NAVSHIPS 91907

RESTRICTED
(Non-Registered)

INSTRUCTION BOOK

for

RECEIVER, TELEGRAPH CARRIER TYPE R551/UC

SCHUTTIG AND COMPANY, INC.
NINTH AND KEARNY STREETS, N. E.
WASHINGTON 17, D. C.

BUREAU OF SHIPS

NAVY DEPARTMENT

Contract: NObsr-52670

Approved by BuShips: 10 April, 1953

LIST OF EFFECTIVE PAGES

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DEPARTMENT OF THE NAVY
BUREAU OF SHIPS
WASHINGTON 25, D. C.

IN REPLY REFER TO
Code 993-100
10 April 1953

From: Chief, Bureau of Ships
To: All Activities concerned with the Installation, Operation and Maintenance of the Subject Equipment

Subj: Instruction Book for Telegraph Carrier Receiver R-551/UC, NAVSHIPS 91907

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H. N. WALLIN
Chief of Bureau

RECORD OF CORRECTIONS MADE

CHANGE NO.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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GUARANTEE

The Contractor guarantees that at the time of delivery thereof the supplies provided for under this contract will be free from any defects in material or workmanship and will conform to the requirements of this contract. Notice of any such defect or non-conformance shall be given by the Government to the Contractor within one year of the delivery of the defective or non-conforming item, unless a different period of Guaranty is specified in the Schedule. If required by the Government within a reasonable time after such notice, the Contractor shall with all possible speed correct or replace the defective or non-conforming item or part thereof. When such correction or replacement requires transportation of the item or part thereof, shipping costs, not exceeding usual charges, from the delivery point to the Contractor's plant and return, shall be borne by the Contractor; the Government shall bear all other shipping costs. This Guaranty shall then continue as to corrected or replacing supplies or, if only parts of such supplies are corrected or replaced, to such corrected or replacing parts, until one year after the date of redelivery, unless a different period of Guaranty is specified in the Schedule. If the Government does not require correction or replacement of a defective or non-conforming item, the Contractor, if required by the Contracting Officer within a reasonable time after the notice of defect or non-conformance, shall repay such portion of the contract price of the item as is equitable in the circumstances.

INSTALLATION RECORD

Contract Number NObsr-52670 Date of Contract, 30 June 1951

Serial Number of equipment . . . . . .

Date of acceptance by the Navy . . . . . .

Date of delivery to contract destination . . . . . .

Date of completion of installation . . . . . .

Date placed in service . . . . . .

Blank spaces on this page shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its entire service life, shall be made to the Bureau of Ships in accordance with current regulations using form NAVSHIPS NBS 383 (revised) except for Marine Corps equipment, in which case the "Signal Equipment Failure Report" form shall be used and distributed in accordance with instructions pertaining thereto. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the "Bureau of Ships Manual," or superseding instructions.

ORDERING PARTS

All requests or requisitions for replacement material should include the following data:

1. Federal stock number or, when ordering from a Marine Corps or Signal Corps supply depot, the Signal Corps stock number.
2. Name and short description of part.

If the appropriate stock number is not available the following shall be specified:

1. Equipment model or type designation, circuit symbol, and item number.
2. Name of part and complete description.
3. Manufacturer's designation.
4. Contractor's drawing and part number.
5. JAN or Navy type number.

SAFETY NOTICE

The attention of officers and operating personnel is directed to Chapter 67 of the "Bureau of Ships Manual" or superseding instructions on the subject of radio-safety precautions to be observed.

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised when working with the equipment.

RESUSCITATION

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR, OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

SECTION 1

GENERAL DESCRIPTION

1. PURPOSE

The Receiver, Telegraph Carrier is a device for converting keyed audio tone Teletype signals to direct current on-off pulses suitable for operating a Teletype printer. Provisions are included for generating Teletype synchronizing pulses of variable rate and duration when used with an appropriately equipped Teletype receiver. Each of these functions is handled by a specific section of the equipment.

a) Demodulator Section. This section of the equipment rectifies and filters the audio input signal to obtain d-c pulses suitable for keying a Teletype receiver.

b) Synchronization Section. This section generates stop and start pulses of controlled duration and spacing when appropriately keyed. The output pulses from this section are applied to the output tubes of the equipment in such a manner that they always override any signal pulses from the demodulator section.

(1) Keying. Keying is accomplished by shorting the synchronizing contacts, J104. When the synchronizing feature is used, the terminals are shorted by a switch attached to the Teletype receiver in such a way that each rotation of the Teletype selector shaft closes the switch momentarily. Before this cycle can be started, it is necessary for a start pulse to be received from external sources in order to start the Teletype receiver. Once started, the synchronization section provides the start and stop pulses for the Teletype machine and, in turn, is keyed by the machine.

2. REFERENCE DATA

a. Nomenclature: Receiver, Telegraph Carrier; Type R-551/UC.
b. Contract: NObsr 52670, dated 30 June 1951.
c. Manufacturer: Schuttig and Company, Inc., Washington 17, D. C.
d. Inspected by Inspector of Naval Material, Baltimore, Maryland.
e. Impedance Data: (nominal) input - 600 ohms; output - 40 to 200 ohms.
f. Power Requirements: 115 volt, 60 CPS, single phase alternating current - 100 watts.
g. Input Frequency: 400 - 8000 CPS.
h. Input Level: 0.1 to 2 volts RMS.
j. Output: 60 milliamperes.
k. Number of Shipping Boxes: 1.

TABLE 1-1

EQUIPMENT SUPPLIED

Quantity per Equipment	Name of Unit	Navy Type Desig.	Over-all Dimensions			Shipping Volume	Weight	
			High	Wide	Deep		Net	Shipping
1	Receiver, Telegraph Carrier	R-551/UC	8-1/2		13-1/2	.79 cu. ft.	33	97
1	Mounting Strip							
1	Instruction Book							
1	Spare Parts Box with Parts		6-3/4	13-1/4	7	.36 cu. ft.	24	

TABLE 1-2

PLUGS AND CONNECTORS REQUIRED

Reference Symbol	Where Used	Type	Part of
P101	J104	AN3108A-12S-3P	Synchronizing Contacts connecting cable*
P102	J105	AN3108A-16S-43	Power Cable*
P103	A. C. Line	N17-C-7143S-8453	Power Cable*
-	Signal Input	PL-55	--
-	Input monitor	PL-55	Headphones
-	Neutral Output	PL-55	Teletype Input

*Furnished with equipment

TABLE 1-3

ELECTRON TUBE COMPLEMENT

Reference Symbol	Type Designation	Function	Total Quantity
V101	12AX7	Rectifier Doubler	3
V102	12AX7	DC Amplifier	-
V103	12AX7	DC Amplifier	-
V104	6J6	DC Amplifier	5
V105	6J6	Multivibrator	-
V106	6J6	Multivibrator	-
V107	6J6	Sig. Blocking Tube	-
V108	6J6	Multivibrator	-
V109	6AS7	Power Output Tube	1
V110	5R4GY	Rectifier B+ Supply	1
V111	OA2	Voltage Regulator	2
V112	6X4	Rectifier B- Supply	1
V113	OA2	Voltage Regulator	-

SECTION 2

THEORY OF OPERATION

1. DEMODULATOR SECTION

This section consists of an impedance matching input transformer, a demodulator-amplifier, several amplifier-clipper stages and two power amplifier stages terminating in a neutral output jack. All stages of this section are direct-coupled to permit d-c amplification and to minimize time delay in the response of the system.

a) Signal Input Circuits. The input signal is received at J101 and applied across the input terminals of the impedance matching transformer, T101. J2 permits monitoring of the input signal and is connected in parallel with the input through isolating resistors R101 and R102. Resistor R103 is the load resistor across the output of T101.

b) Demodulator-Amplifier. V101, a type 12AX7 dual triode, is a full-wave amplifier-demodulator whose grids are driven by the output of transformer T101. R104 and R108 are the grid isolating resistors for V101. R105 (THRESHOLD) controls the gain of this stage by adjusting the bias voltage applied to the grids via the center tap of the secondary winding of T101. R106 is the plate isolating resistor. R106, R109, and R110 form a bleeder network from which are tapped the plate voltage of V101 and the bias for the first grid of V102. By driving the two grids of V101 180^{o} out of phase and connecting the two plates together, this tube becomes a frequency doubler; i.e. the d-c output pulses of this tube are of twice the frequency of the input signal. This permits more complete filtering of the rectified signal by capacitor C101 and resistor R109.

c) Voltage Amplifiers. D-C voltage amplification and signal limiting action are provided by V102 and V103, type 12AX7 twin triodes. Switch S102 (NORMAL-REVERSE) permits phase inversion of the output by cutting out one section of V102. No loss of gain results when this section is eliminated because each stage is overdriven so that a given tube section is either biased to cut-off or driven to the maximum conductivity permitted by its plate resistor. By saturating each tube in this manner, noise and unfiltered audio ripple are prevented from appearing in the output signal. Plate voltage and grid bias for each section are obtained from voltage bleeders across the positive and negative B supplies which permit direct interstage coupling while retaining correct plate and grid voltages. Figure 2-1 illustrates this system.

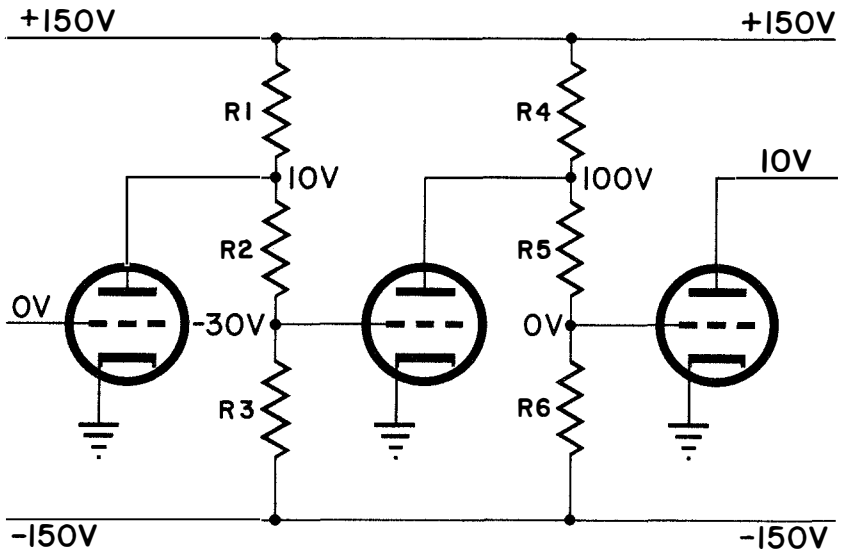

Figure 2-1. D-C Amplifier, Functional Diagram

d) Power Amplifiers. To obtain sufficient power output to key a Teletype, driver tube, V104, and power output tube, V105, are included. V104 provides enough power to drive the 6AS7 power output stage either to cut-off or maximum conductivity. Each section of V104 drives one grid of the 6AS7 output tube. The output of V105 is taken from the cathode current of only one of the tube triode sections, the other cathode being grounded. Since the two triode sections of the power output tube are driven 180° out of phase, one section conducts when the other is cut off so that the load imposed on the power supply is constant, regardless of whether the output is keyed or unkeyed.

