UNCLASSIFIED

TM 11-1510

WAR DEPARTMENT TECHNICAL MANUAL

Obsolete per SR 310-20-4,
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SERVICE MANUAL FOR RADIO SETS SCR-270-B, -C, -D, -E, -BA, -CA, SCR-271, SCR-271-A, -AA, -AAA, -AB, -B, -BA, -D, -E, -F, -G, -H, -J, -K, -L, AND -M.

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WAR DEPARTMENT · 25 AUGUST 1944

WAR DEPARTMENT TECHNICAL MANUAL

TM 11-1510—CONFIDENTIAL

SERVICE MANUAL FOR RADIO SETS SCR-270-B, -C, -D, -E, -BA, -CA, SCR-271, SCR-271-A, -AA, -AAA, -AB, -B, -BA, -D, -E, -F, -G, -H, -J, -K, -L, AND -M.

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TM 11-1510, War Department Technical Manual, Service Manual for Radio Sets SCR-270-B, -C, -D, -E, -BA, -CA, SCR-271, SCR-271-A, -AA, -AAA, -AB, -B, -BA, -D, -E, -F, -G, -H, -J, -K, -L, and -M, is published for the information and guidance of all concerned.

[A.G. 300.7 (25 Mar 44).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,

Chief of Staff.

OFFICIAL:

J. A. ULIO,

Major General,

The Adjutant General.

DISTRIBUTION:

As prescribed in paragraph 9*a*, FM 21-6: Armies (2); Corps (2); SvC (5); Def Comds (5); Depts (2); IC 11 (2); C of Tech Sv (2); Sig C Rep Shops (2).

IC 11: T/O 11-107, Sig Dep Co; 11-237, Sig Co, Sv Gp; 11-327, Sig Port Sv Co; 11-400, Sig AW Orgn; Radar Rep Plat (C); T/O & E 11-500, Sig Sv Orgn; Radar Instl & Maint Team; 11-587, Sig Base Maint Co; 11-592, Hq & Hq Co, Sig Base Dep; 11-597, Sig Base Dep Co; 11-617, Sig Radar Maint Unit.

For explanation of symbols, see FM 21-6.

INDEX

WARNING

HIGH VOLTAGE

is used in the operation of
this equipment

DEATH ON CONTACT

may result if operating personnel
fail to observe safety precautions

CONTENTS

DESTRUCTION NOTICE

WHY — To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN — Ordered by your Commander.

HOW — 1. Smash — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools, etc.

2. Cut — Use axes, handaxes, machetes, etc.

3. Burn — Use gasoline, kerosene, oil, flame throwers, incendiary grenades, etc.

4. Explosives — Use firearms, grenades, TNT, etc.

5. Disposal — Bury in slit trenches, fox holes, or other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THE EQUIPMENT

WHAT — 1. Smash — *a.* All high-voltage bushings and insulators, bleeder resistors, capacitors, terminal blocks, and fuse panels in the rectifier, transmitter, and keying unit.

b. The range unit in the oscilloscope.

c. All dipoles and reflectors on the antenna.

d. Transmission line.

e. Antenna position control unit.

f. Oscilloscope units (2) and receivers (2) after removing them from their cases.

g. Water cooling unit.

2. Cut — All wires, cables, coil windings throughout the entire radio set.

3. Break — *a.* All tubes in every component.

b. All spare tubes. (Be careful when breaking the cathode-ray tube as it will explode when smashed.)

4. Burn — *a.* All insulated wires, cables, and other parts.

b. Instruction books, technical manuals, and schematics.

c. Power and operating vans.

DESTROY EVERYTHING

SAFETY NOTICE

While every practicable safety device has been incorporated in the equipment, the operator should always bear in mind that Radio Sets SCR–270–(*) and SCR–271–(*) involve the use of extremely high voltages, which are a constant danger to personnel. Operators must at all times observe all safety regulations. The voltages generated in the set, if not handled properly, are sufficient to cause death on contact.

The following precautions must be strictly observed:

(1) Do not change tubes nor make any adjustments inside the equipment with the high-voltage switch ON.

(2) Do not depend upon door switches nor interlocks for protection, but always disconnect the power to the equipment when any possible danger may exist.

(3) Keep away from live circuits.

(4) Do not try to reach within, or in any manner gain access to, the inclosures while the interlocked doors are closed, or while the power-supply line switches are closed.

(5) Do not connect any apparatus, external to the inclosure, to circuits within the equipment.

(6) Do not apply voltages to the equipment for testing purposes while any noninterlocked portion of the shielding or inclosure is removed or open.

(7) Always use the grounding stick to short-circuit large capacitor terminals and to ground the high-voltage circuits before performing service operations within the high-voltage rectifier, transmitter, and keyer.

(8) Before touching any of the terminals or connections, use a screw driver with a well-insulated handle to short-circuit the terminals of the large capacitors in the oscilloscope or receiver.

(9) Do not under any circumstances reach within the inclosures to service or adjust the equipment unless another person, capable of rendering aid, is present.

(10) Do not tamper with interlocks.

(11) Do not under any circumstances remove, short-circuit, or tamper with any access door, gate, or safety interlocked switch, except as directed for specific tests.

(12) Do not expect the interlocking switches (which shut off the high voltage) to be fool-proof.

(13) Keep fire extinguishers accessible and ready for immediate use.

(14) Have a properly stocked first-aid kit available AT ALL TIMES.

(15) Fumes from cleaning agents such as alcohol, carbon tetrachloride, and naphtha are dangerous to human life when used within a confined space. Be careful when using any of these agents. Never use them in an inclosed room nor van which is not well ventilated. Precautions for allowing fumes to be dissipated into the air must always be taken before attempting to use any of the cleaning agents. Alcohol and naphtha are both inflammable and should be kept away from all open flames or sparks.

FIRST AID TREATMENT FOR ELECTRIC SHOCK

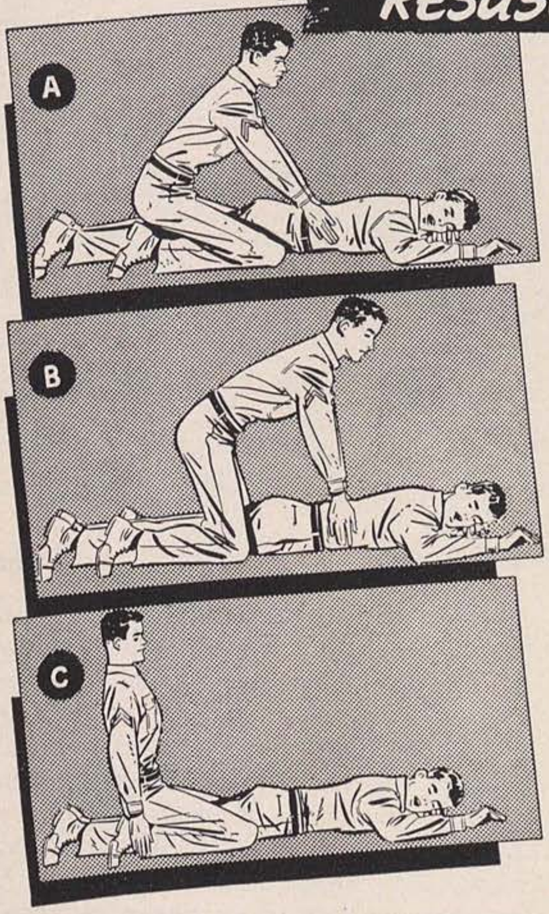
I. FREE THE VICTIM FROM THE CIRCUIT IMMEDIATELY.

Shut off the current. If this is not **immediately** possible, use a dry nonconductor (rubber gloves, rope, board) to move either the victim or the wire. Avoid contact with the victim. If necessary to cut a live wire, use an axe with a dry wooden handle. Beware of the resulting flash.

II. ATTEND INSTANTLY TO THE VICTIM'S BREATHING.

Begin resuscitation at once on the spot. Do not stop to loosen the victim's clothing. Every moment counts. Keep the patient warm; Wrap him in any covering available. Send for a doctor. Remove false teeth or other obstructions from the victim's mouth.

RESUSCITATION



POSITION

1. Lay the victim on his belly, one arm extended directly overhead, the other arm bent at the elbow, the face turned outward and resting on hand or forearm, so that the nose and mouth are free for breathing (fig. A).

2. Stradle the patient's thighs, or one leg, with your knees placed far enough from his hip bones to allow you to assume the position shown in figure A.

3. Place your hands, with thumbs and fingers in a natural position, so that your palms are on the small of his back, and your little fingers just touch his lowest ribs (fig. A).

FIRST MOVEMENT

4. With arms held straight, swing forward slowly, so that the weight of your body is gradually brought to bear upon the victim. Your shoulders should be directly over the heels of your hands at the end of the forward swing (fig.B). Do not bend your elbows. The first movement should take about 2 seconds.

SECOND MOVEMENT

5. Now immediately swing backward, to remove the pressure completely (fig. C).

6. After 2 seconds, swing forward again. Repeat this pressure-and-release cycle 12 to 15 times a minute. A complete cycle should require 4 or 5 seconds.

CONTINUED TREATMENT

7. Continue treatment until breathing is restored or until there is no hope of the victim's recovery. Do not give up easily. Remember that at times the process must be kept up **for hours**.

8. During artificial respiration, have someone loosen the victim's clothing. Wrap the victim warmly; apply hot bricks, stones, etc. Do not give the victim liquids until he is fully conscious. If the victim must be moved, keep up treatment while he is being moved.

9. At the first sign of breathing, withhold artificial respiration. If natural breathing does not continue, immediately resume artificial respiration.

10. If operators must be changed, the relief operator kneels behind the person giving artificial respiration. The relief takes the operator's place as the original operator releases the pressure.

11. Do not allow the revived patient to sit or stand. Keep him quiet. Give hot coffee or tea, or other internal stimulants.

