 | MH-1000 |
| R-136 | V-106B Plate | Same as R-101 | | |

| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | RESISTORS (CONT'D) | | |
| R-137 | AVC Voltage Divider | 1,500 Ohm, 2 Watt | 2 | 316 |
| R-138 | AVC Voltage Divider | 1,000 Ohm, 2 Watt | 2 | 316 |
| R-139 | V-106B Cathode | 500 Ohm, 2 Watt | 2 | 316 |
| R-140 | V-106B Grid Leak | 5 Megohm, ½ Watt | 2 | 310 |
| R-141 | V-107A Plate Filter | Same as R-111 | | |
| R-142 | Degeneration | Same as R-101 | | |
| R-143 | V-109 Grid Leak | Same as R-101 | | |
| R-144 | Noise Limiter Control | Same as R-121 | | |
| R-145 | V-108 Screen | Same as R-110 | | |
| R-146 | V-106A Plate | Same as R-129 | | |
| R-147 | V-107B Output | Same as R-113 | | |
| | | SWITCHES | | |
| S-101 | Power Supply | Three Position Rotary. Rating: 1 Amp., 250 Volts | 5 | 1570NF |
| A | AC Power Input | | | |
| B | B+ ON-OFF | | | |
| S-102 | Control Switch | Same as S-101 | | |
| A | AVC-MVC | | | |
| B | C.W.Osc. ON-OFF | | | |
| S-103 | "S" Meter ON-OFF | SPST, 1 Amp., 250 Volts | 5 | 3597 E |
| S-104 | Tone Control (Cut Lows) | Part of R-115 | | |
| S-105 | Not used | | | |
| | | TRANSFORMERS | | |
| T-101 | Audio Output Coupling | 5000/500 Ohms | 8 | 5363-A |
| T-102 | V-105 to V-107A I.F.Coupling | 456 K.C. | 8 | 19 |
| T-103 | V-104 to V-105 I.F.Coupling | 456 K.C. | 8 | 20 |
| T-104 | C.W.Osc. Tuning | 456 K.C. | 8 | 11 |
| T-105 | Power Transformer | 115 Volt, 50/60 cycles*, 100 Watt | 8 | 11,028# |
| T-106 | H.F. Oscillator Coil | 200 to 400 kc. Range | 8 | 49-H3 |
| T-107 | H.F. Oscillator Coil | 1.3 to 2.8 mc. Range | 8 | 100-D3 |
| T-108 | H.F. Oscillator Coil | 2.8 to 6.4 mc. Range | 8 | 100-C3 |

*See Notice, Page ii.

#Mfr. Type 12,203 used on 25 Cycle Equipment.

| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | TRANSFORMERS (CONT'D) | | |
| T-109 | H.F. Oscillator Coil | 6.4 to 14. mc. Range | 8 | 100-B3 |
| T-110 | H.F. Oscillator Coil | 14. to 30. mc. Range | 8 | 100-A3 |
| T-111 | First Detector Coil | 200 to 400 kc. Range | 8 | 48-H2 |
| T-112 | First Detector Coil | 1.3 to 2.8 mc. Range | 8 | 26-D2 |
| T-113 | First Detector Coil | 2.8 to 6.4 mc. Range | 8 | 100-C2 |
| T-114 | First Detector Coil | 6.4 to 14. mc. Range | 8 | 100-B2 |
| T-115 | First Detector Coil | 14. to 30. mc. Range | 8 | 100-A2 |
| T-116 | R.F. Amplifier Coil | 200 to 400 kc. Range | 8 | 47-H1 |
| T-117 | R.F. Amplifier Coil | 1.3 to 2.8 mc. Range | 8 | 28-D1 |
| T-118 | R.F. Amplifier Coil | 2.8 to 6.4 mc. Range | 8 | 100-C1 |
| T-119 | R.F. Amplifier Coil | 6.4 to 14. mc. Range | 8 | 100-B1 |
| T-120 | R.F. Amplifier Coil | 14. to 30. mc. Range | 8 | 100-A1 |
| T-121 | V-102 to V-104 I.F. Coupling | 456 kc. | 8 | 21 |
| | | VACUUM TUBES | | |
| V-101 | R.F. Amplifier | R.F. Pentode | 9 | 6K7 |
| V-102 | First Detector | R.F. Pentode | 9 | 6J7 |
| V-103 | H.F. Oscillator | Same as V-102 | | |
| V-104 | First I.F. Amplifier | Same as V-101 | | |
| V-105 | Second I.F. Amplifier | Same as V-101 | | |
| V-106 | | Dual Triode | 9 | 6F8G |
| A | First Audio Amplifier | Part of V-106 | | |
| B | Automatic Volume Control | Part of V-106 | | |
| V-107 | | Dual Triode | 9 | 6C8G |
| A | Second Detector | Part of V-107 | | |
| B | Noise Limiter | Part of V-107 | | |
| V-108 | C.W. Oscillator | Same as V-102 | | |
| V-109 | Second Audio Amplifier | Beam Audio Output | 9 | 6V6G |
| V-110 | Rectifier | Full Wave Rectifier | 9 | 5Z3 |
| | | INTERCONNECTING CABLES | | |
| W-101 | AC Power Supply | 2 Wire Rubber Covered | 15 | P0SJ |

| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | SOCKETS | | |
| X-101 | T-105 Primary Tap Connector | Fuse Clip Mounting | 6 | 1068 |
| X-102 | Fuse Holder | Extractor Post | 6 | 1075 |
| X-103 | Socket for V-101 | 8 Prong Ceramic | 8 | CIR-8 |
| X-104 | Socket for V-102 | Same as X-103 | | |
| X-105 | Socket for V-103 | Same as X-103 | | |
| X-106 | Socket for V-104 | Same as X-103 | | |
| X-107 | Socket for V-105 | Same as X-103 | | |
| X-108 | Socket for V-107 | Same as X-103 | | |
| X-109 | Socket for V-106 | Same as X-103 | | |
| X-110 | Socket for V-108 | Same as X-103 | | |
| X-111 | Socket for V-109 | Same as X-103 | | |
| X-112 | Socket for V-110 | 4 Prong Ceramic | 8 | CIR-4 |
| X-113 | "S" Meter Lamp Mtg. | Miniature Screw | 8 | HDL-28 |
| X-114 | Main Dial Lamp Mtg. | Dual Socket Mtg. Assembly | 8 | MDL-100 |

6.3 Loud Speaker

| SYMBOL NUMBER | FUNCTION | DESCRIPTION | MFR. | MFR. TYPE NO. |
|---|---|---|---|---|
| | | TRANSFORMERS | | |
| T-201 | Matching Transformer | 500/2.8 Ohms | 12 | |
| | | INTERCONNECTING CABLES | | |
| W-201 | Speaker Cable | 2 Wire Shielded | 8 | PM8-SC |
| | | LOUD SPEAKERS | | |
| LS-201 | Loud Speaker Chassis | 8" P.M. Field | 12 | PM8C |

## 6.4 Spare Parts List

| NO. | DESCRIPTION | MFR. TYPE | MFR. |
|---|---|---|---|
| 1 | 1. mmf. 400 V DC W Bakelite Capacitor | B-22 | 8 |
| 1 | .0001 mfd. 500 V DC W Mica Capacitor | 1468 | 1 |
| 1 | .00025 mfd. 500 V DC W Mica Capacitor | 1468 | 1 |
| 1 | .001 mfd. 500 V DC W Mica Capacitor | 1467 | 1 |
| 1 | .005 mfd. 300 V DC W Mica Capacitor | 1467 | I |
| 1 | .0085 mfd. 300 V DC W Mica Capacitor | 1467 | 1 |
| 3 | .01 mfd. 600 V DC W Tubular Capacitor | G116AB | 11 |
| 1 | .05 mfd. 600 V DC W Tubular Capacitor | G156AB | 11 |
| 4 | .1 mfd. 400 V DC W Tubular Capacitor | G014AB | 11 |
| 2 | .1 mfd. 600 V DC W Tubular Capacitor | G016AB | 11 |
| 1 | .25 mfd. 200 V DC W Tubular Capacitor | 025AA | 11 |
| 1 | 1. mfd. 200 V DC W Tubular Capacitor | 284 | 11 |
| 1 | 4. mfd. 600 V DC W Oil Filled Capacitor | P8211 | 11 |
| 1 | 25. mfd. 50 V DC W Elect. Capacitor | D9050 | 11 |
| 1 | 3 to 30 mmf. Variable Mica Capacitor | M-30 | 8 |
| 1 | 50 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 250 ohm 2 W Fixed Resistor | 316 | 2 |
| 1 | 450 ohm 5 W Fixed Resistor | 5K | 11 |
| 1 | 500 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 500 ohm 2 W Fixed Resistor | 316 | 2 |
| 1 | 1000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 1000 ohm 2 W Fixed Resistor | 316 | 2 |
| 1 | 1500 ohm 2 W Fixed Resistor | 316 | 2 |
| 1 | 2000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 5000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 20000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 20000 ohm 2 W Fixed Resistor | 316 | 2 |
| 1 | 50000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 50000 ohm 1 W Fixed Resistor | 314 | 2 |
| 1 | 70000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 100000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 250000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 500000 ohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 5 megohm 1/2 W Fixed Resistor | 310 | 2 |
| 1 | 1000 ohm W.W. Variable Resistor | MH-1000 | 7 |
| 1 | 10000 ohm W.W. Variable Resistor | P-58 | 7 |
| 1 | 500000 ohm Comp. Variable Resistor | 62-106 | 2 |
| 1 | 500000 ohm Comp. Variable Resistor | 72-105 | 2 |
| 1 | Three Position Rotary Switch | 1570NH | 5 |
| 1 | Audio Output Transf. 5000/500 ohms | 5363A | 8 |
| 1 | Power Transformer, 115 V. 50/60 Cycles | 11028 | 8 |
| 1 | Speaker Transformer 500/2.8 ohms | - - | 12 |
| 1 | Filter Choke, 17 H. | 80 | 8 |
| 3 | Pilot or Dial Lamps | 40 | 4 |
| 10 | Fuses, 1 Amp. | 3AG | 6 |