2. SYNCHRONIZER SECTION

Synthetic Teletype synchronizing pulses are generated in this section and key the power output stages of the demodulator section in such a way that these pulses override any signal pulses appearing from the signal input. Provisions are included for varying the duration and spacing of these generated pulses.

a) Function. These synchronizing pulses are generated by a series of three "one-shot" multivibrators. The "stop" pulse and the "start" pulse each originate in one of these multivibrators, while the variable interval between these pulses is controlled by the third multivibrator circuit.

(1) "One-shot" Multivibrator Operation. Figure 2-2 shows a diagram of a basic cathode coupled single stroke multivibrator similar to those used in this equipment. Figure 2-3 shows the voltage potentials on various circuit elements during the multivibrator firing cycle.

In the resting stage, V2 is heavily conductive, due to the positive bias on the grid. As a result, there is a large potential drop across the common cathode resistor, KR. Since the cathode of V1 is well above ground potential, this tube is completely cut off. When a positive pulse strong enough to overcome the cut off bias is applied to the grid of V1, this tube begins to conduct, causing a voltage drop across the plate resistor, PR_1. This voltage drop appears on the grid of V2 via coupling capacitor C2 and causes V2 to approach cut off. Due to the common cathode coupling, this lowers the cathode potential of V1 with respect to its grid and V1 conducts even more strongly. This situation is strongly regenerative so that V1 reaches its limit of conductivity, lowering the potential across C2 even more and forcing V2 into full cutoff. This persists until the negative charge on C2 leaks off through grid resistor GR_2. When this occurs, the regeneration reverses and the circuit reverts to its resting state. By varying the value of GR_2, the length of time that the circuit remains "flipped over" may be varied.

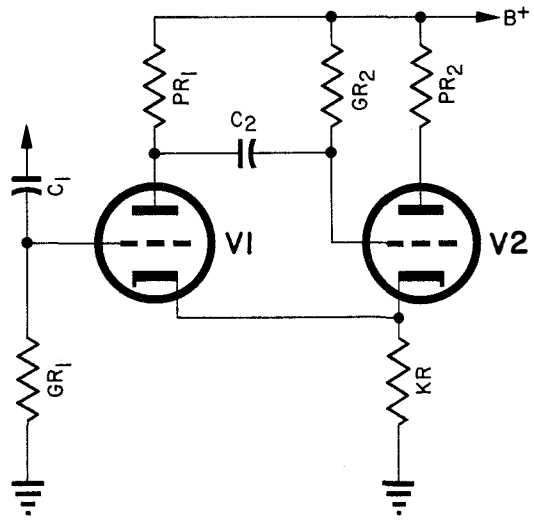

Figure 2-2. Basic Single Stroke Multivibrator

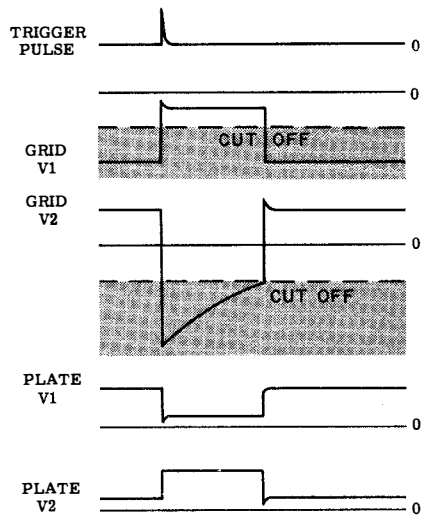

Figure 2-3. Multivibrator Tube Element Potentials

b) Detailed Circuit Description

(1) Synchronizer Input and Stop Width. J104 is the receptacle containing the synchronizer contacts. When these terminals are shorted, the 150 volt B+ voltage is applied to the grid of V108A via

a differentiating network consisting of R151, R152, C110, R153 and R154. This network improves the uniformity of firing the multivibrator and minimizes the effect of tube variations. R155 is a two-section potentiometer used to vary the duration of the firing of this multivibrator. R155B is part of the cathode resistance and R155A is part of the V108B time constant circuit. The addition of R155B in the cathode circuit increases the range of pulse duration over that available from R155A alone. R149 and R150 are the plate load resistance of V108A and, together with capacitor C108, form a surge filter to prevent pulses from appearing in the high voltage supply. R159, R160 and C113 perform the same filtering action for V108B. R157 is the grid isolating resistor for V108B. The duration of the firing cycle is determined by the time constant controlling components, C109, R156, R117 and R155A. When a pulse is generated by the operation of this circuit, V108B cuts off, causing a rise in voltage at its plate and therefore across resistor R173. Since the grid bias on V107B, a gating tube, is the sum of voltages appearing at the junction of R172 and R173, the V107B grid voltage goes up, and the tube conducts. When V107B conducts, the bias on V104A is lowered, and the output tube is keyed, thus causing a "stop" pulse to appear in the output. The action of V107 is more fully described in paragraph 2-2C (4).

(2) Start Delay Circuit. V105 is a "one-shot" multivibrator identical in operation to V108. No variable cathode resistor such as the one used with V108 is present because of the smaller operating time range required. The input of this circuit is connected to the plate of V108A. When V108 fires, the resultant negative pulse is partially differentiated by R138, C106, R137 and R139 to yield a pair of spikes of opposite polarity, the second of which is positive and which triggers V105. (See Figure 5-5 for a diagram showing operational waveforms of these circuits.) Since these multivibrators can be triggered by a positive voltage on the grid, this is done by the positive spike appearing in the output of the differentiating circuit. Since this positive spike results from the plate voltage rise at the end of a cycle, this tube is only triggered at the conclusion of the previous multivibrator's firing cycle. This time constant for this tube's operation is varied by R140, the START DELAY control. This operation determines the time interval between the end of the stop pulse and the beginning of the start pulse. All components in this circuit are similar in function to their counterparts in the preceding multivibrator stage.

(3) Start Pulse Generator. The sudden rise of voltage on the plate of V105 as it returns to its normal state causes a positive voltage pulse to appear across the output of the differentiating network in the grid circuit of V106. This tube is a multivibrator similar in circuitry and function to the other two except that the R-C time constant network in the grid circuit of the second stage is not variable and therefore only pulses of fixed duration are produced. When this multivibrator fires, the rise of potential on the plate of the second section (V106B) raises the V107A grid bias voltage obtained at the junction of bleeder resistors R170 and R171 so that this section conducts. This lowers the grid potential of V103B and causes the output to be keyed for the duration of the multivibrator cycle, thus producing a "start" pulse.

(4) Gating Circuits. V107 acts as a "gate" or control circuit to transmit the pulses generated by the multivibrator to the output tubes. The plate of V107A is connected to the plate of the start pulse generator, V108, and V107B is connected to V106 in the same manner. Each section of V107 is normally cut off by a negative bias voltage obtained at the junction of a pair of voltage bleeder resistor. When either multivibrator is triggered, the potential at the plate connected to the bleeder goes up, causing the bias voltage on the grid to rise well above cut off. Each plate of V107 is connected in parallel with one plate of V103 so that when either section of V107 conducts it shunts to ground its section of V103. As a result, pulses generated in the synchronizer section always override pulses originating in the input. Since the two plates of V103 are 180^{O} out of phase, stop pulses from the synchronizer section appear in the output as "mark" or "on" pulses, while start pulses appear as "space" or "off" pulses.

3. POWER SUPPLY

All internal operating voltages are furnished by this section of the equipment.

(a) Circuit Description. This unit requires an input power source of 115 volts, 60 cycle alternating current. Power is supplied to the input winding of the power transformer T102 via power switch S102 and fuse F101. Transformer T102 has a 5 volt winding for supplying the filament voltage for the full wave rectifier, V110, two 6.3 volt windings for supplying filament voltage to all other

tubes in the equipment, and a high voltage winding from which is obtained the higher voltages required in the equipment.

(1) Positive and Negative Voltage Supplies. Two separate voltage sources are incorporated in this equipment. One supplies all positive voltages required by the equipment and has considerable current capacity. This positive power supply consists of full wave rectifier, V110, followed by a conventional pi section ripple filter consisting of L101, C119, C120, C121 and C122. A voltage regulating tube, V111, together with its limiting resistor, R174, furnishes regulated B voltages used in all stages except the output stage. The negative power supply consists of half wave rectifier, V112, and its associated filter network R176, C115, C117 and C118. This supply is voltage stabilized by a voltage regulating tube, V113 and its limiting resistor, R175. The negative power supply is of limited current capacity because its primary function is to furnish negative bias voltage for the d-c amplifier stages and gating tubes.