HOLD RESUSCITATION DRILLS REGULARLY

REFERENCE NOTICE

TM 11–1510, Service Manual, is one of six technical manuals on Radio Sets SCR–270–(*) and SCR–271–(*). It is used with TM 11–1110D, TM 11–1114D, TM 11–1110M, Technical Manuals; TM 11–1310, Technical Operation Manual; and TM 11–1410, Preventive Maintenance Manual.

CHAPTER 1

TROUBLE SHOOTING

Section I. INTRODUCTION

1. Purpose

This manual is designed to help the trouble shooter locate any defect in the radar installation with speed and accuracy and make proper and permanent repairs. A simple, logical procedure is developed and is presented in a step-by-step form, which will enable the trouble shooter to avoid the loss of time and efficiency which would result if trial and error procedures were used.

NOTE. When used throughout this manual, the symbol (*) following momenclature will refer to all items of equipment regardless of model or procurement. Thus Radio Sets SCR-270-(*) and SCR-271-(*) refer to:

SCR-270-B, SCR-270-C, SCR-270-D, SCR-270-E, SCR-270-BA, SCR-270-CA, SCR-271, SCR-271-A, SCR-271-AA, SCR-271-AAA, SCR-271-AB, SCR-271-B, SCR-271-BA, SCR-271-D, SCR-271-E, SCR-271-F, SCR-271-G. SCR-271-H, SCR-271-J, SCR-271-K, SCR-271-L, and SCR-271-M.

2. Scope

The following discussion will deal briefly with the contents of each chapter in this manual and will serve as a guide to the way the manual is to be used.

a. TROUBLE SHOOTING *(ch. 1).* This chapter contains a discussion of the information necessary to assist in rapidly locating defects. The need for sectionalization and localization of a fault is explained. Signal tracing, signal substitution, voltage measurements, and resistance measurements are thoroughly discussed.

b. TEST EQUIPMENT *(ch. 2).* This chapter describes the use, operation, and limitations of test equipment available in the field. The text is supplemented by detailed illustrations and diagrams.

c. NORMAL SET *(ch. 3).* The conditions found in a normal set during the starting and stopping procedure and while the set is operating normally are explained in this chapter. Each condition described here is correlated with an abnormal condition in the following chapter.

d. ABNORMAL SET *(ch. 4).* The use of the starting procedure for tracing a fault to a particular component and then to a particular part is explained in this chapter. The abnormal conditions which may be present in a set are thoroughly analyzed by procedures, charts, waveforms, diagrams, and illustrations. The use of the Equipment Performance Log for trouble shooting purposes is also explained.

e. REPLACEMENT *(ch. 5).* When a fault has been located, the trouble shooting process is completed by repairing or replacing the defective part. This chapter describes and illustrates the proper steps for removing and replacing the major parts of the rectifier, transmitter, keyer, receiver, water cooler, oscilloscope, and antenna position control system.

f. EMERGENCY REPAIRS *(ch. 6).* Occasionally, replacement parts or necessary tools are not available, and the trouble shooter must resort to emergency repairs to keep the station on the air. This chapter describes field-tested methods for making quick temporary repairs.

g. MAINTENANCE PARTS LIST *(ch. 7).* This chapter lists the replaceable parts for Radio Sets SCR-270-( ) and SCR-271-( ) and gives the Signal Corps Stock number for each part. The availability of each part and the echelons in which it is carried is also shown on the maintenance parts list.

Section II. TROUBLE SHOOTING PROCEDURES

3. Introductory Notes

No matter how well equipment is designed and manufactured, faults are bound to occur in service. Preventive maintenance will minimize difficulties. When troubles do occur, the repairman must locate and correct them as rapidly as possible. This section gives general information for aid to personnel engaged in the important duty of trouble shooting.

a. TROUBLE SHOOTING DATA. Every advantage should be taken of the material supplied in this manual to aid in rapidly locating faults. The following data should be consulted as needed:

(1) *Complete schematic diagrams.* The diagrams include all components and show all the connections (power, input, and output) to other units.

(2) *Simplified and partial schematics.* These diagrams are particularly useful in trouble shooting, because they enable the electrical functioning of the circuits to be followed more clearly than on the regular schematics, and thus help to speed locating the trouble.

(3) *Voltage and resistance data at all socket connections.* This information is especially useful when the trouble has been traced to a particular stage.

(4) *Illustrations of components.* Front, top, and bottom views aid in locating and identifying parts.

(5) *Pin connections.* Pin connections on sockets, plugs, and receptacles are shown numbered or lettered on the various diagrams, in accordance with standard practice.

(*a*) Socket connections are numbered in a clockwise direction around the sockets, looking at the socket from the bottom. On an octal socket, the first pin clockwise from the keyway is pin number 1. Pin numbers are identified on the schematic diagrams so that any tube element can be readily located.

(*b*) Plugs and receptacles are numbered looking at them from the side to which the associated connector is attached. To avoid confusion, some individual pins are identified by letters which appear directly on the connector.

b. TROUBLE SHOOTING STEPS. The first step in servicing a defective radar set is to sectionalize the fault. The second step is localization of the fault. By sectionalization is meant the tracing of the fault to the component responsible for the abnormal operation of the set. By localization is meant the tracing of the fault to the defective part responsible for the abnormal condition.

(1) Use of the Equipment Performance Log (EPL) and the Starting Procedure aids in tracing the fault to the defective component. The procedures to be followed are explained in subparagraphs *c* and *d*, below.

(2) Some faults such as burned-out resistors, radio-frequency (r-f) arcing, etc. can be located by application of the senses of sight, smell, feeling, and hearing. The majority of faults, however, must be located by checks of voltage, resistance, and waveforms.

c. EPL SECTIONALIZATION. The Equipment Performance Log Sheet is a record of the normal and abnormal operation of the station. In the event of station failure or abnormal operation, reference to the EPL will, in most cases, aid in localizing the defect. When a station failure occurs, refer to the log sheet and note the operation of the station for the past 24 hours. The station failure may have been caused by a previous abnormal condition not serious enough in itself to cause the station to go off the air at that particular time. However, the abnormal condition will have been entered in the station log, and upon consultation of the log entry, direct information leading to the cause of the failure may be obtained.

d. STARTING PROCEDURE SECTIONALIZATION. The starting procedure is the systematic method used in placing the station on the air. This procedure is used in sectionalization when the cause of the station failure is not known and will, in most cases, trace the defect to a particular component. The starting procedure is performed in sequence until an abnormal result is obtained. As each action is performed, the visible and audible results of the action are noted. The use of the starting procedure is described in detail in chapter 3 of this manual.

e. LOCALIZATION. Localization is the tracing of the fault to a particular part. Chapter 4 of this manual tells how to localize faults within the individual components and contains trouble shooting charts which list abnormal symptoms and tells what could cause the symptom. The charts also give the procedure for finding out which of the probable locations of the fault is the right one. In addition, certain sections tell what waveforms should be obtained at the test points and there are drawings which show the resistance and the voltage at every socket-pin connection. How to make use of voltage and resistance data in checking a circuit is described in detail in paragraphs *4d* and *5c* of this chapter.

4. Voltage Measurements

a. GENERAL. Voltage measurements are an almost indispensable aid to the repairman, because most troubles either result from abnormal voltages or produce abnormal voltages. Voltage measurements are convenient because they are always made between two points in a circuit and the circuit need not be interrupted.

(1) Complete information on normal operating voltages is given in chapter 4. Unless otherwise specified, these voltages are measured between the indicated points and ground.

(2) Always set the voltmeter on the highest range, so that the voltmeter will not be overloaded. If it is necessary to obtain increased accuracy, go to a lower range so that the required accuracy will be obtained.

(3) *In checking cathode voltage,* a point which must be watched is that a reading can be obtained when the cathode resistor is actually open. The resistance of the meter may act as a cathode resistor. Thus the cathode voltage may be approximately normal only as long as the voltmeter is connected between cathode and ground. Before the cathode voltage is measured, a resistance check should be made with the circuit cold to determine that the cathode resistor is normal.

b. PRECAUTIONS AGAINST HIGH VOLTAGE. Certain precautions must be followed when measuring voltages above a few hundred volts. *High voltages are dangerous, and can be fatal.* Where it is necessary to measure high voltages, it is desirable to observe the following rules:

(1) Connect the ground lead to the voltmeter.

(2) Place one hand in your pocket.

(3) If not greater than 300 volts, connect the test lead to the hot terminal (which may be either positive or negative with respect to ground).

(4) If greater than 300 volts, shut off the power, connect the hot-test lead, step away from the voltmeter, turn on the power, note the reading on the voltmeter. *Do not touch any part of the voltmeter.* This is especially important where it is necessary to measure the system voltage between two points, both of which are above ground.

c. VOLTMETER LOADING. It is essential that the voltmeter resistance be at least 10 times as large as the resistance of the circuit across which the voltage is measured. If the voltmeter resistance is comparable to the circuit resistance, the voltmeter will indicate a lower voltage than the actual voltage present when the voltmeter is removed from the circuit.

(1) The resistance of the voltmeter on any range can always be calculated by the following simple rule: Resistance of voltmeter equals ohms-per-volt times full-scale range in volts.

Example:

(*a*) What is the resistance of a 1,000 ohm-per-volt meter on the 300-volt range?

R = 1,000 ohms-per-volt times 300 volts full scale = 300,000 ohms.

(*b*) What is the resistance of a 20,000 ohm-per-volt meter on the 300-volt range?

R = 20,000 ohms-per-volt times 300 volts = 6 megohms.

(2) To minimize voltmeter loading in high-resistance circuits, the highest voltmeter range should be used. Although only a small deflection will be obtained (possibly only 5 divisions on a 100-division scale), the accuracy of the voltage measurement will be increased. The decreased loading of the voltmeter will more than compensate for the inaccuracy due to reading only a small deflection on the scale of the voltmeter.