NOTE:- Spare parts, as supplied, may differ from the above list, due to unavoidable substitution of equivalent, interchangeable parts made by other manufacturers.

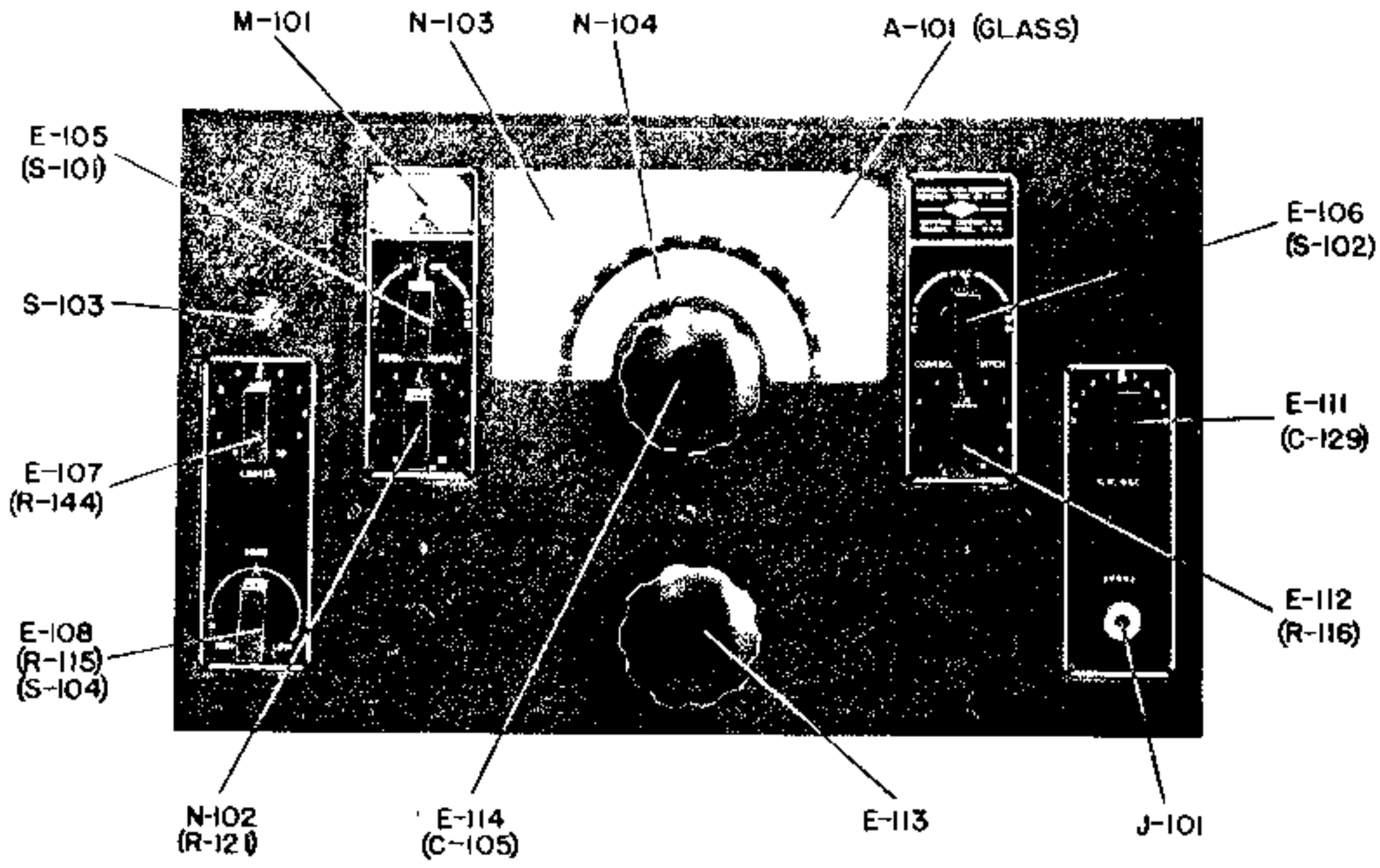



PHOTO NO. 7.1

FRONT VIEW OF RECEIVER

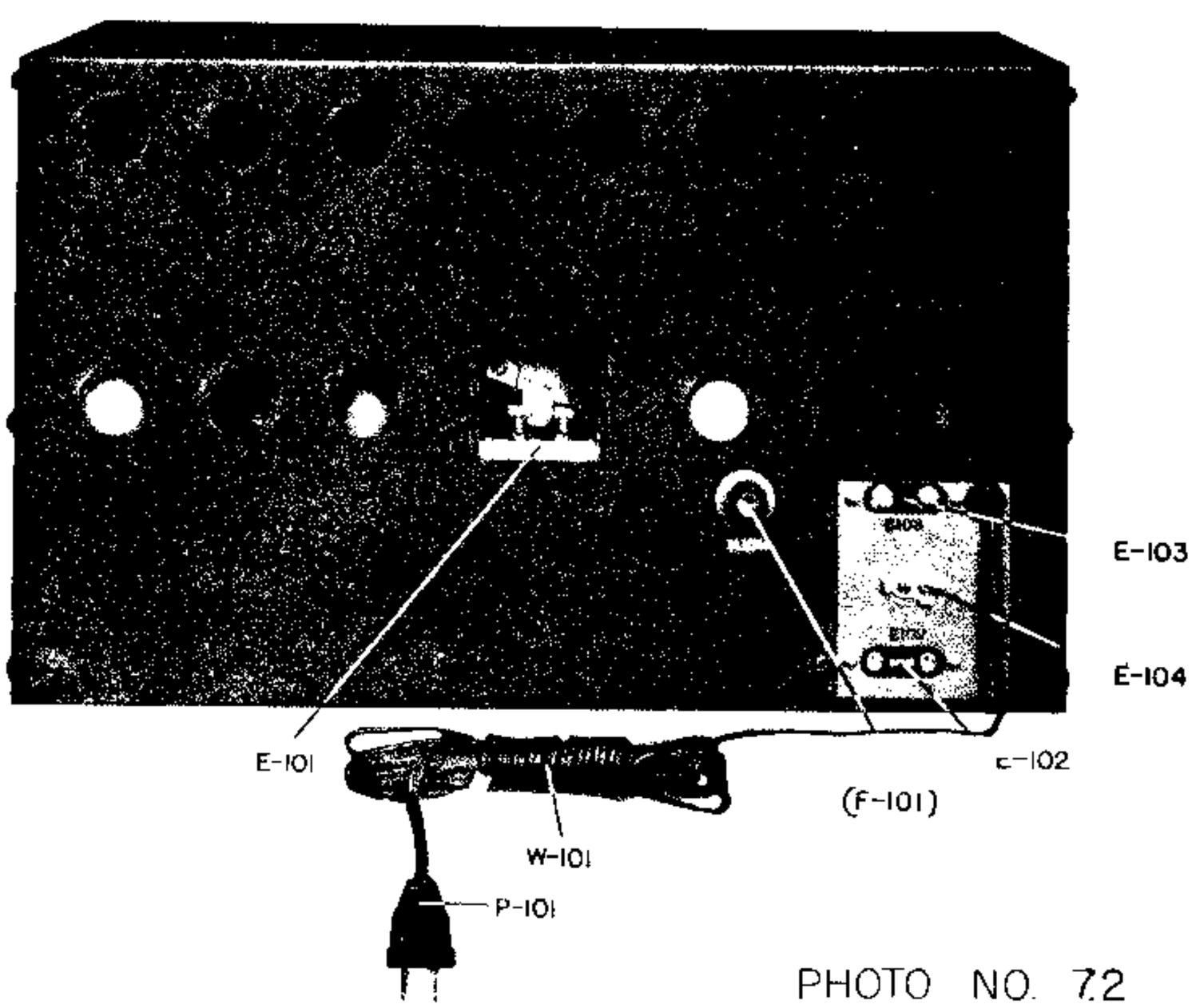
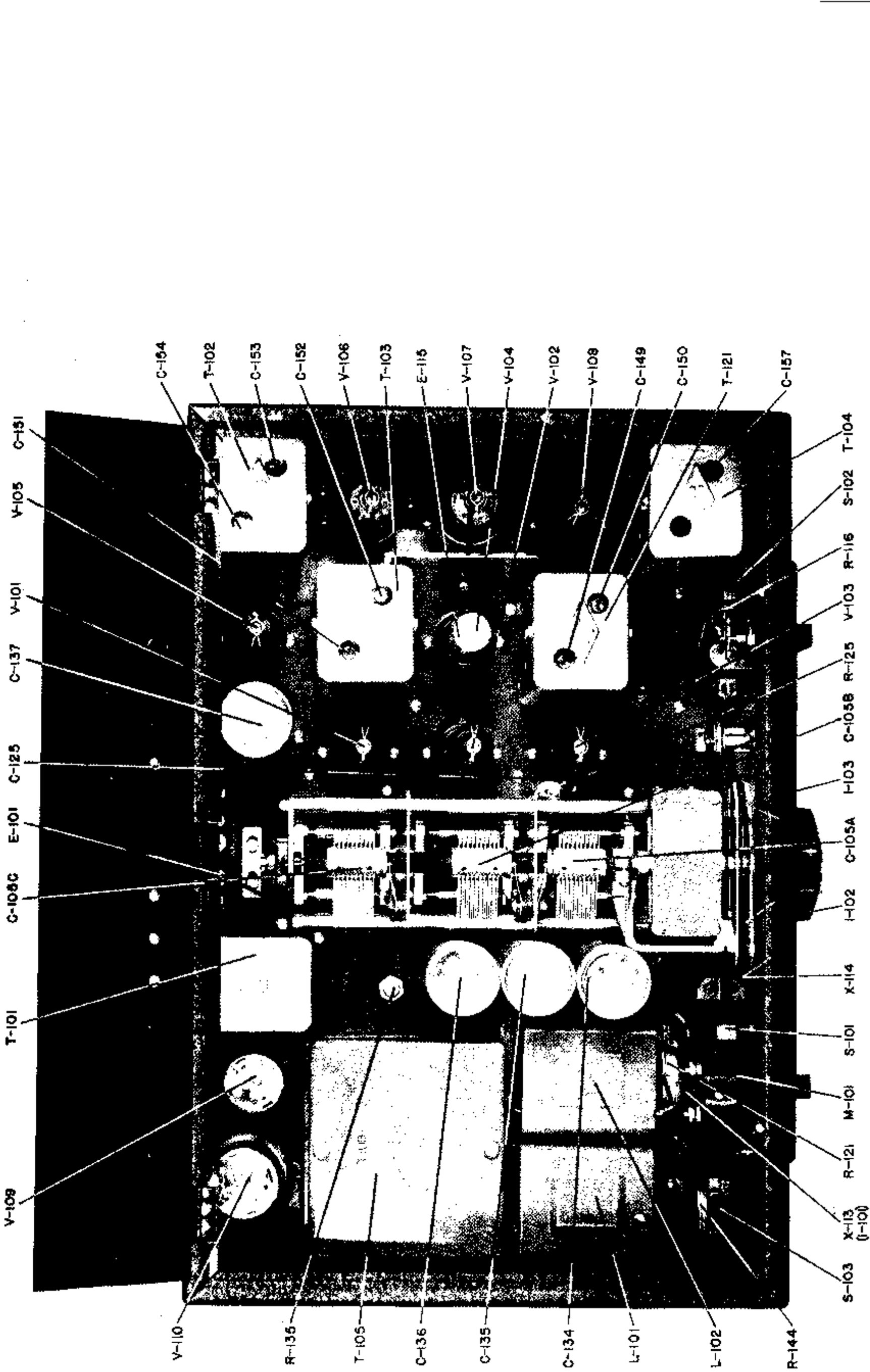