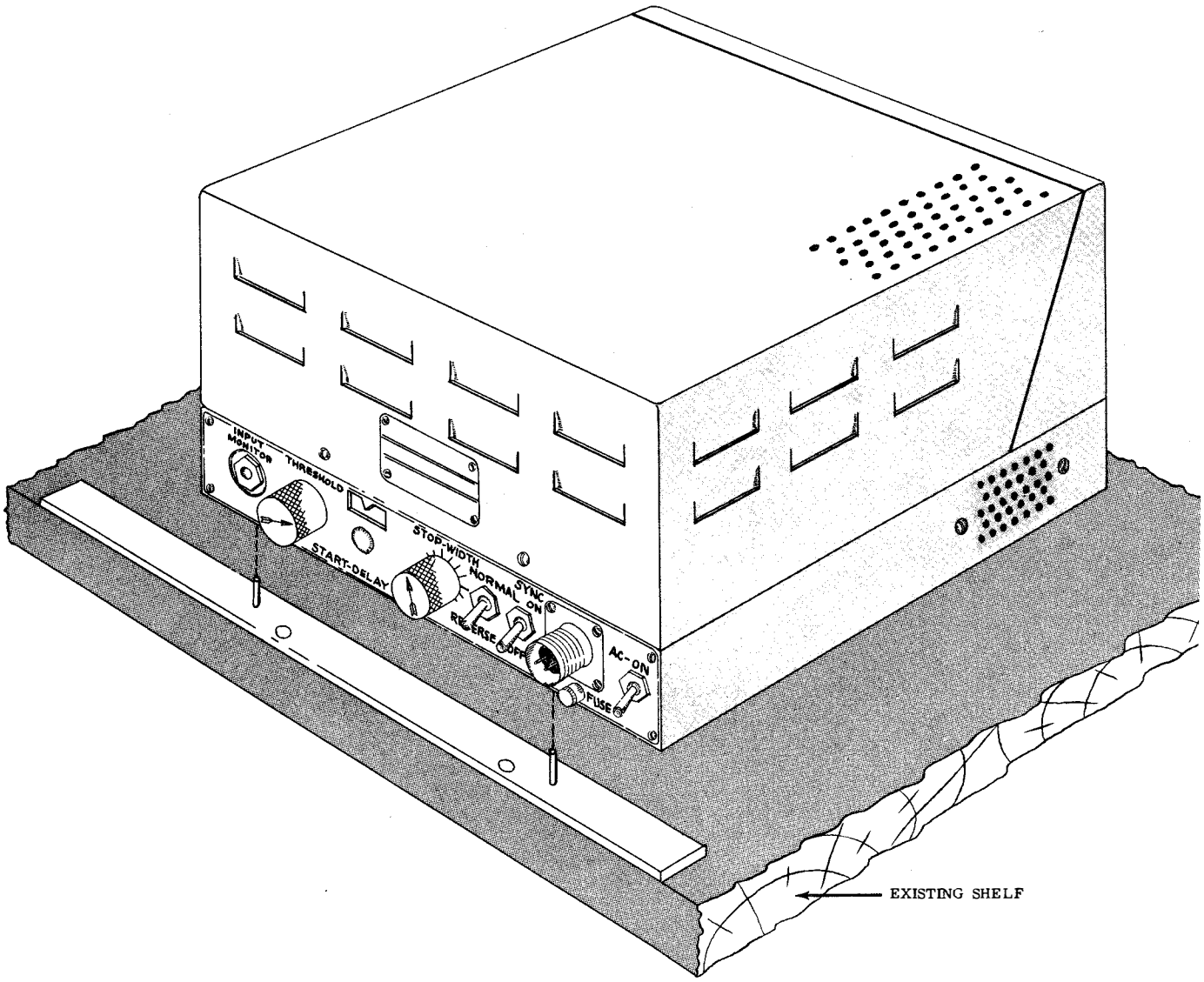

Figure 3-1. Method of Mounting

SECTION 3

INSTALLATION

1. UNPACKING AND CHECKING

Carefully remove the unit from its cartons and inspect it for shipping damage. Cushioning materials should be carefully inspected for spare parts or accessories before discarding. Remove the dust cover and inspect the interior for packing material.

With the dust cover still off, remove the tubes from the equipment and check them for internal short circuits, using an ohmmeter or suitable tube tester. Discard any tubes found to be defective and replace all tubes and shields in the equipment.

2. INSTALLATION

This equipment is designed so that it may be mounted on the lower shelf of a standard teletypewriter stand. When mounted in this location, it should be so placed that the side containing the operating controls and cover fasteners faces outward.

a) Mounting Strip. A mounting strip is provided to facilitate securing the equipment, yet leaving it free for instant removal as shown in Figure 3-1. This strip should be fastened by suitable means to the shelf on which the equipment is to be mounted. The equipment has holes on the bottom of the front of the chassis to receive the studs on the mounting strip. The equipment is mounted by engaging it on the studs.

3. INITIAL ADJUSTMENTS

a) First Energizing. Before energizing the equipment, make sure that all tubes are in their correct places and that all tube shields are on. Make sure that a fuse (of the correct rating) is in place. With the power cord attached to the unit and plugged into a 115 volt 60 cycle a-c power source, turn the power switch, S103, ON. Look for signs of smoking, overheating or other malfunction. If any trouble is observed, its cause should be identified and corrected before further operation is attempted.

b) Operational Adjustments. The demodulator section has two basic operating adjustments, the THRESHOLD control and the NORMAL-REVERSE switch.

(1) THRESHOLD Control. The THRESHOLD control regulates the gain of the input stage and determines the level required to key the output.

Adjust this control so that in a no-signal condition, noise barely keys the teletypewriter. Turn the control counterclockwise only as far as required to stop all keying by noise.

(2) NORMAL-REVERSE Switch. The NORMAL-REVERSE switch is usually kept in NORMAL position. If gibberish is received, the NORMAL-REVERSE switch should be turned to REVERSE. If this fails to resolve the signal, the switch should be returned to NORMAL and attempts made to restore the synchronization.

4. SYNCHRONIZING SWITCH INSTALLATION

Figure 3-2 shows a typical synchronizing switch assembly. It is intended to be installed on the Teletype instrument as shown in Figure 3-3 so that its contacts are momentarily closed once every revolution of the Teletype selector shaft.

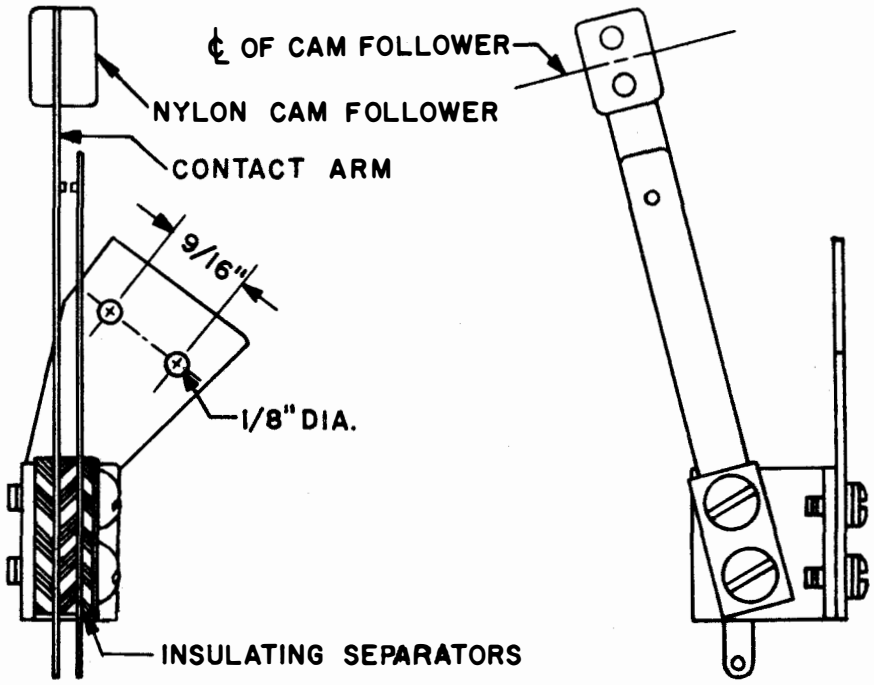

Figure 3-2. Typical Teletype Synchronizing Switch

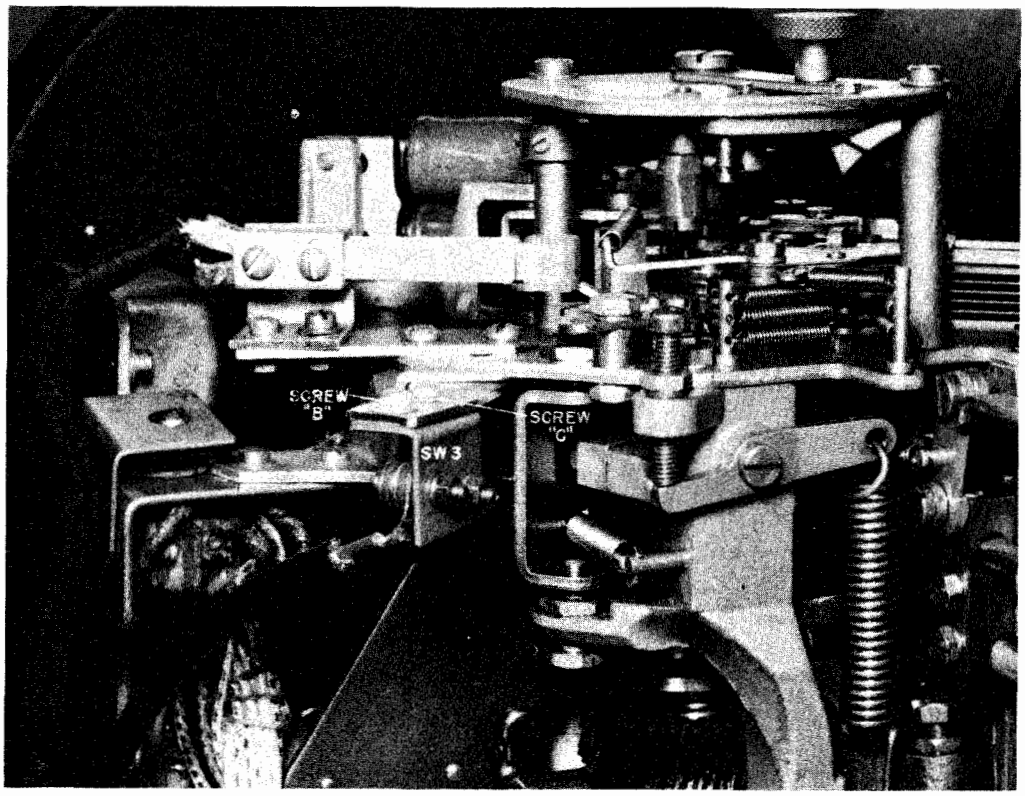

Figure 3-3. Typical Synchronizing Switch Installation

SECTION 4

OPERATION

1. FUNCTION

This unit has two functions:

(1) Demodulation and conversion of keyed audio tones to d-c pulses suitable for keying a Teletype receiver.

(2) Automatic generation and control of synchronizing pulses for the Teletype receiver, otherwise obtained from the input signal.

2. FUNCTIONAL OPERATION

a) Demodulator Section. Signal is introduced to the input via J101 by means of a standard type PL-55 plug. The output is obtained at J103, marked NEUTRAL OUT, and also requires a type PL-55 plug. The neutral, low impedance output is suitable for direct connection to a Teletype input and furnishes direct current pulses coinciding with the input tone pulses. The NORMAL-REVERSE switch reverses the phase of the output. In REVERSE position, current appears in the output when there is no input signal and no output current with input signal. The control marked THRESHOLD is the gain control for the input stage. It is used to adjust the gain of the demodulator section to that level where the unit keys reliably with signal but fails to key from noise pulses.

b) Synchronizing Section. The synchronizing section generates a pair of pulses in the output when keyed by shorting the synch contacts of J104. A switch connected to the Teletype usually performs this operation. This switch is installed in such a way that it is closed momentarily by the Teletype selector shaft after each character. When the synch switch contacts are closed, a stop pulse immediately appears in the output circuit. This pulse may be varied in length by the STOP WIDTH control and stops the Teletype. After a brief interval, a start pulse appears in the output and keys the receiving Teletype to start. When the Teletype selector shaft rotates, the synch contacts are again closed and the cycle repeats itself. The interval between the end of the STOP pulse and the beginning of the start pulse may be controlled by varying the START DELAY control. The START pulse has a fixed duration and may not be varied. Table 4-1 summarizes the time interval ranges involved in this sequence.

TABLE 4-1
Synchronizing Section Time Intervals

FUNCTION CONTROLLED	INTERVAL (MILLISECONDS)	
	Minimum	Maximum
Stop Width	10	35
Start Delay	0	12
Start Width	12	12

3. OPERATIONAL ADJUSTMENTS

The demodulator section has two basic operating adjustments, the THRESHOLD control and the NORMAL-REVERSE switch.

(1) THRESHOLD control. The THRESHOLD control regulates the gain of the input stage and determines the level required to key the output.