(3) When a voltmeter is loading a circuit, the effect can always be noted by comparing the voltage reading on two successive ranges. If the voltage readings on the two ranges do not agree, this indicates that the voltmeter loading is excessive. The reading (not the deflection) on the highest range will be greater than on the lowest range. If the voltmeter is loading the circuit heavily, the deflection of the pointer will remain nearly the same when the voltmeter is shifted from one range to another.

(4) The voltage and resistance drawings used in this manual are based on readings taken with an actual meter. The ohms-per-volt sensitivity of the meter used is printed on the drawing. The trouble shooter should use a meter having the same ohms-per-volt sensitivity. Since the meter used in testing for the voltage will produce the same amount of loading as the meter used in measuring the voltage, no account need be taken of the effect of loading.

d. PRACTICAL EXAMPLE OF VOLTAGE ANALYSIS. Figure 1 illustrates a typical amplifier stage. The values of the various parts are labeled as well as the input voltages. The normal voltages at the V3 tube socket contacts are:

1	2	3	4	5	6	7	8
7.2	6.3 ac	0	0	7.2	195	6.3 ac	185

NOTE. All voltages are direct current (d-c) unless otherwise specified. The d-c readings were taken with a 1,000 ohm-per-volt voltmeter. (A drawing has been made for each component giving the voltage at each socket connection. The drawing can be found in the section on trouble shooting in the component.)

Checking this stage for an abnormal voltage measurement is accomplished by testing the voltages between the socket contacts and the chassis.

(1) The voltage between contact 1 and the chassis is normally 7.2 volts (by referring to chart above). This voltage should be the same as that between socket contact 5 and chassis, since they are directly connected as explained in (3) below.

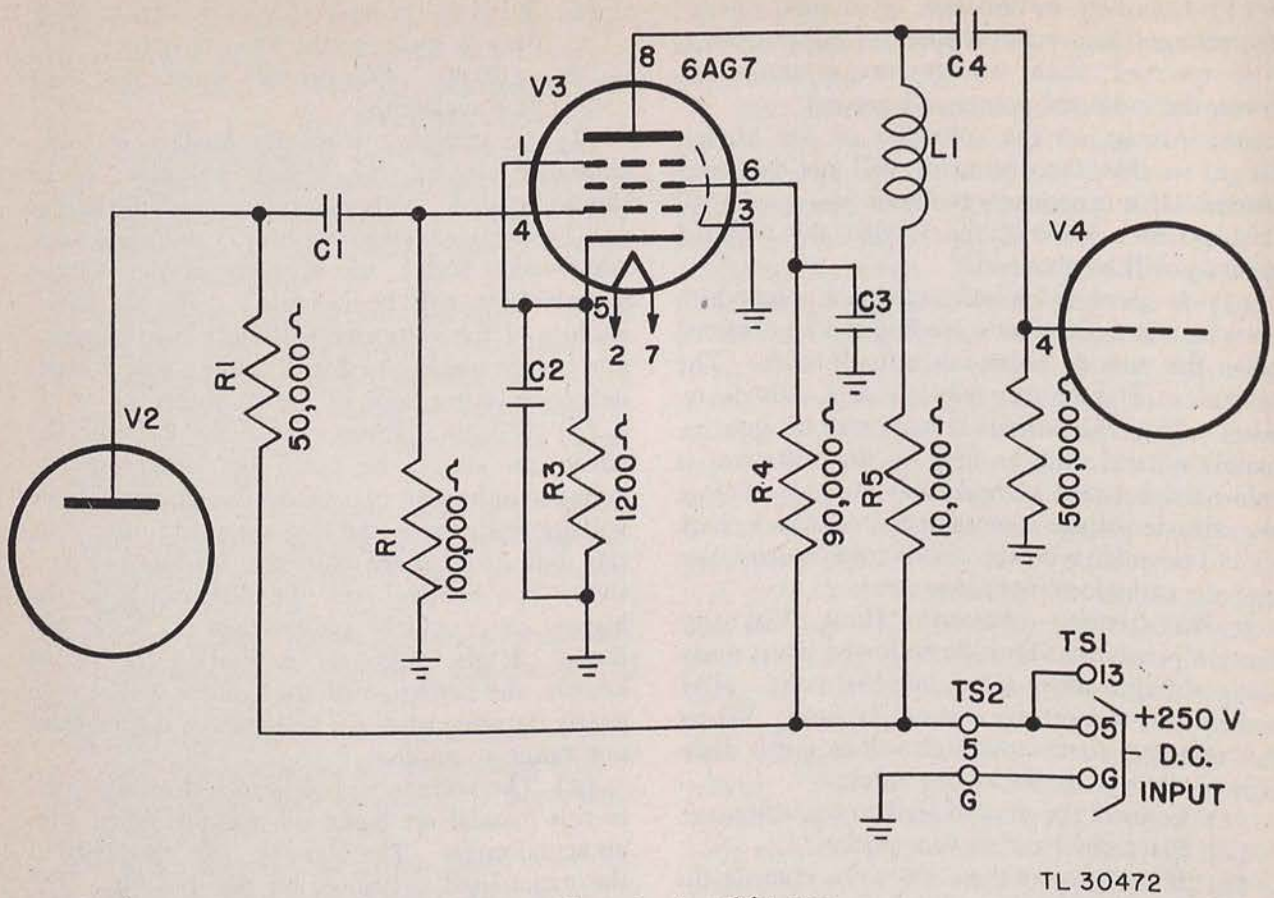


Figure 1. Conventional amplifier stage.

(2) The voltage between contact 2 and contact 7 should be 6.3 alternating current (a-c). On the diagram, no connections are shown since the filaments of amplifier tubes are always connected to a low-voltage a-c source. In the event that this voltage is abnormal, the voltage should be checked across the winding of the transformer which supplies the voltage. If the voltage on the transformer is normal, the only trouble can be a broken connection between the transformer and the contact. If the voltage on the transformer winding is abnormal, the voltage on the transformer primary winding should be measured. If the primary voltage is normal and the voltage on the winding that delivers the filament voltage is abnormal, the transformer is either defective, or an abnormally high drain is being placed on the filament winding. This can be checked by removing one of the wires from the filament winding and again testing the voltage across this winding. If the transformer is defective, the voltage reading will still be abnormal. If the transformer is normal, the voltage will be a little higher than usual. If, however, the voltage on the transformer primary is abnormal, the source of this voltage must be checked.

(3) The voltage between contact 3 and the chassis should be zero since this contact is directly connected to the chassis.

(4) The voltage between contact 4 and the chassis should be zero since this is a Class A amplifier and no grid current flows through the grid resistor (100,000 ohms) normally. If capacitor C1 should short-circuit, however, the high positive voltage on the plate of tube V2 would be delivered to contact 4 and a d-c positive voltage reading would be obtained. It is also possible for a short circuit inside the tube to cause a reading on this contact.

(5) An important consideration in measuring cathode voltage is explained in paragraph 4*a*(3).

(*a*) The voltage on contacts 1 and 5 should normally be 7.2 volts. The plate-cathode voltage and the grid-cathode circuit normally causes a current flow through the cathode resistor R3. This current is normally 0.006 amperes, since the resistor is rated at 1,200 ohms and the voltage across it is 7.2 volts.

$$I = \frac{E}{R} = \frac{7.2}{1,200} = 0.006 \text{ amperes.}$$

(*b*) If no voltage is obtained, the trouble may be a lack of the +250-volt applied voltage, a burned-out tube V3, a shorted resistor R3, a shorted capacitor C2 (this capacitor, if shorted, would connect the cathode to the chassis), or a broken connection.

(*c*) If the voltage is found to be low, the trouble could be a tube V3 with low emission, a leaky capacitor C2, an open-circuited resistor R4 or R5, a shorted capacitor C3 or C4, low +250 applied voltage, an open-circuited coil L1, a poor connection, or a change in the resistance value of any of the resistors. If the voltage is found to be too high, the trouble could be a gassy tube, a short-circuited resistor or coil, too high an applied voltage, or a connection in either the plate-cathode or screen-grid-cathode circuits shorted by another external circuit.

(6) The screen voltage is checked as follows:

(*a*) The voltage on contact 6 should normally be 195 volts. The voltage drop across the resistor normally would be 55 volts, since the voltage on one side of the resistor is 195 volts and on the other side is 250 volts. The normal current through this resistor would be 0.0006 amperes.

$$I = \frac{E}{R} = \frac{55}{90,000} = 0.0006 \text{ amperes.}$$

(*b*) If no voltage is obtained on contact 6, the trouble could be lack of an applied voltage, an open-circuited resistor R4, a broken connection, or a shorted capacitor C3.

(*c*) If the voltage on contact 6 is too low, the trouble could be a gassy tube, a leaky capacitor C3, too low an applied voltage, or too low a bias voltage on the grid of V3 (grid is biased by the 7.2 volts on the cathode).

NOTE. A gassy tube, or lowering of the grid bias of V3 would increase the screen grid current. Increasing this current would increase the voltage drop across R4. If capacitor C3 were leaky or shorted, the screen grid of V3 would be connected near or at ground potential, lowering the voltage on contact 6. The current through R4 would rise if C3 were shorted. R4 would be the only resistance between the applied voltage and the chassis ground. Resistor R4 would probably burn out because of the high current flow unless it had an ample power rating. Any cause that would make high current flow through the screen-grid-cathode circuit might burn out either R3 or R4.