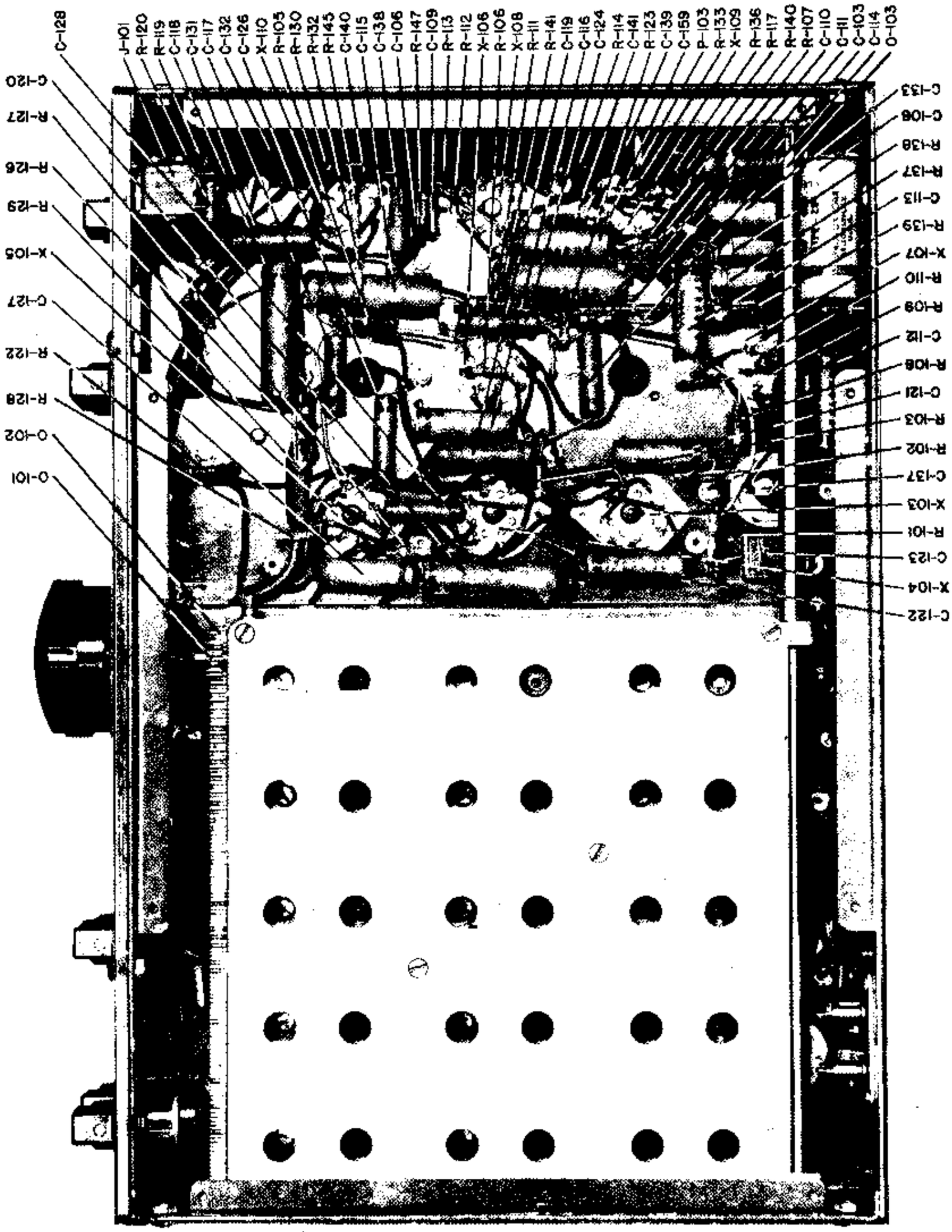

PHOTO NO. 7.2

REAR VIEW OF RECEIVER



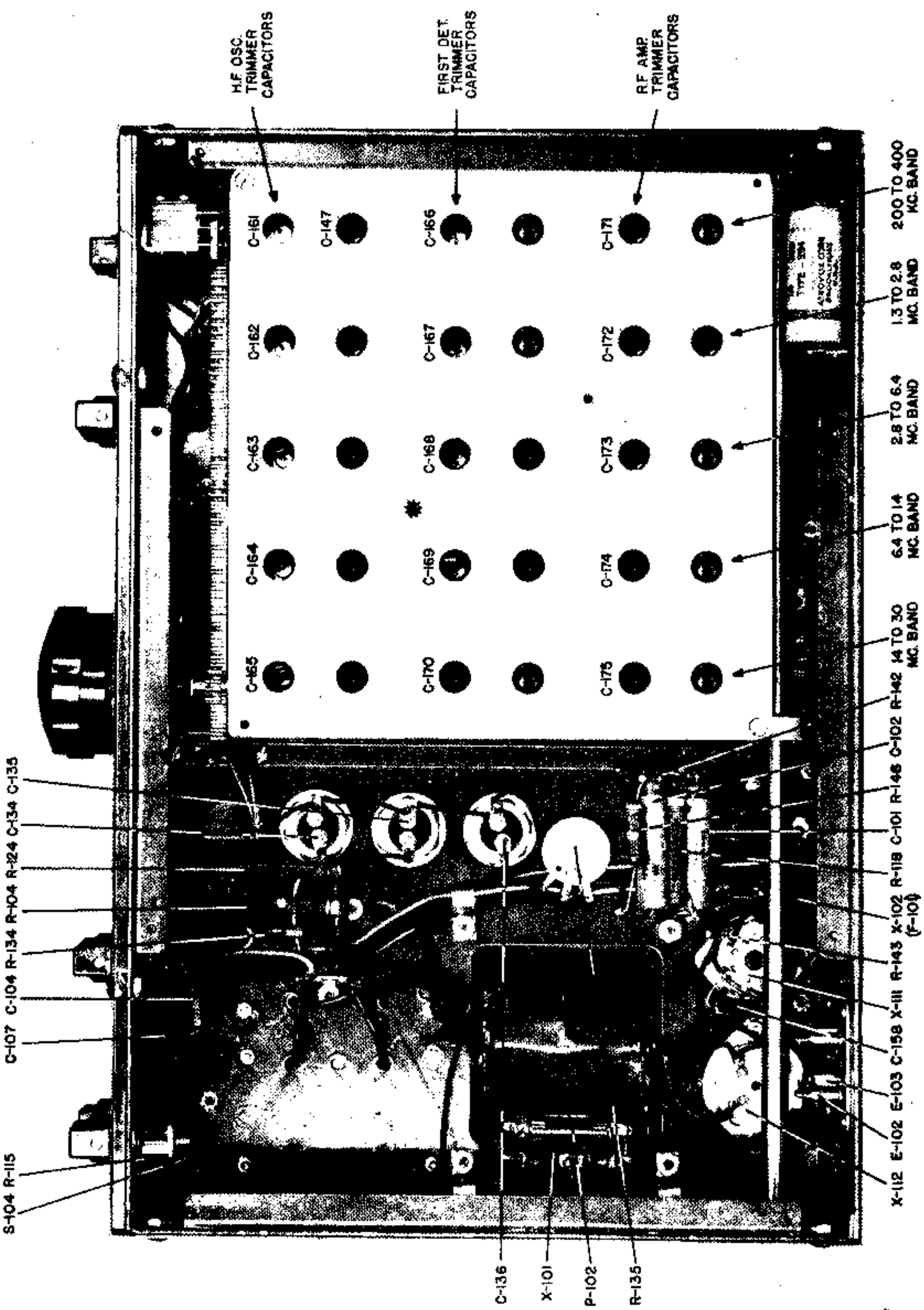

TOP VIEW OF RECEIVER

PHOTO NO. 7.3



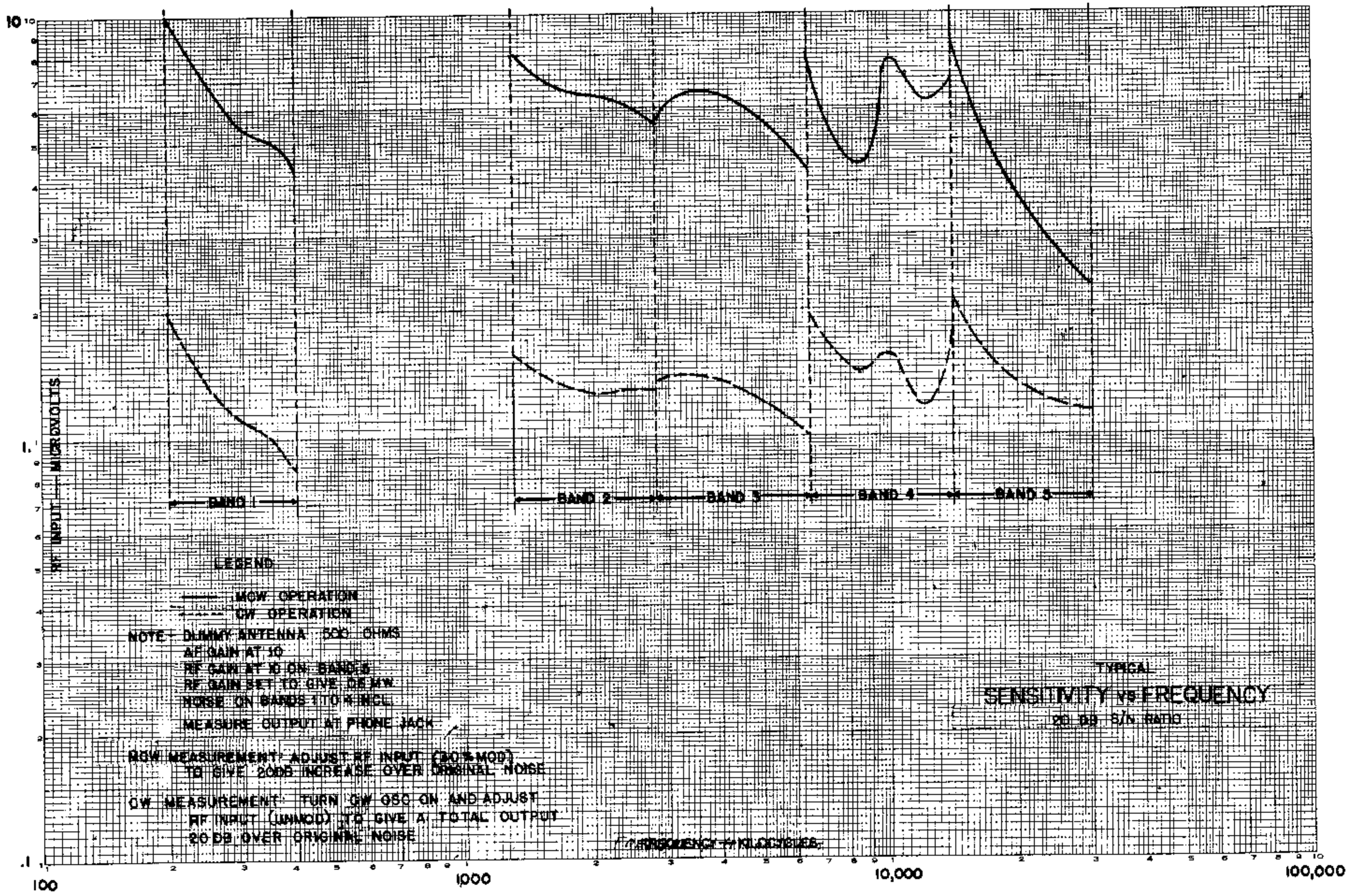

BOTTOM VIEW OF RECEIVER

PHOTO NO. 7.4



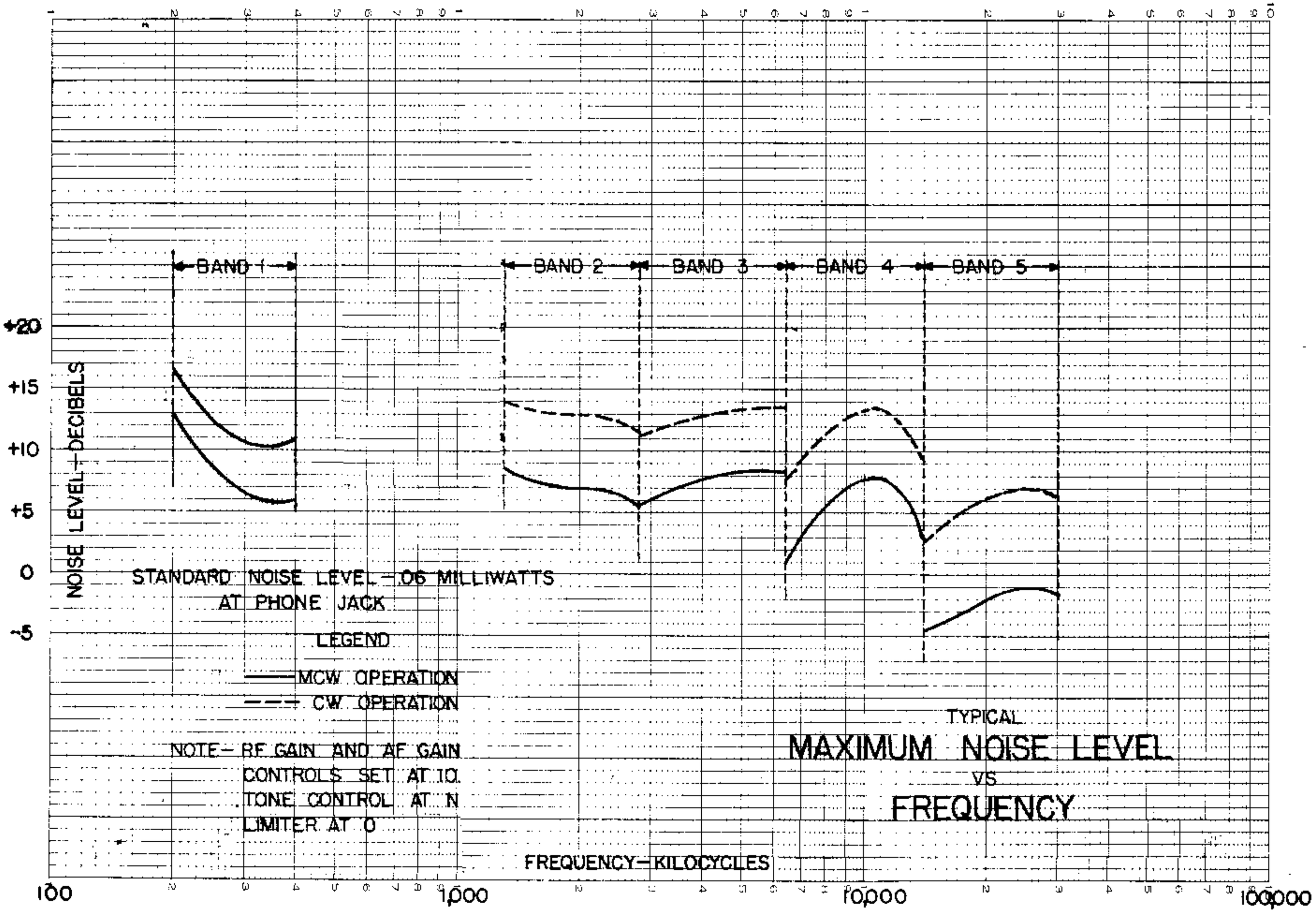

BOTTOM VIEW OF RECEIVER

PHOTO NO. 7.5

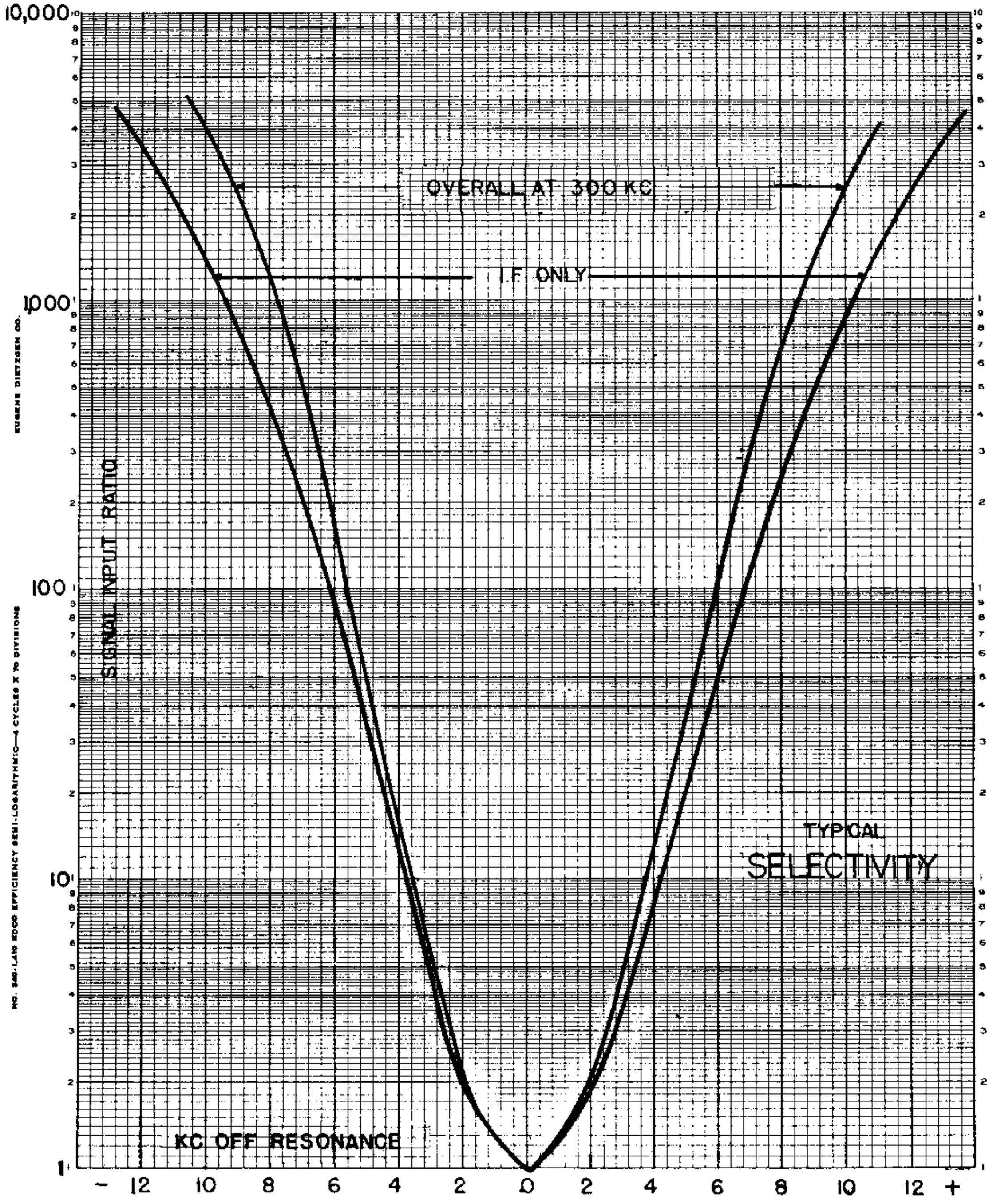

10
MICROVOLTS
BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
LEGEND
MCW OPERATION
CW OPERATION
NOTE- DUMMY ANTENNA 500 OHMS
AF GAIN AT 10
RF GAIN AT 10 ON BAND 5
RF GAIN SET TO GIVE .05 MW
NOISE ON BANDS 1 TO 4 INCL.
MEASURE OUTPUT AT PHONE JACK
MCW MEASUREMENT- ADJUST RF INPUT (30% MOD)
TO GIVE 20DB INCREASE OVER ORIGINAL NOISE
CW MEASUREMENT- TURN CW OSC ON AND ADJUST
RF INPUT (UNMOD) TO GIVE A TOTAL OUTPUT
20 DB OVER ORIGINAL NOISE
FREQUENCY IN KILOCYCLES
100
1000
10,000
100,000
TYPICAL
SENSITIVITY vs FREQUENCY
20 DB S/N RATIO