Adjust this control so that in a no-signal condition, noise barely keys the teletypewriter. Turn the control counterclockwise only as far as required to stop all keying by noise.

(2) NORMAL-REVERSE Switch. The NORMAL-REVERSE switch is usually kept in NORMAL position. If gibberish is received, the NORMAL-REVERSE switch should be turned to REVERSE. If this fails to resolve the signal, the switch should be returned to NORMAL and attempts made to restore the synchronization.

The synchronizing section is used on poor radioteletype circuits where high noise and severe fading is present. By using tape transmission and stable power frequencies, it is possible to keep the receiving Teletypewriter in synchronization with the sending transmitter distributor.

FAILURE REPORTS

A FAILURE REPORT must be filled out for the failure of any part of the equipment whether caused by defective or worn parts, improper operation, or external influences. It should be made on Failure Report, form NAVSHIPS 383, which has been designed to simplify this requirement. The card must be filled out and forwarded to BUSHIPS. Full instructions are to be found on each card.

Use great care in filling the card out to make certain it carries adequate information. For example under "Circuit Symbol" use the proper circuit identification taken from the schematic drawings, such as T–803, in the case of a transformer, or R–207, for a resistor. Do not substitute brevity for clarity. Use the back of the card to completely describe the cause of failure and attach an extra piece of paper if necessary.

The purpose of this report is to inform BUSHIPS of the cause and rate of failures. The information is used by the Bureau in the design of future equipment and in the maintenance of adequate supplies to keep the present equipment going. The cards you send in, together with those from hundreds of other ships, furnish a store of information permitting the Bureau to keep in touch with the performance of the equipment of your ship and all other ships of the Navy.

This report is not a requisition. You must request the replacement of parts through your Officer-in-Charge in the usual manner.

Make certain you have a supply of Failure Report cards and envelopes on board. They may be obtained from the nearest District Printing and Publication Office.

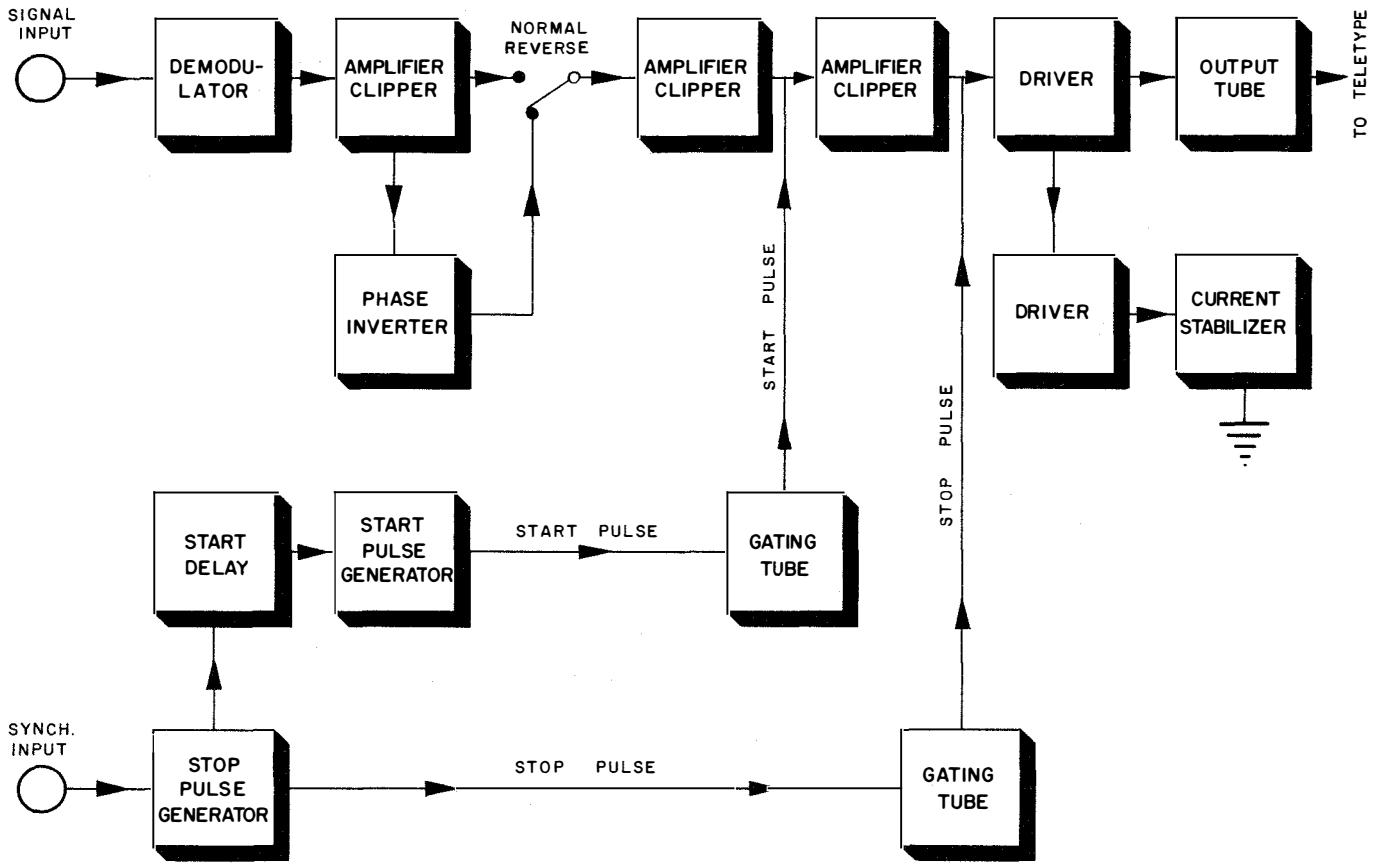

Figure 5-1. Block Diagram, R-551/UC

SECTION 5

MAINTENANCE

1. PERIODIC INSPECTION

This equipment has been designed to provide long, trouble-free service as long as proper preventive maintenance procedures are adhered to. It is recommended that this equipment be periodically inspected as outlined below and any signs of deterioration or defective performance promptly corrected.

a) Weekly Inspection. At least once a week the equipment should be examined internally and externally for signs of improper functioning or damage. Look for charred resistors or leakage from transformers and filter capacitors. Look for signs of corrosion or rust and the loosening of hardware.

b) Monthly Inspection. Once a month, at the time the weekly inspection is made, all tubes should be checked on a good tube checker. To avoid possibly changing the time constants in the synchronizing section, each tube should be tested and replaced before removing the next tube of the same type from its socket. Figure 5-2 shows the location of all electron tubes. Before replacing the tubes in the equipment, clean the pins of each tube with very fine emery cloth, being careful not to bend the pins. A good, noncorrosive contact cleaner may be applied to each pin before replacing the tubes.

2. CORRECTIVE MAINTENANCE

Before attempting to troubleshoot this equipment, the technician should thoroughly familiarize himself with the theory of operation, referring to the material in Section 2 as well as the data and illustrations in this section. Particular attention should be paid to learning a logical system for localizing the sources of trouble.

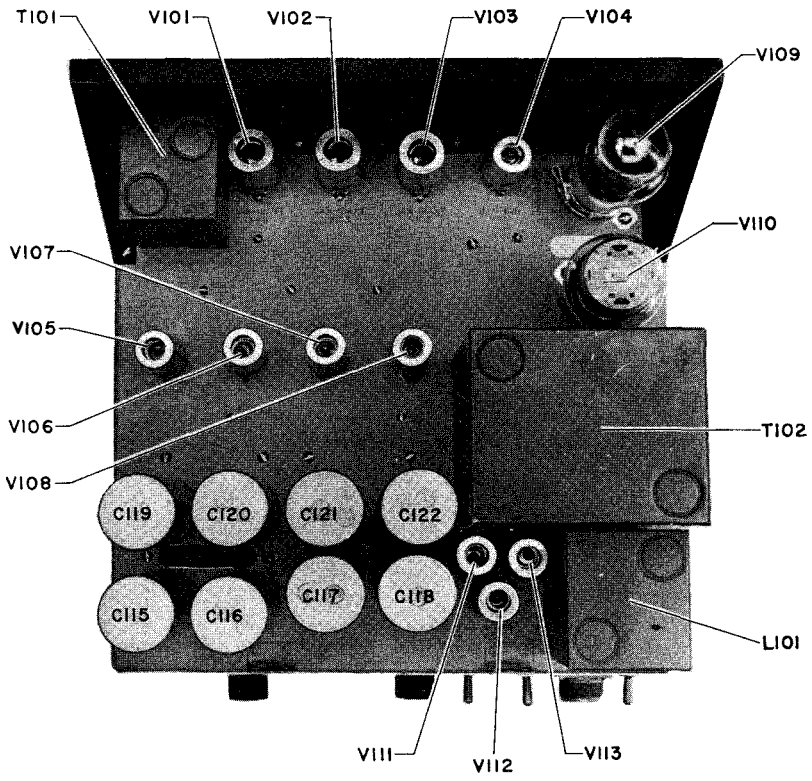

Figure 5-2. Location of Electron Tubes

a) Theory of Localization. It is important in diagnosing troubles and locating their source that the maintenance man be thoroughly familiar with the character of normal operation. A systematic approach to troubleshooting will result in great savings in time and work. Start with the most basic and fundamental causes of trouble and eliminate them before looking for something more complex. Thus, check the fuse and the power supply first, then check the tubes in the affected section.

The Demodulator section requires voltage from both positive and negative voltage supplies for proper functioning. After checking the output voltage of each, check the voltages appearing on the pins of the affected tubes, using the voltages given in Figure 5-3 as a reference. If the observed voltages vary from those given in the illustration, turn the equipment off and measure resistance to ground at the points indicated in Figure 5-3.

b) Circuit Tracing. The following procedures are recommended when signal tracing or checking the time constant calibration.

(1) EQUIPMENT REQUIRED:
Source of 115 volt 60 cycle a-c power
Source of 200 to 8000 CPS signal, 0.1 to 2.0 RMS volts, keyed at 23 pulses per second
Oscilloscope, 100 KC bandwidth or better
Milliammeter, 0 to 100 ma.
40 ohm and 200 ohm output load

(2) CONTROL SETTINGS:
NORMAL - REVERSE switch to NORMAL
Power switch OFF
Threshold control fully counterclockwise
Synch switch OFF
START DELAY control at "0"

(3) Demodulator Section. Connect signal source to the input and connect the milliammeter to the output. Adjust the input level to about 0.1 volt, RMS. Turn the THRESHOLD CONTROL until the output meter indicates that the output tube is being keyed.

In the event that no output keying can be observed and the preliminary checks (power supplies, tubes, etc.) have been made, the oscilloscope should be used to observe the waveforms appearing at each grid and each plate in the Demodulator section, beginning with V101. This permits immediate determination of the stage or section where the trouble is located.

(4) Synchronizing Section. Figure 5-4 illustrates oscilloscope waveforms for each tube element in the synchronizing section. These waveforms represent only a typical cycle of the individual tube, not of the entire section. A theoretical explanation of the operation of this section of the equipment is presented in Section 2.