(7) The plate voltage is checked as follows:

(*a*) The voltage between contact 8 and the chassis should normally be 185 volts. This voltage is at one of the points in the plate-cathode circuit which comprises resistor R5, coil L1, the plate resistance of tube V3, and resistor R3. The applied voltage in this circuit is +250 volts. The voltage drop across R5 and L1 in series is 65 volts (250 volts—185 volts). The current through R5 and L1 is 0.0064 amperes.

$$I = \frac{E}{R} = \frac{65}{10,025} = 0.0064 \text{ amperes.}$$

(*b*) If no voltage is obtained on contact 8, the trouble could be a lack of applied voltage, an open-circuited resistor R5 or coil L1, or a broken connection between terminal 5 on TS1 and contact 8. If the voltage on contact 8 is too low, the trouble could be a gassy tube V3, too low an applied voltage, a shorted or leaky capacitor C2, or a shorted resistor R3. A gassy tube V3, shorted or leaky capacitor C2 or a shorted resistor R3 would cause the current through the plate-cathode circuit to rise, increasing the voltage drop across R5 and L1. This would lower the voltage on contact 8. Increased current through this circuit may also burn out resistor R3 or R5 unless their power rating is ample.

(*c*) If the voltage is too high, the trouble could be a burned-out tube V3, low emission in V3, a burned-out resistor R3, a shorted resistor R5, too high an applied voltage, or a burned-out resistor R4. If the tube were burned out or resistor R3 were open, no current would flow through the plate-cathode circuit, and there would be no voltage drop between the applied voltage and the plate of the tube.

(*d*) Capacitor C4, a coupling capacitor to the grid of V4, can be checked for a shorted or leaky condition by measuring the voltage between contact 4 on V4 and the chassis ground, when the normal 185 volts is on the plate of V3. If the positive d-c voltage is higher than normal when measured on contact 4 of V4, the capacitor is leaky or shorted.

5. Resistance Measurements

a. GENERAL. (1) *Abnormal resistance values.* When a fault develops in the circuit, the effect will very often show up as a change in the resistance values. To assist in the localization of trouble, trouble shooting data include the normal resistance values, as measured at the tube sockets and at the test points. These values are measured between the indicated points and ground, unless otherwise stated. Often it is desirable to measure the resistance from other points in the circuit, in order to determine whether the particular points in the circuit are functioning properly. In these special cases, the normal resistance values can be determined by referring to the resistance values shown in the schematic.

(2) *Precautions.* (*a*) Before any resistance measurements are made, the power should always be turned off. Since an ohmmeter is essentially only a low-range voltmeter and battery, if the ohmmeter is connected to a circuit which already has voltages in it, the needle will be knocked off scale and the voltmeter movement may be burned out.

(*b*) Capacitors must always be discharged before resistance measurements are made. This is a very important point when checking power supplies that are disconnected from their load. The discharge of the capacitor through the meter will burn out its movement and *in some cases may be dangerous to life.*

(3) *Correct use of low and high ranges.* A simple, important point to be considered when using an ohmmeter is when to use the low resistance range, and when to use the high resistance range. When checking the circuit continuity, the ohmmeter should be set on the lowest range. If a medium or high range is used, the pointer may indicate zero ohms, even if the resistance is as high as 500 ohms. When checking high resistances or measuring the leakage resistance of capacitors or cables, the highest range should be used. If a low range is used, the pointer will indicate "infinite" ohms, even though the actual resistance is less than a megohm.

(4) *Parallel resistance connections.* In a parallel circuit the total resistance is less than the smallest resistance in the circuit. This is a very important fact to remember when shooting trouble from a schematic diagram. When a resistance is measured and the value is found to be less than expected, make a careful study of the schematic to make sure that there are no resistances in parallel with the one that has been measured.

(*a*) Whenever a resistor is being replaced because of low resistance, one terminal should be disconnected from the circuit and its value then measured to make sure that the low reading was not because some part of the circuit was parallel with it.

(*b*) In some cases it will be impossible to check a resistor because it has a low-voltage transformer winding connected across it. Where this is true and it is important that the resistor be checked, one terminal of the resistor should be disconnected from the circuit before its resistance is measured.

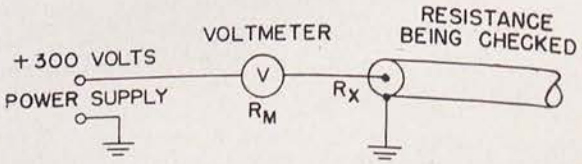
(5) *Checking grid resistance.* When checking grid resistance, a false reading may be obtained if the tube is still warm and the cathode is emitting electrons. This effect will not be observed if the tube has cooled, or if the ohmmeter test leads are reversed so the negative ohmmeter test lead is applied to the grid.

(6) *Tolerance values for resistance measurements.* Tolerance represents the normal difference that may be accepted between the rated value of the resistor and its actual value.

(*a*) Most resistors that are used in radar circuits have a tolerance of at least 10 percent. For example, the grid resistor of a stage might have a rated value of 1 megohm. If the resistor were measured and found to have a value between 900,000 and 1,100,000 ohms it would be considered normal. As a rule the ordinary resistors used in circuits are not replaced unless their values are off more than 15 to 20 percent. Some precision resistors and potentiometers are used. When a resistor is used whose value must be very close to its rated value, the tolerance is stated.

(*b*) The tolerance value for transformer windings is generally between 1 and 5 percent. As a rule, a transformer which shows a resistance which deviates more than 5 per cent from its rated values should be suspected. The transformer should be given a chance to cool off before the resistance test is made.

b. HIGH RESISTANCE. Many leakages will not show up when measured at low voltages. Most ohmmeters use a maximum test voltage of 15 volts on the highest resistance range. Where it is necessary to measure resistance above a few megohms or the leakage resistance between conductors and a test cable, the test should be made using an ap-



$$R_X = \frac{300}{V} R_M \text{ (APPROX.)}$$

EXAMPLE

V = 5 VOLTS. THE METER IS USED ON ITS 300 VOLT RANGE AND HAS A RESISTANCE OF 1,000 OHMS-PER-VOLT.

$$R_M = 300 \times 1{,}000 = 300{,}000 \text{ OHMS.}$$

$$R_X = \frac{300}{5} \times 300{,}000 = 18 \text{ MEGOHMS.}$$

TL 35530

Figure 2. Method of measuring high resistance.

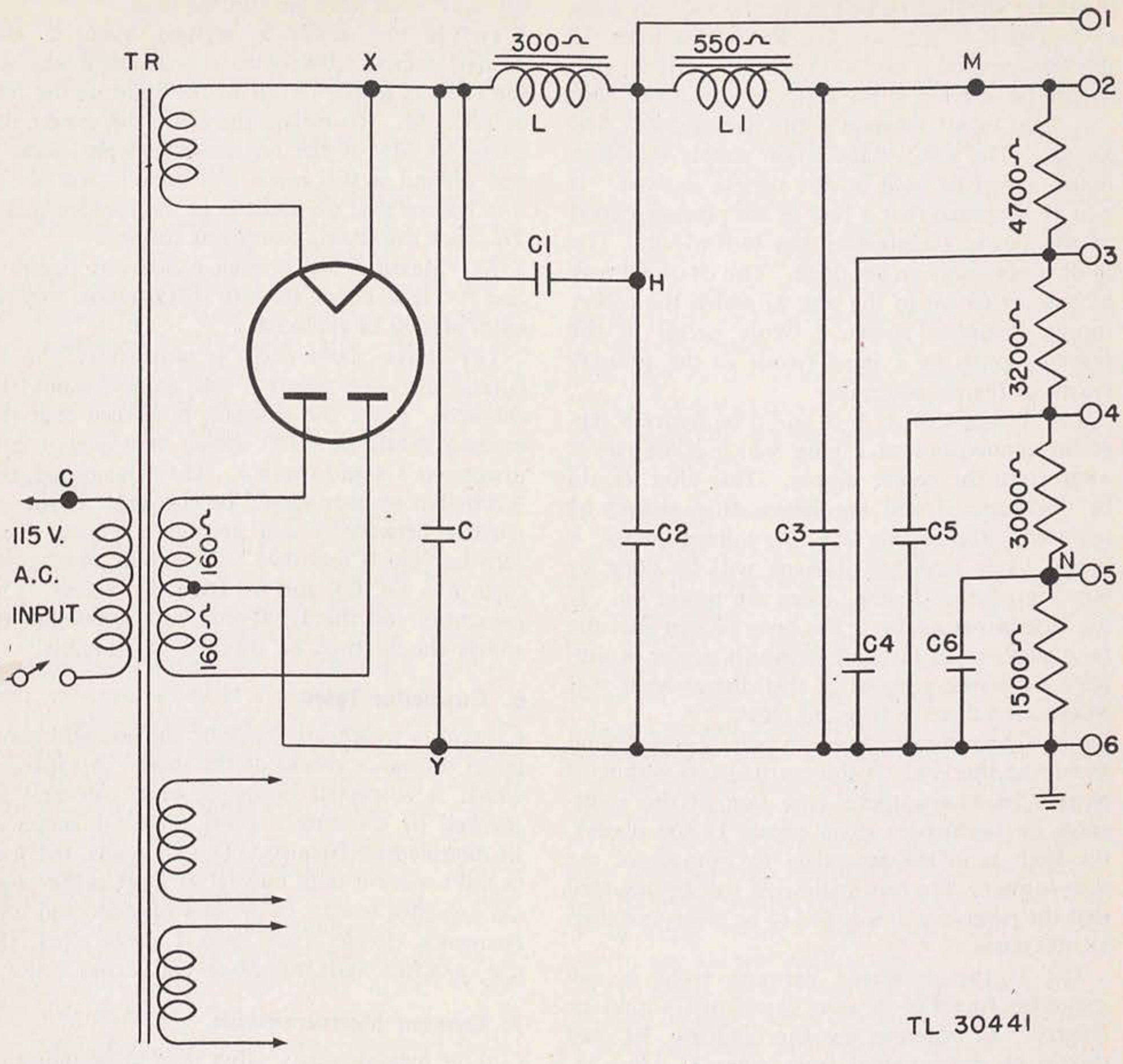


Figure 3. Conventional power supply.

plied voltage of 100 volts or more. Where it is possible to ground one end of the resistance being checked, one of the low-voltage power supplies in the equipment can be used to provide about 300 volts for making these high-resistance measurements. The manner in which such measurements are made is indicated in figure 2.