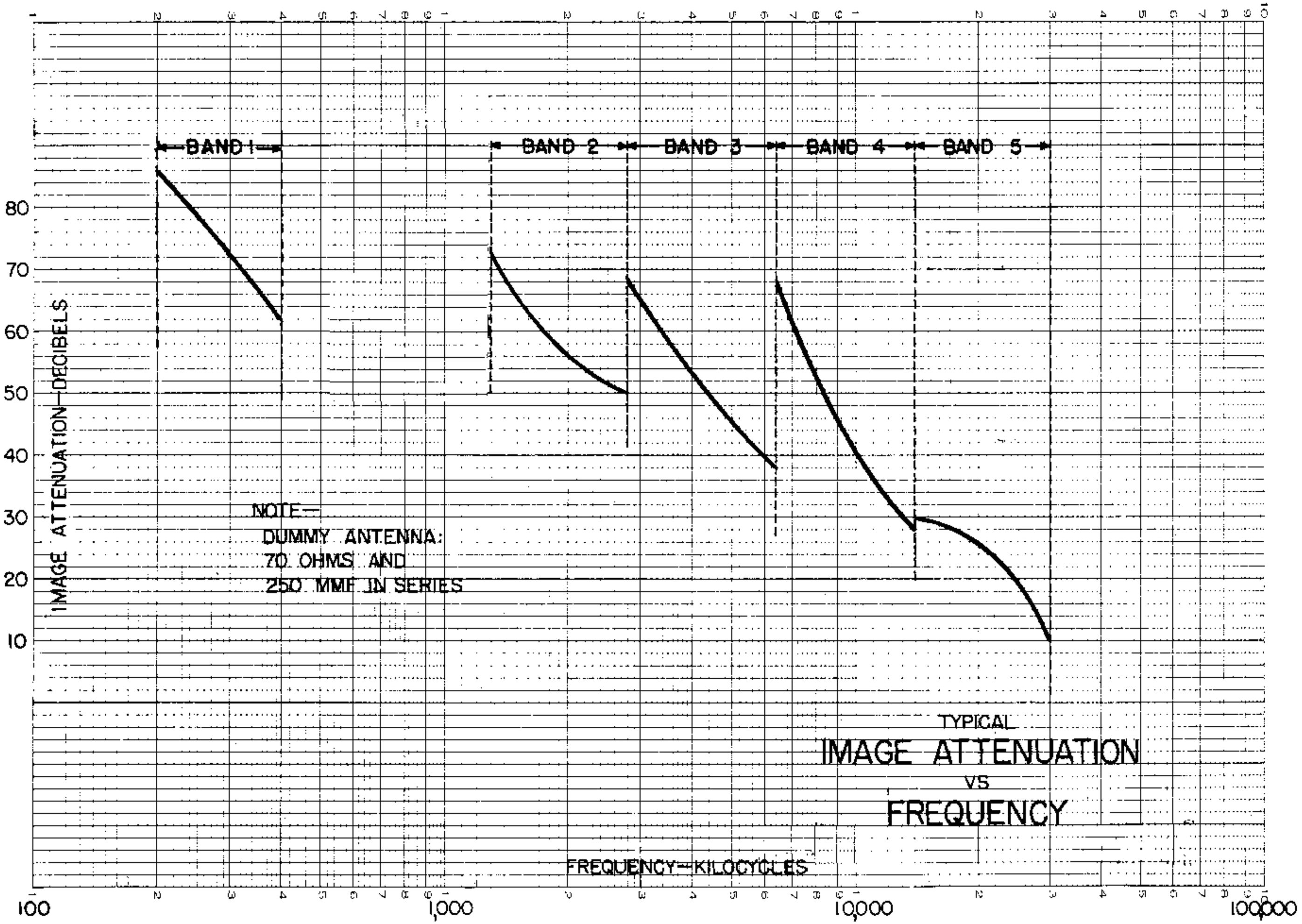
DWG. NO. 91


BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
+20
+15
+10
+5
0
-5
NOISE LEVEL+DECIBELS
STANDARD NOISE LEVEL-.06 MILLIWATTS
AT PHONE JACK
LEGEND
MCW OPERATION
CW OPERATION
NOTE- RF GAIN AND AF GAIN
CONTROLS SET AT 10.
TONE CONTROL AT N
LIMITER AT 0
TYPICAL
MAXIMUM NOISE LEVEL
VS
FREQUENCY
FREQUENCY-KILOCYCLES
100
1000
10000
100000

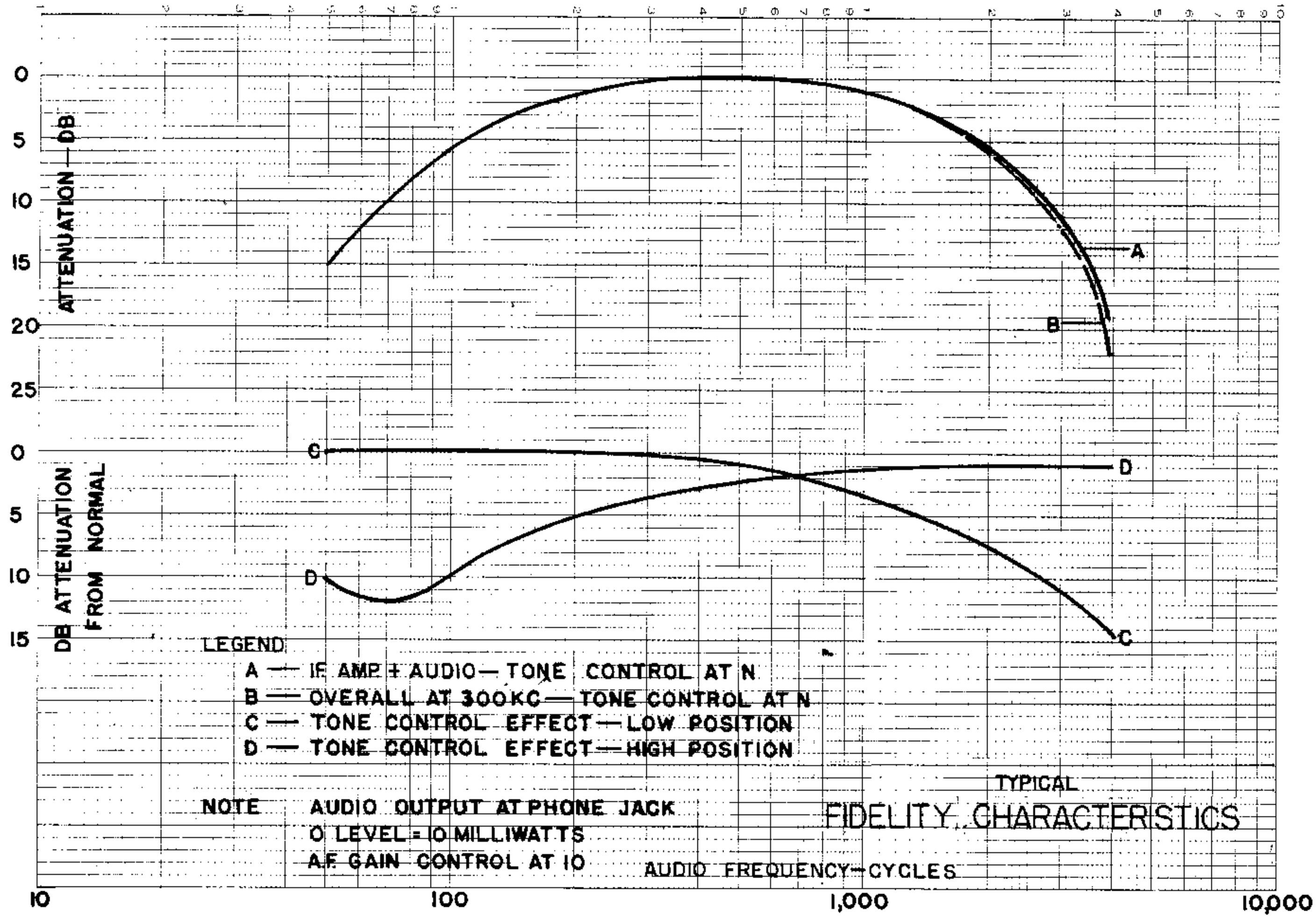
DWG. NO. 92


10,000
1000
100
10
1
SIGNAL INPUT RATIO
OVERALL AT 300 KC
I.F. ONLY
TYPICAL
SELECTIVITY
KC OFF RESONANCE
- 12 10 8 6 4 2 0 2 4 6 8 10 12 +
EUGENE DIETZGEN CO.
NO. 340-L4½ EDCO EFFICIENCY SEMI-LOGARITHMIC—4 CYCLES X 70 DIVISIONS
PRINTED IN U.S.A.