VOLTAGE READINGS TAKEN UNDER FOLLOWING CONDITIONS:

A. MEASURED TO GROUND.
B. INPUT VOLTAGE 115 VOLTS A.C.
C. ALL CONTROLS MAXIMUM CLOCKWISE.
D. VACUUM TUBE VOLTMETER, 1 MEG. INPUT IMPEDENCE.

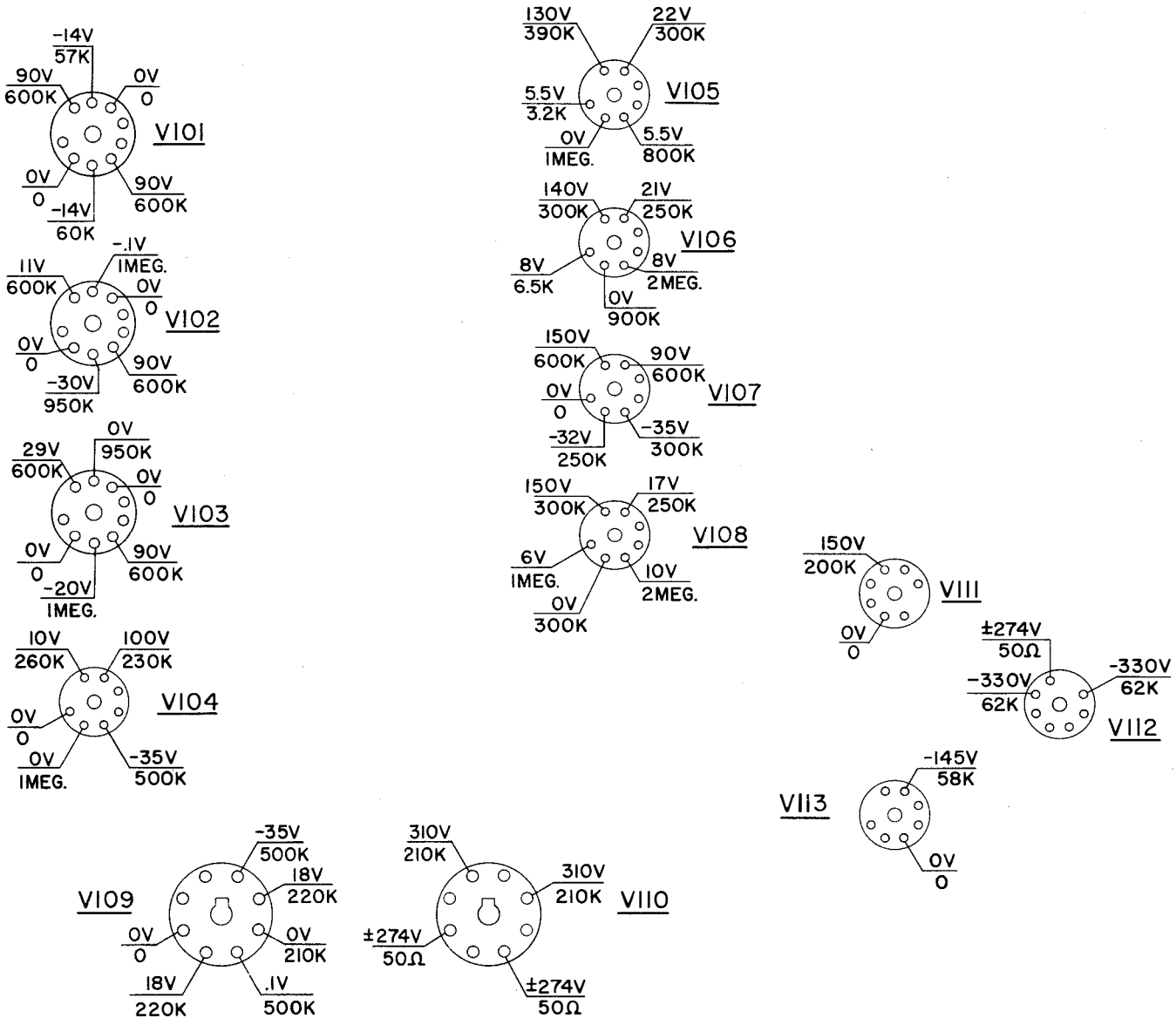

Figure 5-3. Voltage and Resistance Tables

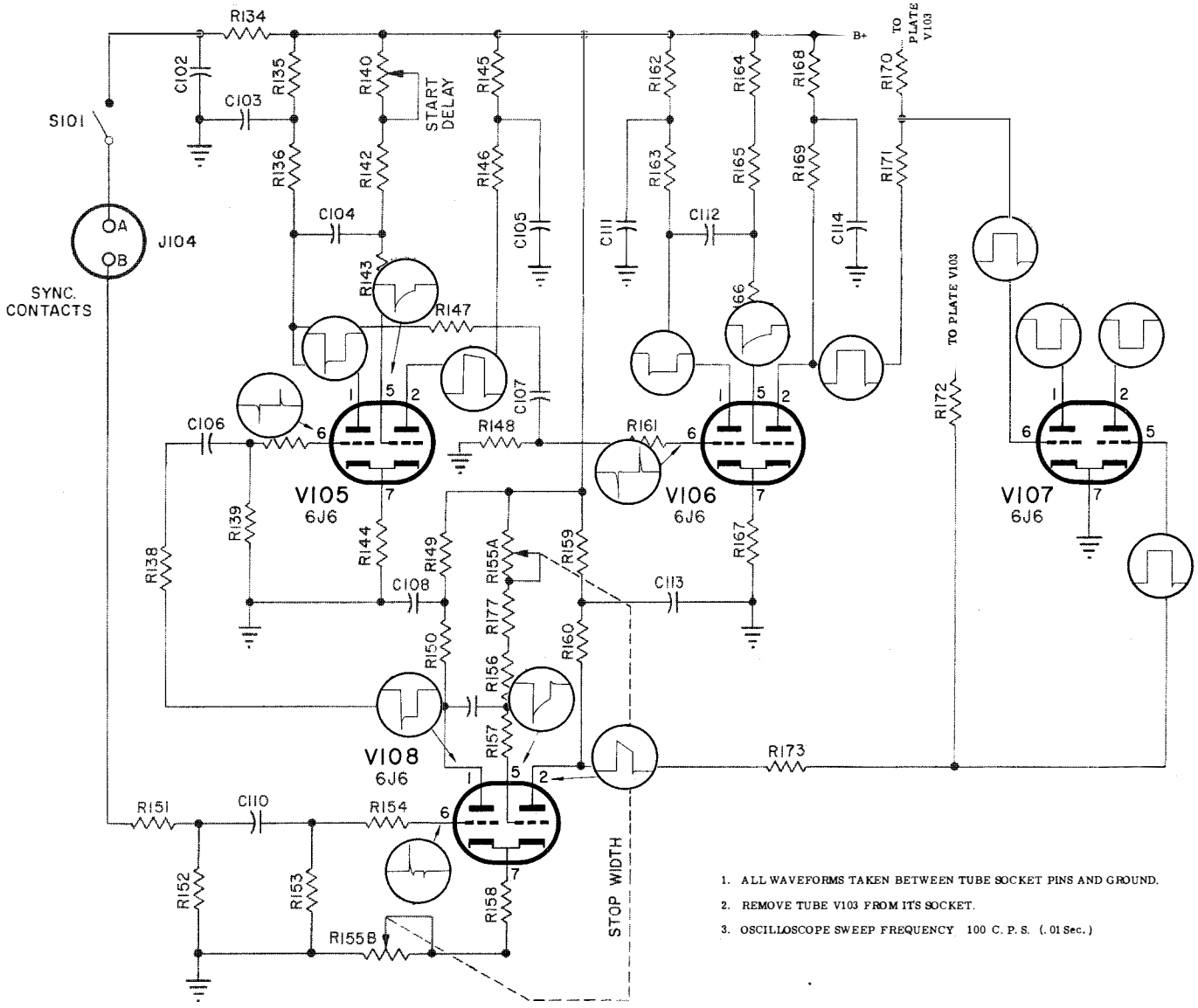

Figure 5-4. Synchronizing Section Oscilloscope Waveforms, Single Cycle

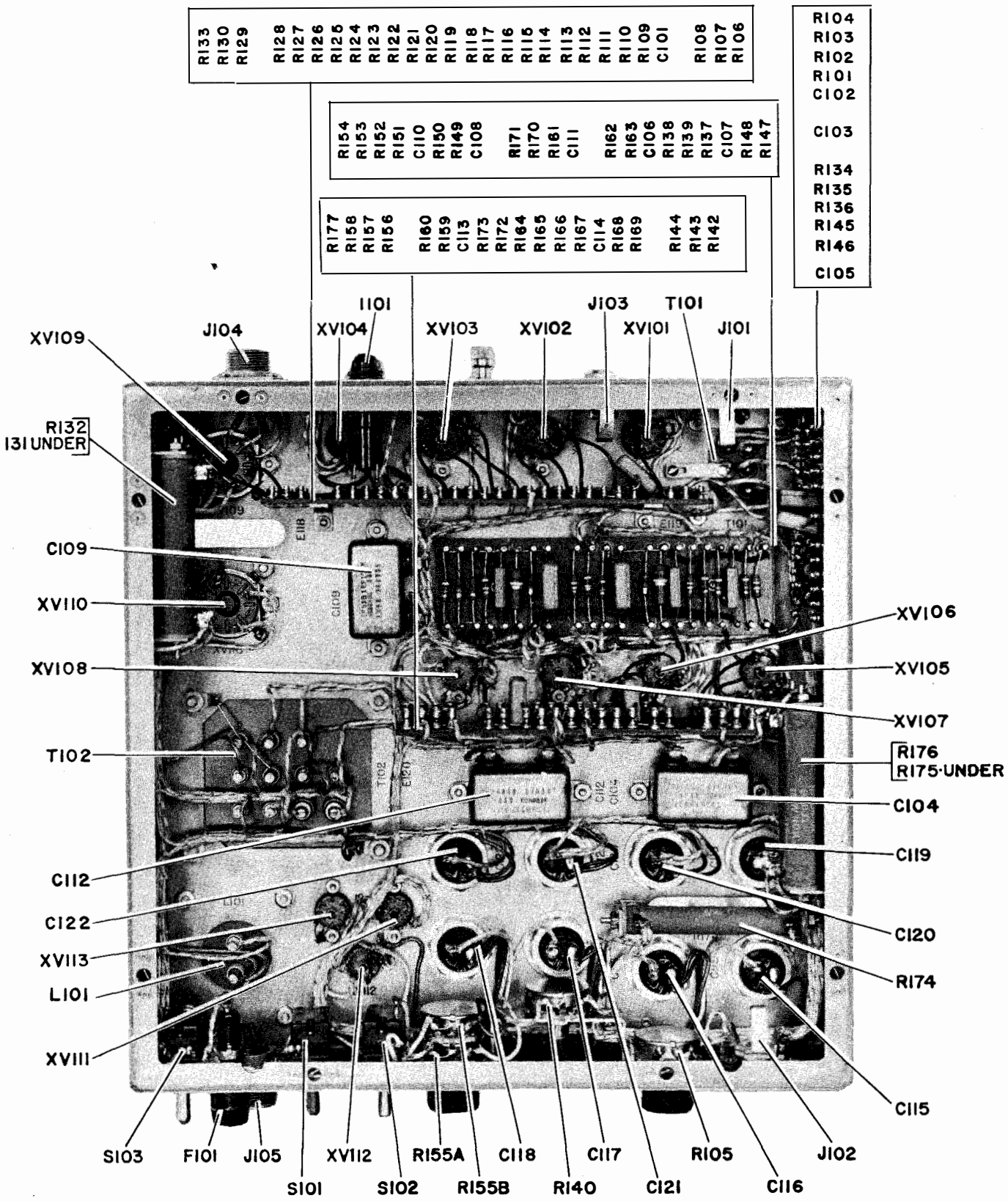

Figure 5-5. Location of Components

TABLE 6-1. LIST OF REPLACEABLE PARTS

Symbol Desig.	Name and Description	Function	JAN Type Number	Standard Navy Stock Number	Mfr. & Mfr. Desig.	All Symbol Desig. Involved
C101	CAPACITOR, FIXED, MICA DIELECTRIC: .002 mfd ±10%; 500 w.v.d.c.	Filter capacitor plate V101	CM30A202K	N16-C-31802-5959	Sangamo Electric Co. C-1220	C101
C102	CAPACITOR, FIXED, MICA DIELECTRIC: .01 mfd ±10%; 300 w.v.d.c.	Filter capacitor sync circuit	CM35A103K	N16-C-33622-5218	Cornell-Dubilier Electric Corp.	C102
C103	CAPACITOR, FIXED, MICA DIELECTRIC: .001 mfd ±10%; 500 w.v.d.c.	Plate by-pass V105A	CM30A102K	N16-C-31090-4159	Sangamo Electric Co. C-1210	C103, C105, C108, C111, C113, C114
C104	CAPACITOR, FIXED, PAPER DIELECTRIC: oil filled; .05 mfd ±10%; 600 w.v.d.c.	RC time constant network capacitor V105A to V105B	CP53B1EF, 503K	N16-C-44257-3124	Aerovox Corp. Type No. 630	C104, C112
C105	Same as C103	Plate by-pass V105B				
C106	CAPACITOR, FIXED, MICA DIELECTRIC: 2000 mmfd ±5%; 500 w.v.d.c.	RC time constant network capacitor V108A to V105A	CM20A201J	N16-C-29265-2991	Sangamo Electric Co. K-1320	C106, C107
C107	Same as C106	RC time constant network capacitor V105A to V106A				
C108	Same as C103	Plate by-pass V108A				
C109	CAPACITOR, FIXED, PAPER DIELECTRIC: oil filled; 0.1 mfd ±10%; 600 w.v.d.c.	RC time constant network capacitor V108A to V108B	CP53B1EF, 104K	N16-C-45777-3122	Aerovox Corp. Type No. 630	C109
C110	CAPACITOR, FIXED, MICA DIELECTRIC: 300 mmfd ±5%; 500 w.v.d.c.	RC time constant network capacitor sync input to V108A	CM20A301J	N16-C-29660-8991	Sangamo Electric Co. K-1330	C110
C111	Same as C103	Plate by-pass V106A				
C112	Same as C104	RC time constant network capacitor V6A to V6B				
C113	Same as C103	Plate by-pass V108B				
C114	Same as C103	Plate by-pass V106B				
C115	CAPACITOR, FIXED, PAPER DIELECTRIC: oil filled; 4 mfd +20% -10%; 500 w.v.d.c.	Filter capacitor regulated negative power supply	CP41B1EF, 405V	N16-C-49981-9995	Cornell-Dubilier Electric Corp.	C115, C116, C117, C118, C119, C120, C121, C122
C116	Same as C115	Filter capacitor regulated negative power supply				

C117	Same as C115	Filter capacitor regulated negative power supply				
C118	Same as C115	Filter capacitor regulated negative power supply				
C119	Same as C115	Filter capacitor B+ power supply				
C120	Same as C115	Filter capacitor B+ power supply				
C121	Same as C115	Filter capacitor B+ power supply				
C122	Same as C115	Filter capacitor B+ power supply				
E101	SHIELD, ELECTRON TUBE: miniature; brass; nickel plated	Shields V101	TS103U02	N16-S-34576-6514	Electro Connector Corp. No. 191	E101, E102, E103
E102	Same as E101	Shields V102				
E103	Same as E101	Shields V103				
E104	SHIELD, ELECTRON TUBE: miniature; brass; nickel plated	Shields V104	TS102U02	N16-S-34557-8351	Electro Connector Corp. No. 120	E104, E105, E106, E107, E108
E105	Same as E104	Shields V105				
E106	Same as E104	Shields V106				
E107	Same as E104	Shields V107				
E108	Same as E104	Shields V108				
E109	SHIELD, ELECTRON TUBE: miniature; brass; nickel plated	Shields V111	TS102U03	N16-S-34607-6039	Electro Connector Corp. No. 149	E109, E110, E111
E110	Same as E109	Shields V112				
E111	Same as E109	Shields V113				
E112	POST, BINDING: metal brass; nickel plated	Ground post		N17-P-69135-7720	Hugh H. Eby Co. No. 7312	E112
E113	CLAMP, CABLE: aluminum anodized and bichromate seal	Sync circuit connector cable clamp	AN3057-3 (02-4C)	N17-C-781257-908	American Phenolic Corp. AN3057-3	E113
E114	CLAMP, CABLE: aluminum anodized and bichromate seal	AC line connector cable clamp	AN3057-8 (02-4C)	For replacement use N17-C-781444-504	American Phenolic Corp. AN3057-8	E114
F101	FUSE, CARTRIDGE: 1 amp; 250 v; slow-blow; ferrule terminals; 1/4 in.	115 v a-c input		N17-F-14310-380	Bussmann Mfg. Co. MDL-1	F101