This method should be used only when the resistance being measured is very high. Care should be taken not to handle the meter after the circuit has been completed. The meter used should have an ohms-per-volt sensitivity of 1,000 ohms or more. The resistance of the meter is equal to the ohms-per-volt sensitivity multiplied by the range to which the meter is set. The derivation of the formula $Rx = \frac{300Rm}{V}$ is shown below. Rx is the unknown resistance, Rm the meter resistance, and V the voltmeter reading.

$$\frac{Rx}{Rm} = \frac{300\text{-}V}{V}$$

If Rx is very large, V will be small with comparison to 300. Making the assumption that 300–V can be replaced by 300, the formula becomes $\frac{Rx}{Rm} = \frac{300}{V}$ which, when solved for Rx, gives $Rx = \frac{300Rm}{V}$. When making the measurement, the meter should first be put on the 300-volt scale to protect it in the case that Rx is very low. If the voltage used is not 300 volts, the correct value should be inserted in the formula in place of 300.

c. Practical Example of Resistance Analysis. The low-voltage power supply shown in figure 3 will be used in this sample analysis. It will be supposed that a fuse in the primary circuit of the power transformer has blown out. The fault is obviously an overload. The overload may be a short circuit in the unit to which the power supply furnishes power, a short circuit in the power supply, or a short circuit in the primary circuit of the transformer.

(1) Points 1, 2, 3, 4, 5, and 6 on figure 3 represent connections to a plug which takes power away from the power supply. This plug should be disconnected and the blown fuse should be replaced. (Since this is a low-voltage circuit, it is not likely that any damage will be done by blowing another fuse.) Turn the power on. If the fuse blows again, it has been proven that the fault was not in the unit to which power is supplied. For the purpose of this discussion it will be assumed that the fuse did blow.

(2) The resistance between point 2 and ground should be checked. If this resistance is within 10 percent of 12.400 ohms (the sum of the resistances in the bleeder chain equals 12,400 ohms), the fault is in the secondary or primary of the transformer. For this analysis it will be assumed that the resistance was found to be much less than 12,400 ohms.

(3) If the resistance between point 2 and ground is found to be zero, capacitor C3 must be shorted. In order to test the capacitor, its lead should be disconnected from point M (fig. 3). The actual resistance of the capacitor can then be measured.

(4) If the resistance between point 2 and ground is found to be about 550 ohms, it is indicated that C2 is shorted. This is known because L1 has a resistance of 550 ohms. C2 can be tested by disconnecting it from ground and measuring its resistance.

(5) If the resistance between point 2 and ground is found to be about 850 ohms, it is indicated that either the rectifier tube, the filament winding, or capacitor C has a short in it. To tell which is shorted, remove the tube from its socket and again measure the resistance between point 2 and ground. If the fault is still there, it is known that it is in capacitor C or the filament winding. If the fault cleared up when the tube was removed, the fault must have been in the tube.

(6) If the resistance between point 2 and ground is about 1,000 ohms, it is doubtful whether the fault is in the circuit to the right or the left of point M. To isolate the fault, disconnect the circuit at M. If the resistance between point 2 and ground is still much less than 12,400 ohms, it is known that the fault is in the bleeder chain. To check the chain, proceed as follows:

(*a*) Measure the resistance between points 2 and 3. If it is not close to 4,700 ohms, this resistor should be replaced.

(*b*) If the above check is satisfactory, the resistance between points 3 and ground should be checked. From the diagram it is seen that the reading should be 7,700 ohms. If it is zero, first disconnect C4 and check it. If C4 is normal, the 3,200-ohm resistor should be checked. If the resistance between 3 and ground is greater than zero but much less than 7,700 ohms, disconnect capacitors C4, C5, and C6 from the circuit. The capacitors and the 1,500-ohm and 3,000-ohm resistors should then be checked individually.

6. Capacitor Tests

Capacitors which are leaky or shorted will show up in resistance checks of the stage. A capacitor which is suspected of being open can best be checked by shunting a good capacitor across it. In intermediate-frequency (i–f) circuits, the lead to this capacitor must be kept as short as the original capacitor leads. In the case of video and low-frequency circuits (less than 1 megacycle), the test capacitor leads may be several inches long.

7. Current Measurements

Current measurements, other than those indicated by the panel meters, are not ordinarily required in trouble shooting in the radar set. Under special circumstances where the voltage and resistance measurements by themselves are not sufficient to localize the trouble, a current measurement can be made by opening the circuit and connecting an ammeter to measure the current. This procedure is not recommended except in very difficult cases.

a. When the meter is inserted in a circuit in this way to measure current, it should always be inserted next to the cold end of the resistance. For example, when measuring *plate* current, the meter should not be inserted next to the plate of a tube, but should be inserted next to the end of the resistor which connects to the power. This precaution is necessary to keep the meter from upsetting the r–f voltages.

Caution: A meter has minimum protection against damage when it is used to measure current. Always set the current range to the highest value and, if it is necessary, decrease the range to give a more accurate reading. Avoid working close to full-scale reading, because this increases the danger of overload.

b. In most cases, the current to be measured flows through a resistance which is either known or can be measured with an ohmmeter. In such instances, the current flowing in the circuit can be determined by dividing the voltage drop across the resistor by its resistance value. In this connection, the drop across the cathode resistor is a convenient method of determining the cathode current. For an example, see paragraph *4d*.

8. Tubes

a. Tube Failures. Tube failures are responsible for a large percentage of the faults which occur in radar sets. There are, however, too many tubes in a radar set for a trouble shooter to attempt to find a fault by indiscriminate tube changing. Tube changing should not be resorted to until the fault has been traced to a particular stage.

(1) When a new tube is put into a circuit, the position of all controls should be noted before any controls are changed. If retuning the controls with the new tube in the circuit does not correct the abnormal condition, the controls should be returned to their original position and the old tube should be put back in the circuit, unless a tube test has shown the tube to be definitely bad.

(2) In many radar circuits the interelectrode capacitance is a part of the tuned circuit. When tubes are switched, the tuning of the circuits is upset and, if enough tube substitutions are made, the set can be thrown seriously out of alignment as a result of the tube changes.

(3) When a tube is replaced in a circuit, it should be definitely decided whether or not the old tube is to be kept. Unless a great deal of thought is taken in the matter of changing tubes, the spares box will become full of tubes whose exact age and condition is uncertain.

b. Tube Checking. The tube checker supplied with Radio Sets SCR–270–(*) and SCR–271–(*) is explained in chapter 2. This checker will not test the performance of high-voltage tubes and rectifiers and the special tubes in the keyer and rectifier, but it is useful for checking receiving-type tubes used in the various components.

(1) The indication of a tube checker is not always conclusive, because the tube is not checked under the same conditions under which it operates in the stage from which it was removed. For this reason, the final test of a tube must be its replacement with a tube which is known to be good. If the equipment performs with a new tube and it does not function with the suspected tube, obviously the suspected tube is defective. In many instances it is quicker and more reliable to replace a suspected tube with a tube which is known to be good than to check it with the tube checker.

(2) An operating chart and an instruction book are provided with the tube checker. The controls of the tube checker are set for each tube type, according to the instructions contained on this chart. The number of controls, their arrangement, and their settings vary with different types of tube checkers.

9. Checking Waveforms

a. Signal Tracing. Basically, signal tracing amounts to following the progress of a signal through a circuit. By *signal* is meant a video signal, a sweep voltage, or any other waveform which appears in the various parts of the equipment. A departure from the normal waveform indicates a fault located between the point where the waveform is last normal and the point where it is observed to be abnormal. For example, if a waveform is observed to be normal at the grid of a stage and abnormal at the plate of the same stage, this indicates the trouble lies in that stage. The following subparagraphs give some hints of use in signal tracing. See *b* and *c* below to tell how to use the test oscilloscope.

(1) When the waveform of a multivibrator, a blocking oscillator tube, or similar circuit is found to be wrong, the tube should first be replaced before any further tests are made. If replacing the tube does not correct the waveform, place the original tube back in the socket.

(2) In some cases the expected waveform may not be found in a particular component. The fault need not necessarily be in the component. It should be remembered that in radar equipment the operation of a particular component is often dependent upon a synchronizing or triggering pulse from another component. The point at which to start signal tracing a component is at the input of the synchronizing voltage.

b. Use of Test Oscilloscope. Waveforms are the basis of radar operation. The outstanding advantage of the oscilloscope (or *scope* as it will be called) is that it can be used to observe and to measure waveforms at the various test points in the equipment. By comparing the observed waveform with the actual reference waveform shown in the data, the fault can be rapidly localized. If, however, waveforms are measured at random without a logical procedure such as that originating with the starting procedure, the result may be a loss of time in finding the fault. The measurements of the waveforms with the test oscilloscope involve several essential points, covered in the following subparagraphs:

(1) *Initial adjustments.* The oscilloscope must be set up in accordance with definite instructions. Detailed instructions for Oscilloscope I–134–A are given in section VI, chapter 2.

(2) *Sweep frequency.* The sweep frequency should be adjusted to a frequency lower than the repetition frequency of the waveform being observed. For ordinary measurements, it is recommended that the sweep frequency be adjusted so that two or three cycles of the waveform appear on the screen. Where more detail is desired, the sweep amplitude may be increased to spread the waveform.

(3) *Synchronization.* Excessive synchronizing voltage should be avoided. If the SYNC control is advanced too far, the sweep will become nonlinear, with the result that the waveform will be distorted. Be sure the fine-frequency control on the scope is properly set so as to obtain a nearly stationary image. Then advance the SYNC control only far enough to make the trace stationary.