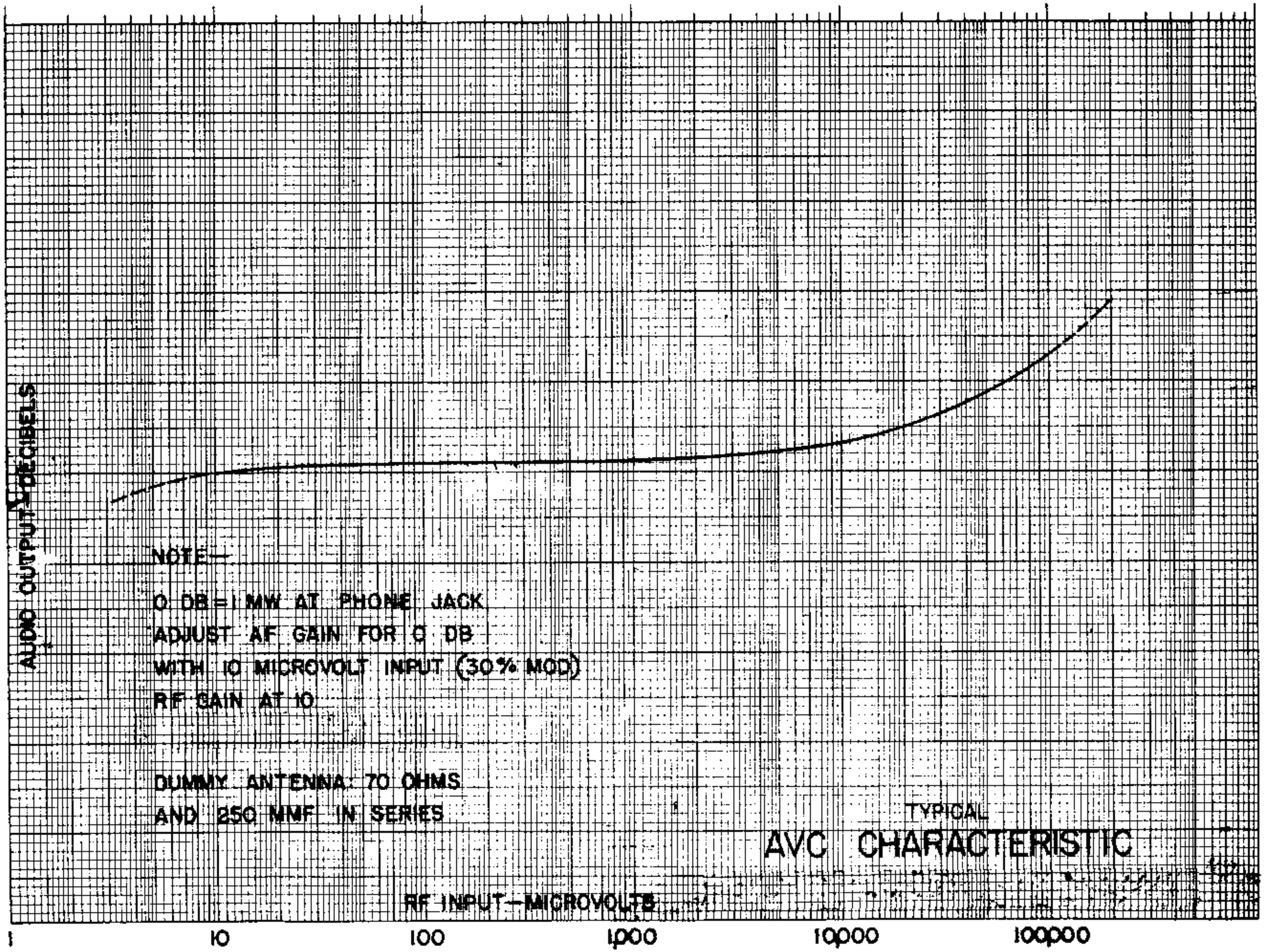
DWG. NO. 9.3


BAND 1
BAND 2
BAND 3
BAND 4
BAND 5
IMAGE ATTENUATION—DECIBELS
80
70
60
50
40
30
20
10
NOTE—
DUMMY ANTENNA:
70 OHMS AND
250 MMF IN SERIES
TYPICAL
IMAGE ATTENUATION
VS
FREQUENCY
FREQUENCY—KILOCYCLES
100
1,000
10,000
100,000

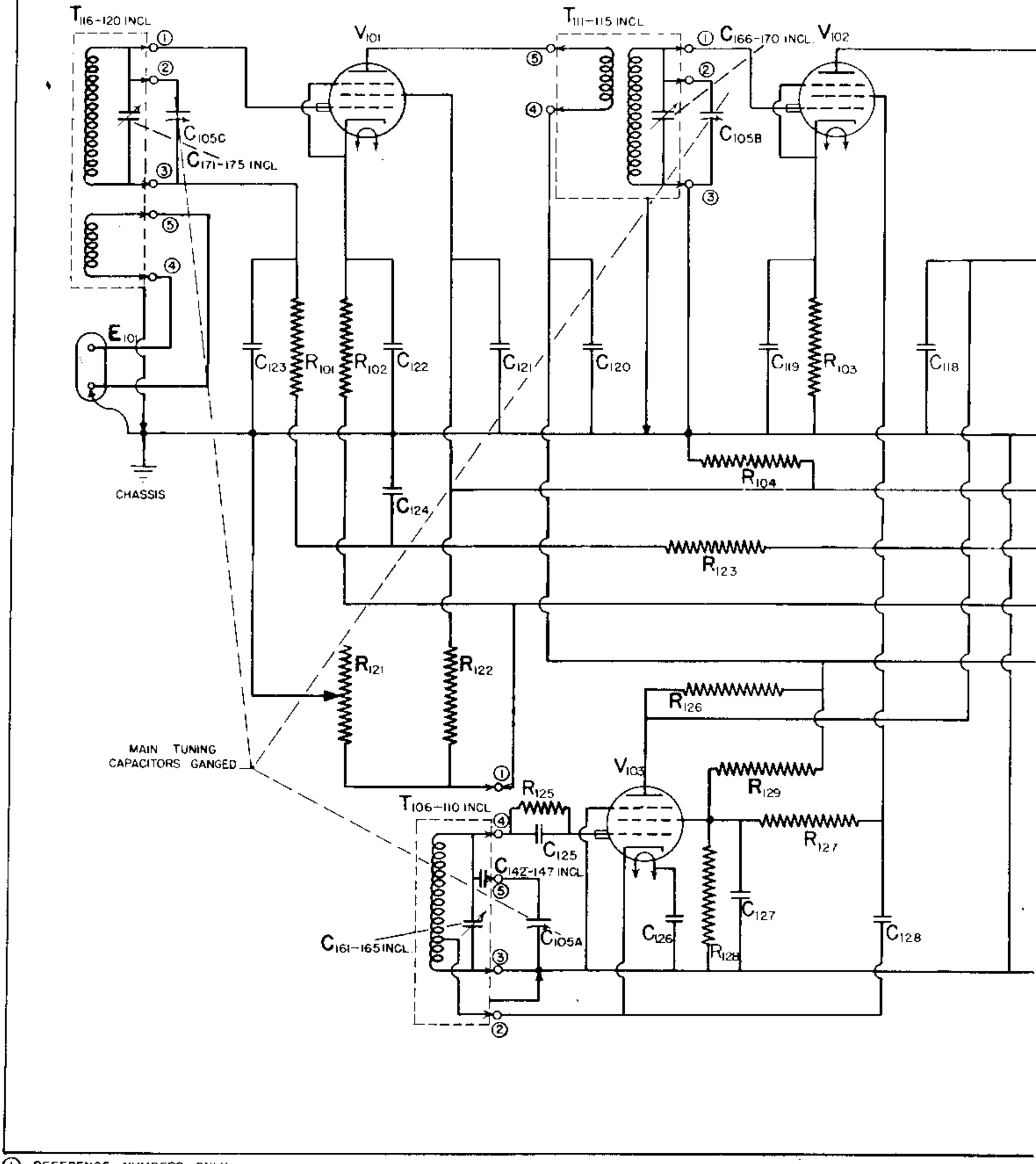
DWG. NO. 94


ATTENUATION — DB
0
5
10
15
20
25
A
B
DB ATTENUATION FROM NORMAL
0
5
10
15
C
D
D
C
LEGEND
A — IF AMP + AUDIO — TONE CONTROL AT N
B — OVERALL AT 300KC — TONE CONTROL AT N
C — TONE CONTROL EFFECT — LOW POSITION
D — TONE CONTROL EFFECT — HIGH POSITION
NOTE AUDIO OUTPUT AT PHONE JACK
0 LEVEL = 10 MILLIWATTS
A.F. GAIN CONTROL AT 10
TYPICAL
FIDELITY CHARACTERISTICS
AUDIO FREQUENCY — CYCLES
10
100
1,000
10,000