TABLE 6-1. LIST OF REPLACEABLE PARTS - Continued

Symbol Desig.	Name and Description	Function	JAN Type Number	Standard Navy Stock Number	Mfr. & Mfr. Desig.	All Symbol Desig. Involved
	lg 1/4 in. dia; glass body 1-1/4 in. lg. 1/4 in. dia					
I101	LAMP, INCANDESCENT: 6-8 v; 1 w; .15 amp; miniature bayonet base; bulb T3-1/4; tungsten; 1-1/8 in. max over-all height; rated life over 25 hours any burning position	Indicator lamp		G17-L-6297	General Electric Co. No. 47	I101
J101	JACK: single circuit normally open	Signal input jack	JJ-034	N17-J-39248-4418	Switchcraft, Inc. No. C-11	J101-J102
J102	Same as J101	Input monitor jack				
J103	JACK: single circuit normally closed	Output jack	JJ-089	N17-J-39253-3043	Switchcraft, Inc. No. C-12A	J103
J104	CONNECTOR, RECEPTACLE: 2 contacts female; aluminum anodized and bichromate seal	Sync input connector	AN3102A-12S-3S (02-4C)	N17-C-72231-6120	American Phenolic Corp. AN3102A-16S-4P	J104
J105	CONNECTOR, RECEPTACLE: 2 contacts male; aluminum anodized and bichromate seal	A-c line connector	AN3102A-16S-4P (02-4C)	N17-C-72596-6201	American Phenolic Corp. AN3102A-16S-4P	J105
L101	REACTOR, FILTER CHOKE: 1 section; 10 henries; 150 ma d.c.; 300 ohms d-c resistance; 150 v RMS test; hermetically sealed steel case; 2-3/4 in. lg x 2-3/8 in. w x 3-13/16 in. high; r integral mounting studs 6-32 1/2 in. lg on 2-1/8 in. x 1-3/4 in. mounting centers; 2 stud terminals; double turret solder type; located axially on bottom	Filter choke B+ power supply		N16-R-29238-4171	Audio Development Co. A-7699	
P101	CONNECTOR, PLUG: 2 contact male; aluminum anodized and bichromate seal	Sync line cord connector	AN3108A-12S-3P (02-4C)	N17-C-70161-6120	American Phenolic Corp. AN3108A-12S-3P	P101
P102	CONNECTOR, PLUG: 2 contact female; aluminum anodized and bichromate seal	A-c line cord connector	AN3108A-16S-4S (02-4C)	N17-C-70032-8640	American Phenolic Corp. AN3108A-16S-4S	P102
P103	CONNECTOR, PLUG: 2 contact male flat; straight type; 1-1/2 in. lg; 1.437 in. dia contacts; 10 amps; 250 v; brass cadmium plated; body cylindrical rubber molded black rubber insert max cable opening; .437 in. finger grip cap with cord-grip	A-c line cord connector	For replacement use G17-C-3360		Harvey Hubbell, Inc. No. 9940	P103

R101	RESISTOR, FIXED, COMPOSITION: 300 ohms, ±5%; 1/2 watt	Bridging resistor	RC20BF301J	N16-R-49696-431	International Resistance Corp. Type BTS	R101, R102
R102	Same as R101					
R103	RESISTOR, RIXED, COMPOSITION: 100,000 ohms, ±10%; 1/2 watt	Transformer load resistor	RC20BF104K	N16-R-50633-811	International Resistance Corp. Type BTS	R103, R123, R124
R104	RESISTOR, FIXED, COMPOSITION: 47,000 ohms, ±10%; 1/2 watt	Grid bias resistor V101A	RC20BF473K	N16-R-50480-811	International Resistance Corp. Type BTS	R104, R107, R108, R137, R139, R143, R148, R154, R157
R105	RESISTOR, VARIABLE, COMPOSITION: 1 section 5,000 ohms, ±10%; 2 watts; std A. taper	Threshold control	RV4ATFD502A	N16-R-89519-4784	Chicago Telephone Supply Corp. Type 95	R105, R161, R166
R106	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, ±10%; 1/2 watt	Plate load resistor V101A, B	RC20BF474K	N16-R-50822-811	International Resistance Corp. Type BTS	R106, R111, R112, R117, R118, R127, R129, R134, R151, R170, R172
R107	Same as R104	Bias supply dropping resistor				
R108	Same as R104	Grid bias resistor V101B				
R109	RESISTOR, FIXED, COMPOSITION: 820,000 ohms, ±10%; 1/2 watt	Bias voltage divider network V102A	RC20BF824K	N16-R-50930-811	International Resistance Corp. Type BTS	R109, R113, R115, R119, R121
R110	RESISTOR, FIXED, COMPOSITION: 2,000,000 ohms, ±5%; 1/2 watt	Bias voltage divider network V102A	RC20BF205J	N16-R-51046-431	International Resistance Corp. Type BTS	R110, R114, R116, R120, R122, R141
R111	Same as R106	Plate load resistor V102A				
R112	Same as R106	Plate load resistor V102B				
R113	Same as R109	Bias voltage divider network V102B				
R114	Same as R110	Bias voltage divider network V102B				
R115	Same as R109	Bias voltage divider network V103A				
R116	Same as R110	Bias voltage divider network V103A				
R117	Same as R106	Plate load resistor V103A				
R118	Same as R106	Plate load resistor V103B				