(4) *Sixty-cycle pick-up.* If some fault is present, it may be impossible to obtain a stationary pattern, even though the oscilloscope frequency control is properly adjusted. This effect is most commonly due to the presence of 60-cycle modulation or 60-cycle pick-up combined with the observed waveform. To check whether this defect is present, turn the oscilloscope sweep frequency to 30 cycles. If the effect is due to lines pick-up, a stationary pattern will be observed. The inside of this pattern will, of course, be more or less "filled," because of the much higher frequency of the waveform being observed.

(5) *Reactions of scope on waveform.* In connection with the waveforms observed on the oscilloscope, it must be kept in mind that the oscilloscope, because it shunts capacitance and resistance across the circuit, modifies the actual operating waveforms present in the circuit. However, it does not affect the usefulness of waveform measurements, because the reference waveforms shown in this manual were taken with a typical oscilloscope under the same conditions as when the repairman takes the waveforms.

(6) *Test leads.* Avoid the use of a shielded test lead or twisted leads when taking waveforms. Either shunts a capacitance across the circuit under test and distorts the waveform, so that it will differ from the waveform shown in the data. The waveforms shown in the test data were taken by using an unshielded lead. The ground lead should be connected at all times.

(*a*) Keep the ungrounded oscilloscope test lead away from other circuits to avoid the possibility of feedback being introduced. The test leads should be brought away from the test points in a way which introduces the minimum amount of coupling to other stages.

(*b*) The leads to the oscilloscope must be kept short when measuring grid voltages from circuits where the grid capacitors are small. The smallest reaction on the waveform is introduced when measuring the voltage across the output (cathode) of a cathode follower, and of course across low-impedance circuits in general.

(*c*) In measuring waveforms in high-impedance circuits, *do not handle the "hot" test leads.* If this precaution is not observed, the waveform will be distorted as a result of loading the circuit and picking up 60-cycle voltage.

(*d*) A misleading indication may sometimes be obtained as the result of a signal voltage picked up. For example, a plate-to-grid coupling capacitor may be open, yet a signal will appear on the oscilloscope. This effect, which occurs most often in circuits carrying narrow-pulse waveforms, can be recognized because the waveform will be reduced in amplitude below the normal and will be distorted because the high-frequency components are over-emphasized.

(7) *R–F and I–F circuits.* Do not attempt to measure voltages or waveforms in any of the r-f or i-f circuits. These frequencies are beyond the range of ordinary test oscilloscopes, and no indications which are useful in trouble shooting can be obtained.

(8) *Reversing line plug.* In some instances, a more stable pattern may be obtained by reversing the a-c line plug of the scope circuit. This may reduce the amount of 60-cycle pick-up if it happens to be troublesome.

(9) *Relative amplitude.* In following the path of the signal through a component, the amplitude of the waveform will usually increase as the checking point is advanced from the input stage

toward the output stage. As the reference waveforms show, however, this is not always true. For example, when going from the grid to the cathode of the cathode-follower stage, there is a loss in signal amplitude of about 10 percent or more. This is a normal condition. Another example is in connection with wave-shaping circuits, where a decrease in the width of a signal is sometimes accompanied by a decrease in amplitude (as in differentiating circuits). These points are taken care of when the actual waveform is compared with the reference waveform.

(10) *Calibration.* If it is necessary to measure the actual voltage of the waveform, the scope must be calibrated. Calibration consists of finding how many volts correspond to a 1-inch deflection on the screen of a scope, that is, in finding the sensitivity of the scope. Calibration procedure for the scope provided with Radio Sets SCR–270–(*) and SCR–271–(*) will be discussed in section VI, chapter 2.

(11) *High-voltage measurements.* When voltages above a few hundred volts are being measured, turn the power OFF on the component under test, and connect the test lead. Note that most of the test jacks do not have blocking capacitors so as to permit measurements of a d–c voltage at the test points.

c. COMPARISON OF WAVEFORMS. The following points should be noted when a reference waveform is compared with the actual waveform taken at a point in the equipment. If there is no fault in the circuit or equipment, the two waveforms should be quite similar. However, in some instances differences in shape may occur for the following reasons:

(1) The test leads to the scope may not be placed in the same manner.

(2) A different scope may be used, having values of input resistance and capacitance which differ from those of the scope used in taking the reference waveforms.

(3) The various controls in the equipment may not be in the same position as when the reference waveforms were taken. Note the conditions specified in the reference waveform.

(4) The same number of cycles may not be present.

(5) The vertical or horizontal amplitudes ot the reference and the test patterns may not be proportional. This will produce apparent differences in the shape of the two waveforms, when there is actually no real difference.

(6) Whether or not a waveform is regarded as abnormal will depend upon the symptom accompanying the fault which is being traced. If it is considered that the fault is such as could be caused by a minor difference in waveform at the point under test, then this discrepancy should be considered as significant. Otherwise, time should not be spent in hunting down the cause for relatively minor differences between the shape of the reference waveforms and the test waveforms.

10. Use of Signal Generator

Signal generators are used to locate defective stages in radar receivers and to align the i–f amplifiers.

a. SIGNAL TRACING. The signal generator output is fed to the first i–f stage, and the progress of the signal is then traced through the receiver. The procedure is indicated below:

(1) The signal generator frequency should be set to the i–f frequency of the radar receiver. The output of the signal generator should be amplitude modulated at an audio-frequency (a–f) rate of between 400 and 10,000 cycles per second (cps). For information concerning the setting up of the signal generator, see chapter 2.

(2) The leads from the signal generator to the receiver should be made as short as possible. A coupling capacitor should be inserted in the hot lead. For frequencies above 20 megacycles (mc) the capacitance of the coupling capacitor should be in the neighborhood of 0.005 microfarads (μf).

(3) The i–f signal should be coupled, via the coupling capacitor, to the grid of the first i–f stage. If no output is shown on the radar scope, a test oscilloscope should be connected to the plate of the detector. If no output is seen on the oscilloscope it can be assumed that the fault lies in or between the first i–f amplifier and the detector. The procedure in that case is discussed in (*a*) below. If a sinusoidal waveform having the same frequency as the chosen modulating frequency is seen, the i–f stages and the detector are known to be operating. In that case, the test oscilloscope should be connected to the plate of the output stage of the receiver. If no output is seen there, the fault is known to lie in or between the first video amplifier and the output stage. The procedure in that case is as indicated in (*b*) below.

(*a*) If the fault is found to be in the i–f stages or the detector, connect the signal generator to the grid of the middle stage of the i–f amplifier. If there is a normal output from the detector, it is known that the fault is in one of the first i–f stages. If the detector has no output, the fault is known to lie in or between the middle stage and the detector. By moving the signal generator output either forward or backward, stage by stage, the faulty stage can be rapidly located. In order to locate the defective part in the stage (2), the tube should first be changed. If replacing the tube does not clear up the fault, make a resistance-voltage check of the stage.

(*b*) If the fault is found to be in the video amplifiers, the signal generator should be left connected to the first i–f stage and the test oscilloscope should be moved from the grid to the plate of each video stage until the defective stage is located. If changing the tube does not correct the fault, make a resistance-voltage check to locate the defective part.

b. I–F ALIGNMENT. A signal generator is used in aligning i–f stages. The modulated output is fed to the grid of the stage preceding the stage being aligned. This is done to prevent the shunting effect of the signal generator from upsetting the circuit being aligned. The stage closest to the detector is aligned first. By working backward through the i–f stages, they are all brought into alignment. Each stage is adjusted to produce maximum indication on the oscilloscope. The stages should be adjusted with a nonmetallic aligning tool. If no tool is available, one can be made from any wooden rod. At all times use the minimum signal generator output that will produce a satisfactory indication.

11. Replacing Parts

Careless replacement of parts often makes the occurrence of new faults inevitable. The following points should be considered:

a. Before a part is unsoldered, note the position of the leads. If the part has a number of connections to it, such as a transformer has, the leads should be tagged.

b. Care should be exercised not to damage other leads by pulling or pushing them out of the way.

c. Do not allow drops of solder to fall into the set, since they may cause short circuits.

d. A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints since a poorly soldered joint is one of the most difficult faults to find.

e. When a part is replaced in r–f or i–f circuits, it must be placed exactly as the original one was. A part which has the same electrical value, but different physical size, may cause trouble in high-frequency circuits. Particular attention should be given to proper grounding when replacing a part. Use the same ground point as in the original wiring. Failure to observe these precautions may result in decreased gain, or possibly in oscillation of the circuit.

CHAPTER 2

TEST INSTRUMENTS

Section I. GENERAL INFORMATION

12. Introduction

a. Know your test instruments! Upon the thorough knowledge of the purpose and use of these instruments depends the speed, accuracy, and efficiency with which defects can be located and repaired.

b. There is no time for guesswork or hit-and-miss methods when trouble develops in any of the station components. If the station is to be kept on the air or if serious damage to the station equipment is to be averted, the trouble must be traced quickly to its source. The proper test instrument will be an invaluable aid in this connection. In fact, efficient trouble shooting is almost impossible without complete familiarity with and experience in the use of test instruments.

c. Each test instrument is designed for specific functions and applications. Unless these functions and applications are thoroughly understood, the information obtained from the meter readings may be inaccurate, and the instruments themselves may be damaged. An example of the thought required in selecting and applying the proper instrument is demonstrated in the use of the voltmeter. In this instrument, the sensitivity factor plays an important role in voltage measurements. Within the same circuit, a high-resistance voltmeter may show one reading, while a low-resistance voltmeter may show another. Thus it is important when making measurements to select the best meter available to make these measurements accurately. If an unsuitable meter must be used, the error introduced by the meter must be accounted for.

d. Unfortunately, there is only a limited variety of test equipment available in the field. Therefore, learn the exact range and limitations of the instrument on hand and interpret the meter readings accordingly, making allowance for any margin of error introduced when the test equipment is connected in the circuit. For this reason, it must be borne in mind that when measurements are made in the station components and are compared with those in chapter 4, apparent differences in the two measurements may be due to the fact that like instruments may not have been used in both cases.

e. In reading this section, frequent reference to the explanatory illustrations and schematic diagrams will aid in clarifying the application and operation of the test instruments.