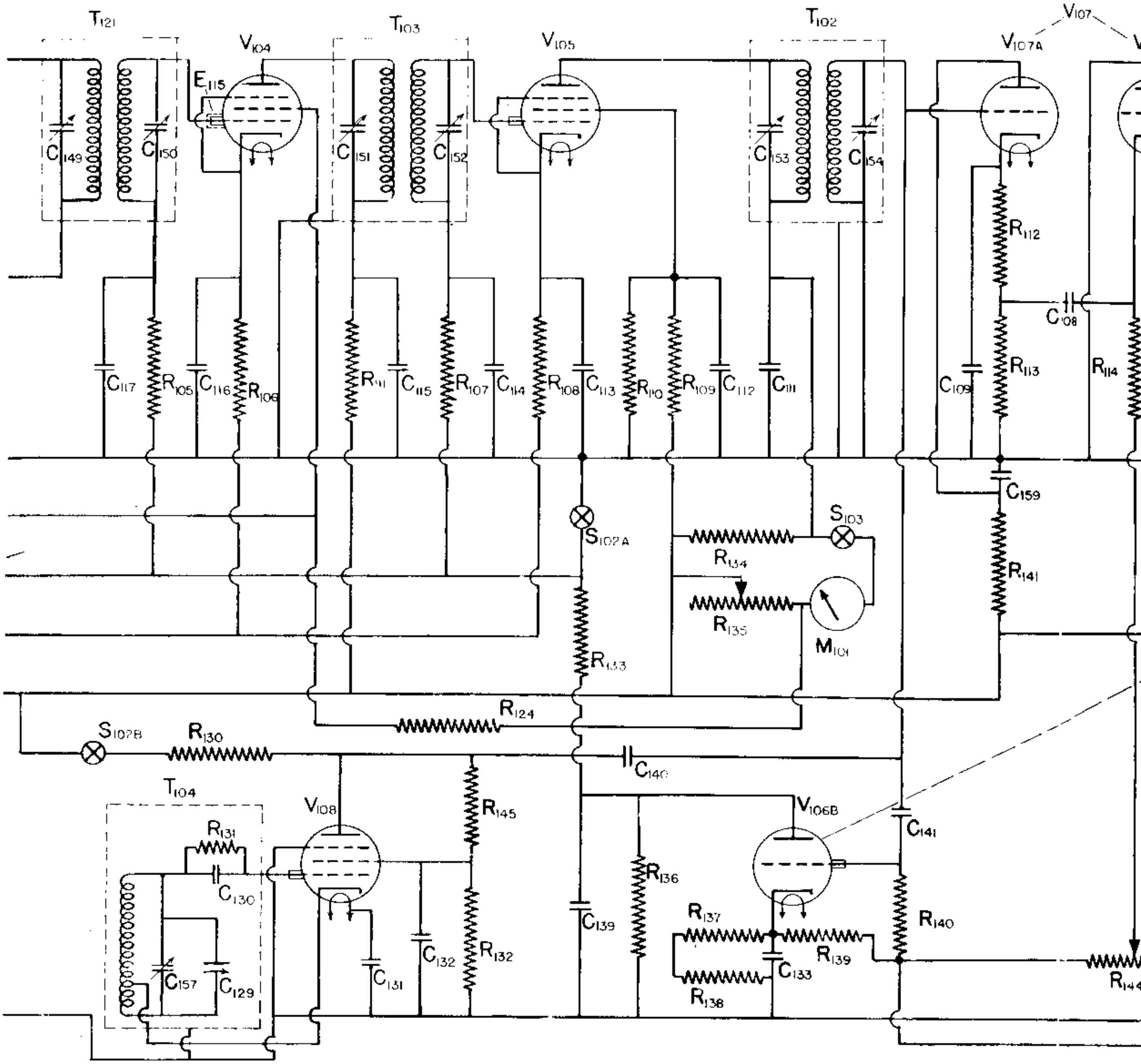
DWG. NO. 95


+10
+5
0
-5
AUDIO OUTPUT—DECIBELS
NOTE—
0 DB = 1 MW AT PHONE JACK
ADJUST AF GAIN FOR 0 DB
WITH 10 MICROVOLT INPUT (30% MOD)
RF GAIN AT 10
DUMMY ANTENNA: 70 OHMS
AND 250 MMF IN SERIES
TYPICAL
AVC CHARACTERISTIC
RF INPUT—MICROVOLTS
1
10
100
1000
10000
100000

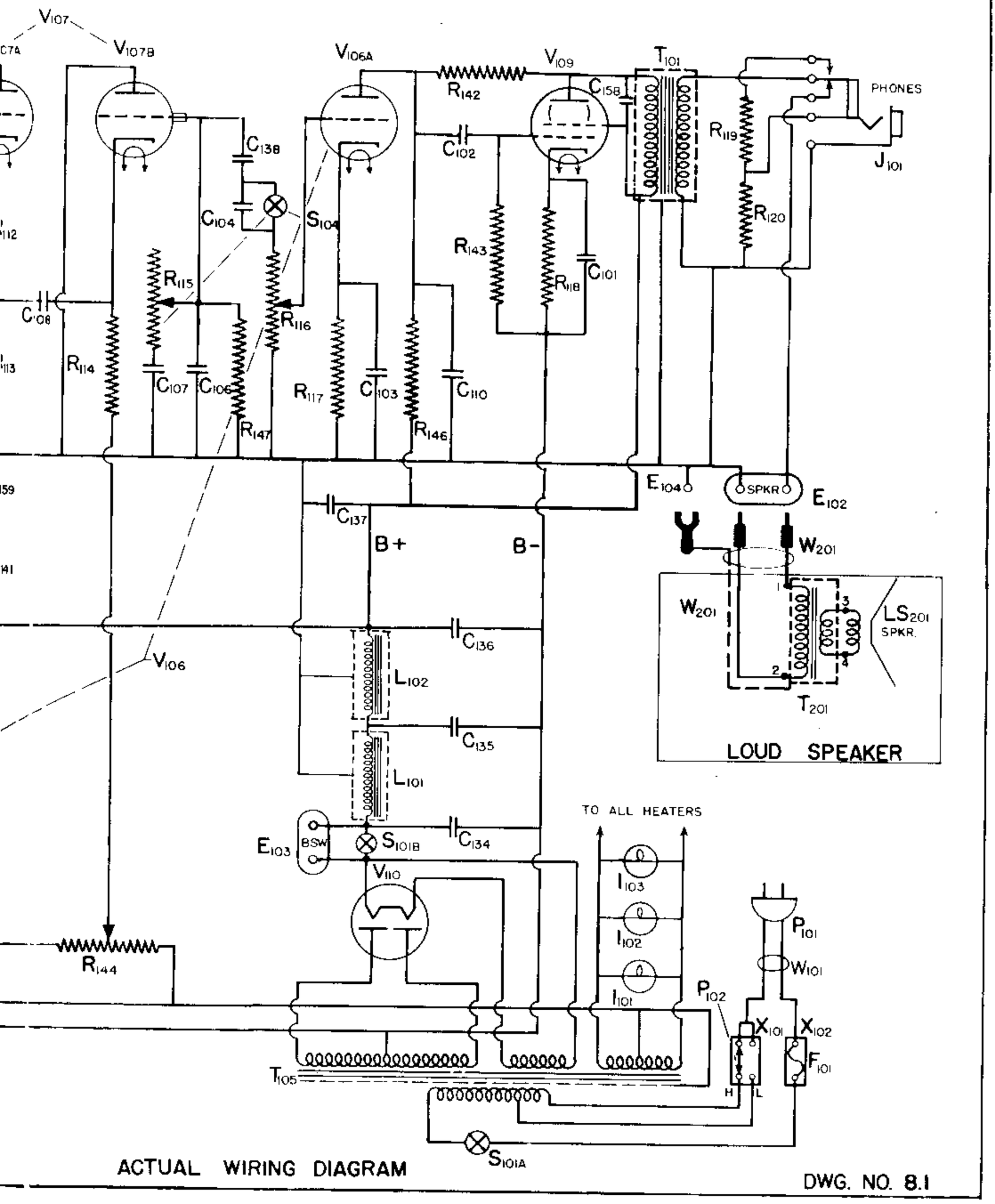
DWG. NO. 9.6




① REFERENCE NUMBERS ONLY




RADIO RECEIVER


V107
V107B
V106A
V109
T101
PHONES
R142
C158
C102
R119
J101
R120
R143
R118
C101
C104
S104
R115
R116
C108
R114
C107
C106
R147
R117
C103
C110
R146
E104
SPKR
E102
C137
B+
B-
W201
C136
L102
C135
L101
W201
LS201
SPKR.
T201
LOUD SPEAKER
V106
E103
BSW
S101B
C134
V110
TO ALL HEATERS
I103
I102
I101
P101
W101
P102
X101
X102
F101
R144
T105
S101A
ACTUAL WIRING DIAGRAM
DWG. NO. 8.1