TABLE 6-1. LIST OF REPLACEABLE PARTS - Continued

Symbol Desig.	Name and Description	Function	JAN Type Number	Standard Navy Stock Number	Mfr. & Mfr. Desig.	All Symbol Desig. Involved
R119	Same as R109	Bias voltage divider network V103B				
R120	Same as R110	Bias voltage divider network V103B				
R121	Same as R109	Bias voltage divider network V104A				
R122	Same as R110	Bias voltage divider network V104A				
R123	Same as R103	Plate load resistor V104A				
R124	Same as R103	Plate load resistor V104B				
R125	RESISTOR, FIXED, COMPOSITION: 200,000 ohms, ±5%; 1/2 watt	Grid isolating resistor V104B	RC20BF204J	N16-R-50704-431	International Resistance Corp. Type BTS	R125, R126, R128, R130, R133
R126	Same as R125	Bias voltage divider network V104A-V109A				
R127	Same as R106	Bias voltage divider network V104A-V109A				
R128	Same as R125	Bias voltage divider network V109B				
R129	Same as R106	Bias voltage divider network V109B				
R130	Same as R125	Grid isolating resistor V109A				
R131	RESISTOR, FIXED, WIRE WOUND: 2500 ohms, ±5%; 18 watts	Plate load resistor V109	RW33G252	For replacement use N16-R-66141-1086	International Resistance Corp. Type BTS	R131, R132
R132	Same as R131	Plate load resistor V109				
R133	Same as R125	Grid isolating resistor V109B				
R134	Same as R106	Sync voltage dropping resistor				
R135	RESISTOR, FIXED, COMPOSITION: 2000 ohms, ±5%; 1/2 watt	Isolating resistor plate V105A	RC20BF202J	N16-R-49993-431	International Resistance Corp. Type BTS	R135, R145, R149, R159, R162, R168
R136	RESISTOR, FIXED, COMPOSITION: 100,000 ohms, ±10%; 1 watt	Plate load resistor V105A	RC30BF104K	N16-R-50634-231	International Resistance Corp. Type BTS	R136, R146, R150, R160, R163, R169

R137	Same as R104	Grid isolating resistor V105A				
R138	RESISTOR, FIXED, COMPOSITION: 240,000 ohms, ±5%; 1/2 watt	RC time constant network resistor V105A	RC20BF244J	N16-R-50722-431	International Resistance Corp. Type BTS	R138, R147, R171, R173
R139	Same as R104	Grid bias resistor V105A				
R140	RESISTOR, VARIABLE, COMPOSITION: 1 section, 1,000,000 ohms, ±10%; 2 watts; std C. taper	RC time constant network resistor V105B	RV4ATSA105C	N16-R-88339-4800	Chicago Telephone Supply Corp. Type 95	R140
R141	Same as R104	Shunt R140				
R142	RESISTOR, FIXED, COMPOSITION: 240,000 ohms, ±5%; 1/2 watt	RC time constant network resistor V105B	RC20BF434J	N16-R-50803-431	International Resistance Corp. Type BTS	R142
R143	Same as R104	Grid isolating resistor V105B				
R144	RESISTOR, FIXED, COMPOSITION: 3300 ohms, ±5%; 1 watt	Cathode bias resistor V105A, B	RC30BF332J	N16-R-50065-751	International Resistance Corp. Type BTS	R144
R145	Same as R135	Isolating resistor plate V105B				
R146	Same as R136	Plate load resistor V105B				
R147	Same as R104	RC time constant network resistor V106A				
R148	Same as R104	Grid bias resistor V106A				
R149	Same as R135	Isolating resistor plate V108A				
R150	Same as R136	Plate load resistor V108A				
R151	Same as R106	Sync isolating resistor				
R152	RESISTOR, FIXED, COMPOSITION: 1,000,000 ohms, ±10%; 1/2 watt	RC time constant network resistor V108A	RC20BF105K	N16-R-50975-811	International Resistance Corp. Type BTS	R152
R153	RESISTOR, FIXED, COMPOSITION: 10,000 ohms, ±10%; 1/2 watt	Grid bias resistor V108A	RC20BF103K	N16-R-50282-811	International Resistance Corp. Type BTS	R153
R154	Same as R104	Grid isolating resistor V108A				
R155A, B	RESISTOR, VARIABLE, COMPOSITION: 2 sections; 750,000 ohms first section; 2500 ohms second section; 10% each section; 2 watts nominal power rating each section; first section std. C. taper, second section std.	First section RC time constant network resistor V108B Second section cathode bias resistor V108		N16-R-88827-8256	Chicago Telephone Supply Corp. Type 2-95	R155A, B

TABLE 6-1. LIST OF REPLACEABLE PARTS - Continued

Symbol Desig.	Name and Description	Function	JAN Type Number	Standard Navy Stock Number	Mfr. & Mfr. Desig.	All Symbol Desig. Involved
	A. taper; 3 solder lug type terminals each section; metal enclosed case, 1-1/8 in. dia 31/32 in. deep; round metal shaft; flatted as per JAN-A-94, 1/4 in. dia 7/8 in. lg; normal torque; insulated contact arm; no "OFF" data; mounted by 3/8 in. long, 32 threads per inch bushing non-turn device located on radius 17/32 in. radius at 9 o'clock					
R156	RESISTOR, FIXED, COMPOSITION: 470,000 ohms, ±5%; 1 watt	RC time constant network resistor V108B	RC30BF474J	N16-R-50821-751	International Resistance Corp. Type BTS	R156
R157	Same as R104	Grid isolating resistor V108B				
R158	RESISTOR, FIXED, COMPOSITION: 1500 ohms, ±5%; 1 watt	Cathode bias resistor V108	RC30BF152J	N16-R-49966-751	International Resistance Corp. Type BTS	R158
R159	Same as R135	Isolating resistor plate V108B				
R160	Same as R136	Plate load resistor V108B				
R161	Same as R104	Grid isolating resistor V106A				
R162	Same as R135	Isolating resistor V106A				
R163	Same as R136	Plate load resistor V106A				
R164	RESISTOR, FIXED, COMPOSITION: 1,000,000 ohms, ±5%; 1 watt	RC time constant network resistor V106B	RC30BF105J	N16-R-50974-751	International Resistance Corp. Type BTS	R164
R165	RESISTOR, FIXED, COMPOSITION: 330,000 ohms, ±5%; 1 watt	RC time constant network resistor V106B	RC30BF334J	N16-R-50758-751	International Resistance Corp. Type BTS	R165, R177
R166	Same as R104	Grid isolating resistor V106B				
R167	RESISTOR, FIXED, COMPOSITION: 6800 ohms, ±5%; 1 watt	Cathode bias resistor V106	RC30BF682J	N16-R-50200-751	International Resistance Corp. Type BTS	R167
R168	Same as R135	Isolating resistor plate V106B				
R169	Same as R136	Plate load resistor V106B				

R170	Same as R106	Bias voltage divider network V107A				
R171	Same as R138	Bias voltage divider network V107A				
R172	Same as R106	Bias voltage divider network V107B				
R173	Same as R138	Bias voltage divider network V107B				
R174	RESISTOR, FIXED, WIRE WOUND: 5000 ohms, ±5%; 18 watts	Regulated voltage dropping resistor +150 v supply	RW33G502	N16-R-66251-4196	Ward Leonard Electric Co.	R174, R176
R175	RESISTOR, FIXED, WIRE WOUND: 3500 ohms, ±5%; 18 watts	Regulated voltage dropping resistor +150 v supply	RW33G352	For replacement use N16-R-66187-1746	Ward Leonard Electric Co.	R175
R176	Same as R174	RC filter resistor -150 v supply				
R177	RESISTOR, FIXED, COMPOSITION: 510,000 ohms, ±5%; 1/2 watt	RC time constant network resistor V108B	RC20AF514J		International Resistance Corp. Type BTS	R177
S101	SWITCH, TOGGLE, SPST: bat handle	Synch 4 circuit switch	ST-16A	N17-S-70778-4234	Arrow-Hart & Hegeman Elec. Co. Type 81015	S101
S102	SWITCH, TOGGLE, SPDT: bat handle	Neutral-reverse switch	ST-16D	N17-S-72018-9294	Arrow-Hart & Hegeman Elec. Co. Type 81015	S102
S103	SWITCH, TOGGLE, DPST: bat handle	AC line switch	ST-26K	N17-S-73083-3285	Arrow-Hart & Hegeman Elec. Co. Type 81015	S103
T101	TRANSFORMER, AUDIO FREQUENCY: input type; primary 600 ohms; secondary 100,000 ohms; both primary and secondary are center tapped; hermetically sealed steel case; ref dwg Group 12, 2-5/16 in. lg; 2-1/16 in. wide; 3-1/8 in. high; 1 to 13 turns ratio primary to secondary; ±1 db from 400 to 8000 cps not tuned; 6 stud type double turret terminals located axially at one end; 4 mounting studs 6-32 1/2 in. lg; 1-11/16 in. lg; 1-7/16 in. wide; center to center	Signal input transformer		N17-T-61606-8101	Audio Development Co. A7553	T101
T102	TRANSFORMER, POWER: step-up; hermetically sealed steel case; input 115 ±10% v a.c.; 50-70 cps single phase; output 4 windings No. 1 sec 5 v; 3 amps; No. 2 sec 6.3 v; 3.5 amps; No. 3 sec 6.3 v; 3.5 amps; No. 4 sec 280 v RMS each side center tap; 150 ma. d.c. 1500 v RMS test; MBCA ref dwg Group 12; 4-5/16 in. lg; 3-11/16 in. wide; 5-9/16 in. high; 11 solder stud;	Power transformer		N17-T-74276-4897	Audio Development Co. A7700	T102