13. Precautions

Test instruments must always be handled with care. Improper treatment can easily damage delicate parts in the instrument, seriously interfere with meter accuracy, and even cause personal harm to the user. Properly used, an instrument is an invaluable aid in trouble shooting and repair. Carelessly handled, the same instrument may be valueless in securing correct measurements. If at any time the meter should be damaged, the officer in charge must be notified of the damage before the slightest repair is attempted. State what is wrong with the instrument and, if necessary, have the instrument sent back to the depot for repairs or replacement. Certain precautions should be followed in handling each type of test instrument. These rules are discussed in detail in the proper subdivisions of this section. In addition to these specific precautions, the following general rules should be observed:

a. Handle with Care. Avoid dropping or unnecessarily jarring a meter. Such a shock may injure the delicate mechanism or throw vital parts out of balance. Handle the meter as though it were a finely made watch.

b. Keep the Instrument Clean. Dust and dirt will interfere with the efficient operation of a meter. Keep it thoroughly clean at all times. However, do not attempt to use a cleaning cloth on the meter while a reading is being taken. Friction will cause an electrostatic charge to form on the glass face of the meter, which will attract the pointer and often cause large errors in the reading. If such a charge accumulates, it can be removed by breathing on the glass.

c. Do Not Overload the Meter. Overloading will damage a meter. Before connecting a voltmeter across a circuit or an ammeter into a circuit, always be sure that the meter is capable of withstanding the load to which it is being subjected. On a multiscale voltmeter, if the approximate voltage is not known, set the meter to the highest voltage scale to make the first measurements. If no indication is obtained, set the meter to a lower scale and continue this process until the meter shows a readable indication. This same procedure applies to ammeters and milliammeters. By following this process, overloads can be avoided. Remember that an overload may cause the pointer to swing heavily against the peg, bending the pointer and damaging the meter movement.

d. CONNECT THE METER PROPERLY. The meter pointer may be damaged if the proper polarities are not observed when connecting d-c meters in a circuit. In a-c meters, the current is continually reversing. A-c meters, therefore, do not have a positive and negative terminal. In a d-c meter connection, the positive side of the circuit must be connected to the positive (red) terminal of the meter. The negative side of the circuit must be connected to the negative (black) terminal of the meter. This precaution will prevent the meter pointer from swinging heavily against the peg, damaging the pointer or the meter movement.

e. CHECK THE ZERO SETTING. Before using a meter, place the meter in the position in which it is to be used, and note whether the scale pointer is precisely on the zero mark. For an exact reading, the line of vision should be directly over the meter pointer. If the pointer is not on the zero line, it should be adjusted. This is accomplished by turning the screw at the bottom of the meter until the pointer is on the zero line.

14. Test Equipment RC–70–A

a. Test Equipment RC–70–A, described in this section, is an assembly of equipment provided for the maintenance and adjustment of the radio set discussed in this manual.

b. In using the test equipment, the technician should bear in mind that frequently the most obvious defect is the one that is overlooked. A unit which is not working properly should be given an over-all inspection. Only after the technician has completed a thorough visual examination should he check for more complicated defects which involve the interior elements of a unit; however, proper use of this equipment will save much time and work in locating failures.

c. Some sets of Test Equipment RC–70–A may be supplied with an analyzer made by the Precision Apparatus Company; others may be supplied with one made by the Weston Electrical Instruments Company. Therefore, both models will be described. If the radar repairman becomes familiar with these instruments, he will have no trouble using other types which he may encounter.

Section II. ANALYZER I–153–A

15. Precision Analyzer, Series 856

a. FUNCTION. The precision analyzer, series 856, is an analyzer capable of measuring volts, ohms, amperes, or milliamperes. The instrument has two sensitivities for d-c voltage measurement: 20,000 ohms-per-volt and 1,000 ohms-per-volt.

b. RANGES. (1) *D-c voltage.* Seven ranges: from zero to 3; 12; 60; 300; 600; 1,200; 6,000.

(2) *A-c voltage.* Seven ranges: from zero to 3; 12; 60; 300; 600; 1,200; 6,000. Sensitivity: 1,000 ohms-per-volt.

(3) *D-c current.* Seven ranges: from zero to 60; 300 microamperes; from zero to 3; 30; 120; 600 milliamperes; from zero to 12 amperes.

(4) *Resistance.* Three ranges: from zero to 6,000; 600,000 ohms; from zero to 60 megohms.

(5) *Output.* Seven ranges: from zero to 3; 12; 60; 300; 600; 1,200; 6,000 volts. Sensitivity: 1,000 ohms-per-volt.

c. LOCATION AND PURPOSE OF CONTROLS (fig. 4). (1) *Switches and jacks.* The selector switch, located in the center directly below the meter, is used for selecting ranges of 3 to 600 volts, 3 to 600 milliamperes, and the resistance ranges. When measuring within these ranges, the test leads should be inserted in the two jacks located in the lower right corner that are labeled — TEST +. The selector switch is not used for ranges of 60 to 300 microamperes, 1,200 to 6,000 volts, or 12 amperes.

(2) *Sensitivity-control switch.* The sensitivity-control switch, located at the right of the selector switch, is used to select a sensitivity of 1,000 ohms-

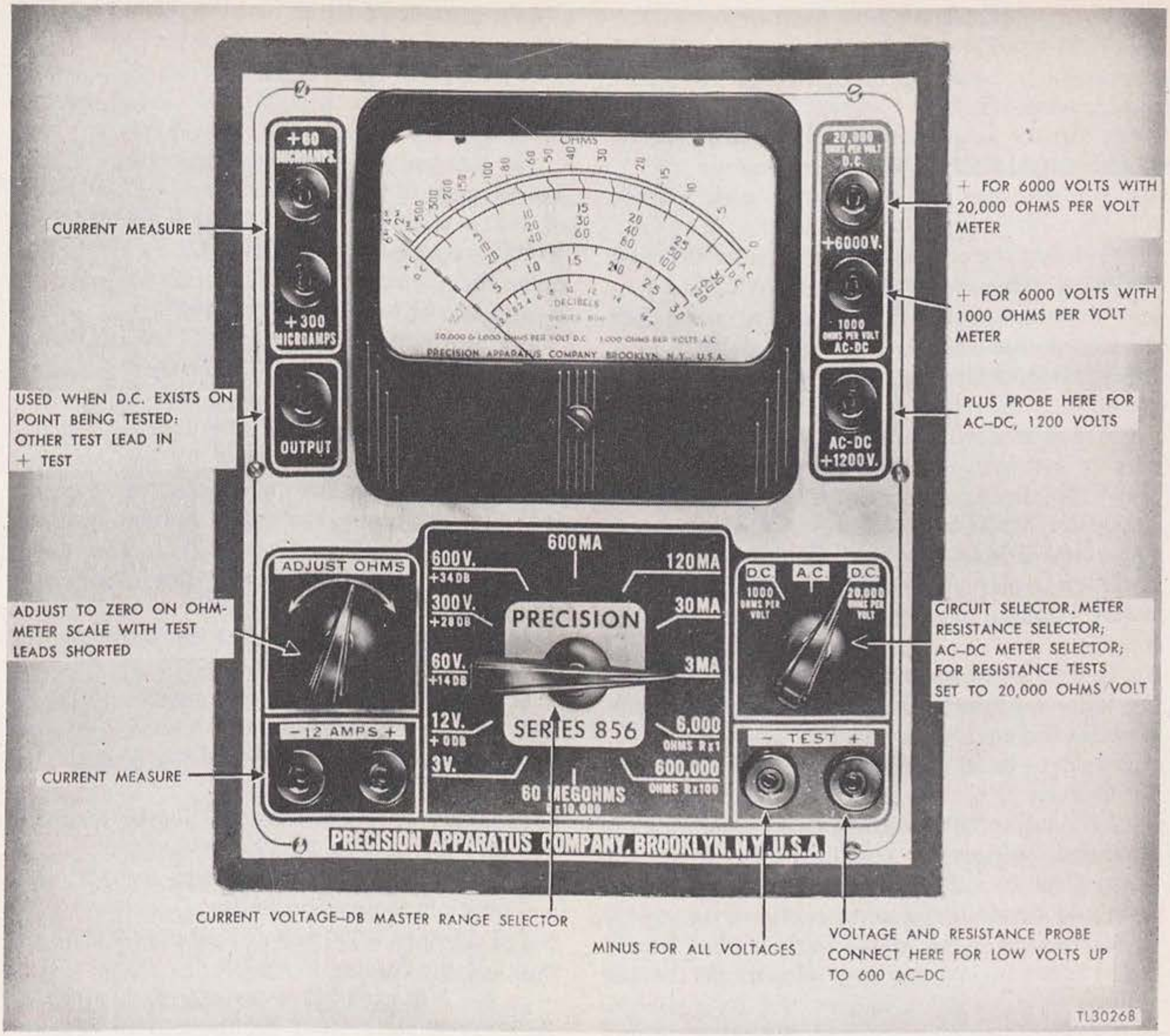


Figure 4. Precision analyzer, series 856.

per-volt or 20,000 ohms-per-volt d-c. It is also used for a-c voltage measurements. When using the analyzer on the voltage ranges, select the sensitivity to fit the circuit under test. If the circuit under test is of low resistance, set the sensitivity-control switch to the left position for the 1,000 ohm-per-volt meter. When making measurements in high-resistance circuits, set the sensitivity-control switch to the right-hand position for the 20,000 ohm-per-volt meter. The total effect upon the current will be small and will not materially affect circuit operation. The center position is used only for a-c volts with one sensitivity, that is, 1,000 ohms-per-volt.