Symbol Desig.	Name and Description	Function	JAN Type Number	Standard Navy Stock Number	Mfr. & Mfr. Desig.	All Symbol Desig. Involved
	double turret type terminals; located axially on bottom; 4 mounting studs 10-32 1/2 in. lg; 3-5/16 in. lg; 2-11/16 in. wide center to center					
V101	ELECTRON TUBE: dual triode; miniature; 9 pin; JAN 12AX7	RF amplifier	JAN-12AX7	N16-T-58241-60	Radio Corp. of America Type 12AX7	V101, V102, V103
V102	Same as V101	DC amplifier				
V103	Same as V101	DC amplifier				
V104	ELECTRON TUBE: dual triode; miniature; 7 pin; JAN 6J6	DC amplifier	JAN-6J6	N16-T-56360	Radio Corp. of America Type 6J6	V104, V105, V106, V107, V108
V105	Same as V104	Start delay multivibrator tube				
V106	Same as V104	Start pulse multivibrator tube				
V107	Same as V104	Isolation amplifier				
V108	Same as V104	Stop width multivibrator tube				
V109	ELECTRON TUBE: dual triode; octal base; JAN 6AS7G	Power output amplifier	JAN-6AS7G	N16-T-56202	Radio Corp. of America Type 6AS7G	V109
V110	ELECTRON TUBE: full-wave power rectifier; octal base; JAN 5R4GY	Power supply rectifier	JAN-5R4GY	N16-T-55444	Radio Corp. of America Type 5R4GY	V110
V111	ELECTRON TUBE: gaseous diode voltage regulator; miniature; JAN 0A2	Positive 150 v regulator	JAN-0A2	N16-T-52001	Hytron Radio & Electronic Corp. Type 0A2	V111, V113
V112	ELECTRON TUBE: full-wave power rectifier; miniature; JAN 6X4	Negative bias supply rectifier	JAN-6X4	N16-T-56840	Radio Corp. of America Type 6X4	V112
V113	Same as V111	Negative 150 v regulator				
W101	CABLE, POWER, ELECTRICAL: flexible; rubber covered; resistant to acid; alkalies and water; 2 conductors #16 AWG 65 strands; 600 volt, 10 amps	AC line cable		Shop manufacture locally	General Electric Supply Co. No. S153028	W101
XF101	SOCKET, FUSE: Molded phenolic; bayonet type; 250 v 15 amp	AC line fuseholder		N17-F-74267-5075	Bussmann Mfg. Co. HKP	XF101
XI101	LIGHT, INDICATOR	Indicates power "ON"		N17-L-76854-4324	Dial Lamp Mfg. Co. No. 81410-111	XI101

XI101A	RECEPTACLE, LAMP: miniature bayonet base; dull black finish (Listed for reference only)	Indicator light holder	*			
XI101B	LENS, INDICATOR LIGHT: part of XI101A (Listed for reference only)					
XV101	SOCKET, ELECTRON TUBE: miniature; 9 phos bronze contacts; molded phenolic base w/base shield	Socket V101	TS103P01	N16-S-64063-6713	Electro Connector Corp. #169PH	XV101, XV102
XV102	Same as XV101	Socket V102				
XV103	Same as XV101	Socket V103				
XV104	SOCKET, ELECTRON TUBE: miniature; 7 phos bronze contacts; molded phenolic base w/base shield	Socket V104	TS102P01	N16-S-62603-67′2	Electro Connector Corp. #235PH	XV104, XV105, XV106, XV107, XV108, XV111, XV112, XV113
XV105	Same as XV104	Socket V105				
XV106	Same as XV104	Socket V106				
XV107	Same as XV104	Socket V107				
XV108	Same as XV104	Socket V108				
XV109	SOCKET, ELECTRON TUBE: octal; 8 phos bronze contacts	Socket V109	TS101P01	N16-S-63515-4151	Electro Connector Corp. #335	XV109
XV110	Same as XV109	Socket V110				
XV111	Same as XV104	Socket V111				
XV112	Same as XV104	Socket V112				
XV113	Same as XV104	Socket V113				

*Not furnished as a maintenance part. If failure occurs do not request replacement unless the item cannot be repaired or fabricated.

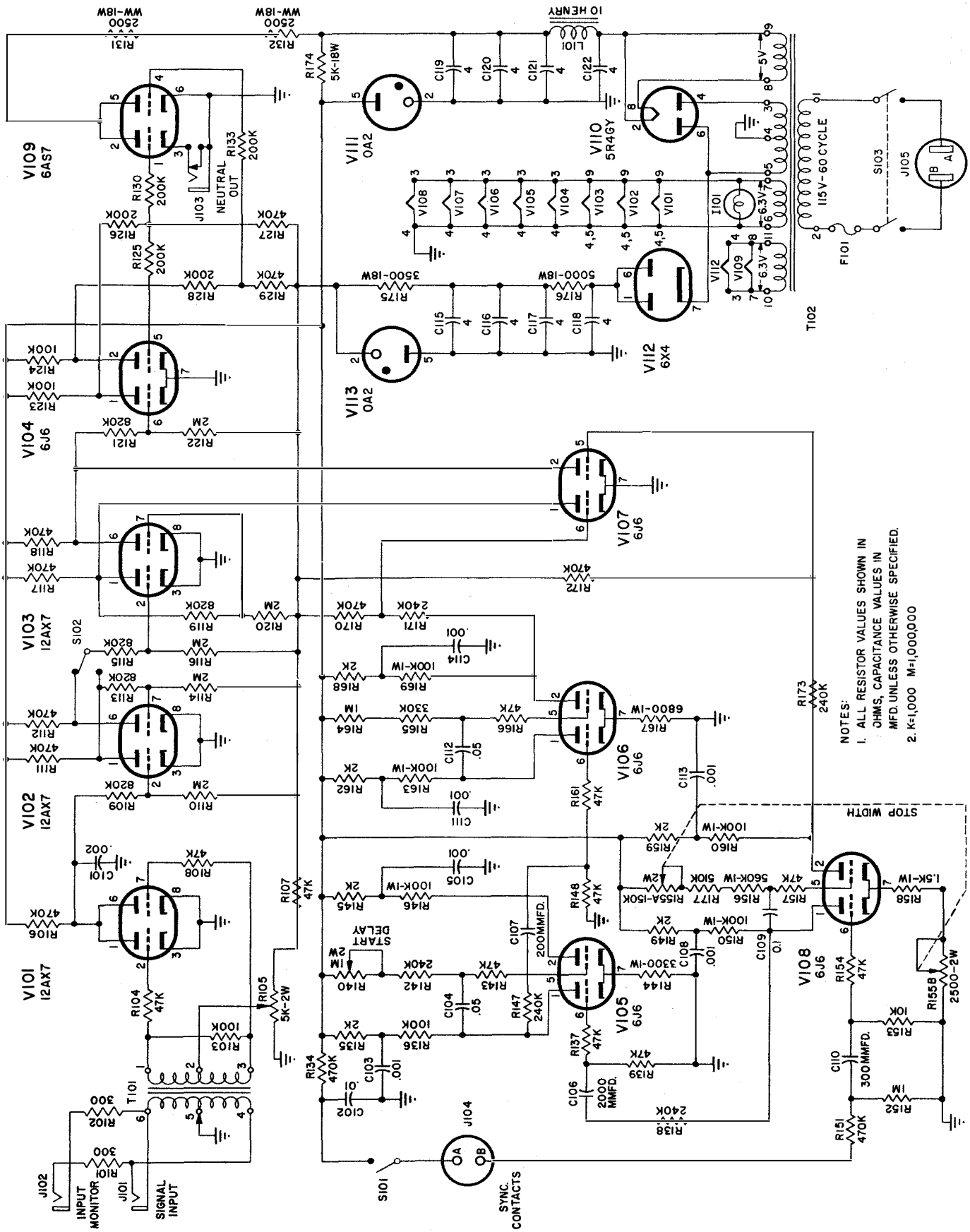

Figure 7-1. Schematic Diagram

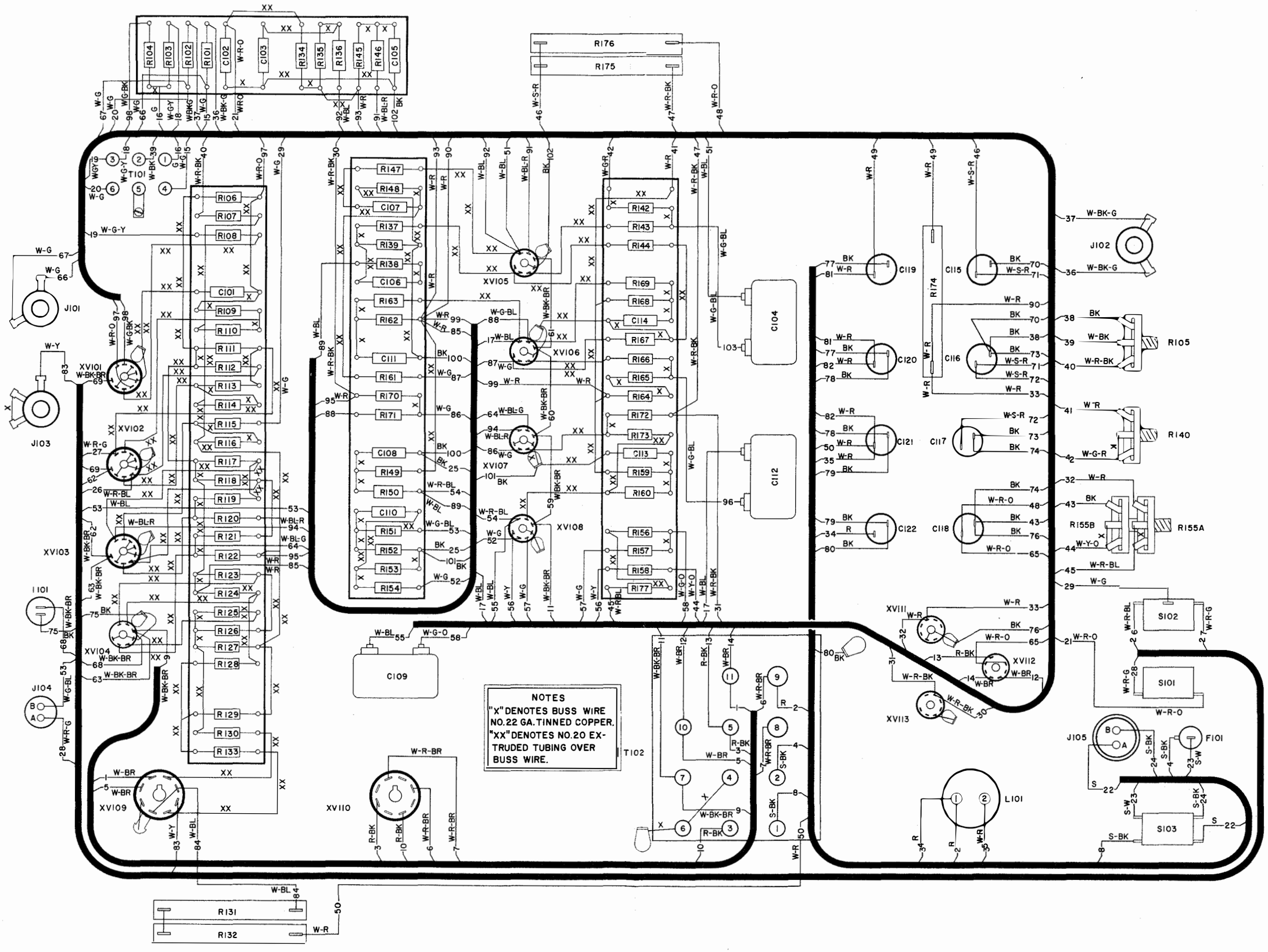

Figure 7-2. Wiring Diagram