(3) *Zero ohms-adjustment switch.* The zero ohms-adjustment switch, located at the left of the selector switch, is used to adjust the meter pointer to full-scale deflection when using the instrument as an ohmmeter.

d. HOW TO USE THE ANALYZER. Before using the analyzer for any of the following measurements, check to see that the pointer is at the left-hand side on the scale. If the pointer is not at the zero mark, turn the adjuster screw on the meter to reset the pointer.

e. D-C MEASUREMENTS. (1) *Scale: Zero to 600 milliamperes.* (*a*) With the range-selector switch, select the range to be used.

(*b*) Set the sensitivity-control switch to the D. C. 20,000 OHMS-PER-VOLT position.

(*c*) Insert the test leads in the jacks marked —TEST+.

(*d*) Connect the test leads in series with the circuit.

Caution: Be sure to observe polarity.

(2) *Scale: Zero to 60 microamperes or 300 microamperes.* (*a*) Set the selector switch to the 30 MA position.

(*b*) Set the sensitivity-control switch to the D. C. 20,000 OHMS-PER-VOLT position.

(*c*) Insert one test lead in the jack marked —TEST.

(*d*) Insert the other test lead in either the +60 MICROAMPS jack or the +300 MICROAMPS jack, depending upon the range desired. (Both jacks are located in the upper left corner.)

(*e*) Connect the test leads in series with the circuit.

(3) *Scale: Zero to 12 amperes.* (*a*) Set the selector switch to the 600 MA position.

(*b*) Set the sensitivity-control switch to D. C. 20,000 OHMS-PER-VOLT.

(*c*) Insert both test leads in the jacks in the lower left corner labeled —12 AMPS+.

(*d*) Connect the test leads in series with the circuit.

(4) *Scale readings for d-c measurements.* Use the following procedures when determining scale readings for d-c measurements:

(*a*) Zero to 60 microamperes: read directly on the 60 scale.

(*b*) Zero to 300 microamperes: read the 30 scale and multiply the reading by 10.

(*c*) Zero to 3 milliamperes (ma): read the 30 scale and divide the reading by 10.

(*d*) Zero to 30 ma: read directly on the 30 scale.

(*e*) Zero to 120 ma: read directly on the 120 scale.

(*f*) Zero to 600 ma: read the 60 scale and multiply the reading by 10.

(*g*) Zero to 12 amp: read the 120 scale and divide the reading by 10.

f. D-C VOLTAGE MEASUREMENTS. (1) *Scale: Zero to 600 volts.* (*a*) Set the selector switch to the desired voltage range.

(*b*) Set the sensitivity-control switch to the desired sensitivity (1,000 ohms-per-volt, or 20,000 ohms-per-volt).

(*c*) Insert both test leads in the jacks in the lower right corner, labeled —TEST+.

(*d*) Connect the test leads across the circuit.

(2) *Scale: Zero to 1,200 volts.* (*a*) Set the selector switch to 600 volts.

(*b*) Set the sensitivity-control switch to the desired sensitivity (1,000 ohms-per-volt, or 20,000 ohms-per-volt).

(*c*) Insert one test lead in the jack in the lower right corner, labeled —TEST.

(*d*) Insert the other test lead in the jack at right of meter, labeled AC-DC + 1,200V.

(*e*) Connect the test leads across the circuit.

(3) *Scale: Zero to 6,000 volts.* (*a*) Set the selector switch to 600 volts.

(*b*) Do not use the sensitivity-control switch. To select sensitivity, insert a test lead in either of the + 6,000V. jacks (20,000 OHMS-PER-VOLT or 1,000 OHMS-PER-VOLT) depending upon the sensitivity desired. (These jacks are located at the top right of the meter.)

(*c*) Insert the other test lead in the jack in the lower right corner, labeled —TEST+.

(*d*) Connect the test leads across the circuit.

Caution: Be sure to observe polarity.

(4) *Scale readings for d-c voltage measurements.* Use the following procedures when determining scale readings for d-c voltage measurements:

(*a*) Zero to 3 volts: read the 30 scale and divide the reading by 10.

(*b*) Zero to 12 volts: read the 120 scale and divide the reading by 10.

(*c*) Zero to 60 volts: read directly on the 60 scale.

(*d*) Zero to 300 volts: read the 30 scale and multiply the reading by 10.

(*e*) Zero to 600 volts: read the 60 scale and multiply the reading by 10.

(*f*) Zero to 1,200 volts: read the 120 scale and multiply the reading by 10.

(*g*) Zero to 6,000 volts: read the 60 scale and multiply the reading by 100.

g. A-C VOLTAGE MEASUREMENTS. (1) *Scale: Zero to 600 volts.* (*a*) Set the selector switch to the desired voltage range.

(*b*) Set the sensitivity-control switch to the A.C. position.

(*c*) Insert both test leads in the jacks in the lower right corner labeled —TEST+.

(*d*) Connect the test leads across the circuit.

(2) *Scale: Zero to 1,200 volts.* (*a*) Set the selector switch to 600 volts.

(*b*) Set the sensitivity switch to the A.C. position.

(*c*) Insert one test lead in the jack at the lower right corner, labeled —TEST+.

(*d*) Insert the other test lead in the jack at the right of the meter, labeled AC-DC +1200V.

(*e*) Connect the test leads across the circuit.

(3) *Scale: Zero to 6,000 volts.* (*a*) Set the selector switch to 600 volts.

(*b*) Set the sensitivity-control switch to the A.C. position.

(*c*) Insert a test lead in either of the +6000V. jacks (20,000 OHMS-PER-VOLT or 1,000 OHMS-PER-VOLT) depending upon the sensitivity desired.

(*d*) Insert the other test lead in the jack in the lower right corner labeled —TEST+.

(4) *Scale readings for a-c voltage measurements.* Use the following procedures when determining scale readings for a-c voltage measurements:

(*a*) Zero to 3 volts: read the lower red scale directly.

(*b*) Zero to 12 volts: read the upper red 120 scale and divide the reading by 10.

(*c*) Zero to 60 volts: read the upper red 60 scale directly.

(*d*) Zero to 300 volts: read the upper red 30 scale and multiply the reading by 10.

(*e*) Zero to 600 volts: read the upper red 60 scale and multiply the reading by 10.

(*f*) Zero to 1,200 volts: read the upper red 120 scale and multiply the reading by 10.

(*g*) Zero to 6,000 volts: read the upper red 60 scale and multiply the reading by 100.

h. RESISTANCE MEASUREMENT. (1) *Procedure.* (*a*) Set the selector switch to the scale desired.

(*b*) Set the sensitivity-control switch at D.C. 20,000 OHMS-PER-VOLT position.

(*c*) Insert both test leads in the jacks in the lower right corner, labeled —TEST+.

(*d*) While shorting the leads, vary the switch labeled ADJUST OHMS until the pointer indicates full-scale deflection (zero ohms).

(*e*) Remove the short from the leads and connect the leads across the resistance to be measured.

(2) *Scale readings for resistance measurements.* (*a*) Only the top black scale marked OHMS is used when measuring resistance.

(*b*) Zero to 6,000 ohms range: read directly.

(*c*) Zero to 600,000 ohms range: multiply the reading by 100.

(*d*) Zero to 60 megohms range: multiply the reading by 10,000.

i. OUTPUT MEASUREMENT. (1) Set the selector switch at the voltage desired.

(2) For output measurements, use same scale readings as for a-c voltage measurements.

j. BATTERY REPLACEMENT. If, at any time, the ohmmeter pointer cannot be adjusted to full-scale deflection when the test leads are shorted, the batteries should be replaced. Follow this procedure:

(1) Remove the six screws on the meter panel.

(2) Grasp the meter panel and carefully lift it out of the box. It may be necessary to put the case on its side for this operation.

(3) Lay the meter panel face down in front of the box.

(4) Using a socket wrench, loosen the nuts on the battery holders.

(5) Turn the battery holders clockwise.

(6) Remove the batteries.

(7) Unsolder the two leads on the small 1½-volt cell.

(8) Using a new cell, solder the black lead to the bottom of the cell (negative terminal). Solder the read lead to the cell cap (positive terminal).

(9) Remove the leads from the 22½-volt battery.

(10) Replace the green lead on the 22½-volt terminal of the new battery.

(11) Replace the brown lead on the remaining terminal of the new battery.

(12) Insert the new batteries in their proper positions in the case.

(13) Turn the battery holders counterclockwise to hold the batteries in place.

(14) Tighten the nuts with a socket wrench.

(15) Replace the meter in the case, taking care to avoid damaging any parts.

(16) Insert and tighten the six panel screws.

k. SCHEMATIC ANALYSIS. Figure 5 shows the schematic diagram for the analyzer. This diagram is to be used only when the officer in charge grants permission for making emergency repairs on the meter. The following discussion is limited to the important parts contained in the analyzer.

(1) The selector switch consists of four gangs with 12 contacts each. These contacts control the circuit switching used in voltmeter, ohmmeter, and milliammeter operation.

(2) The sensitivity-control switch consists of three gangs with four contacts each. The right-hand position of the switch allows the meter to be used at a sensitivity of 20,000 ohms-per-volt. In this case, the only circuits used are the current-limiting resistors for voltmeter operation which are R1, R2, R3, R5, R6, R8, R9, R10, R11, R12, R27, and R28. The center position of the sensitivity-control switch inserts a rectifier in series with the meter to change alternating current into pulsating direct current which can be measured by the meter. The right-hand position of the switch sets a shunt across the meter to lower the sensitivity to 1,000 ohms-per-volt.

(3) The ohmmeter circuit is of the conventional type with a 22½-volt battery and a single

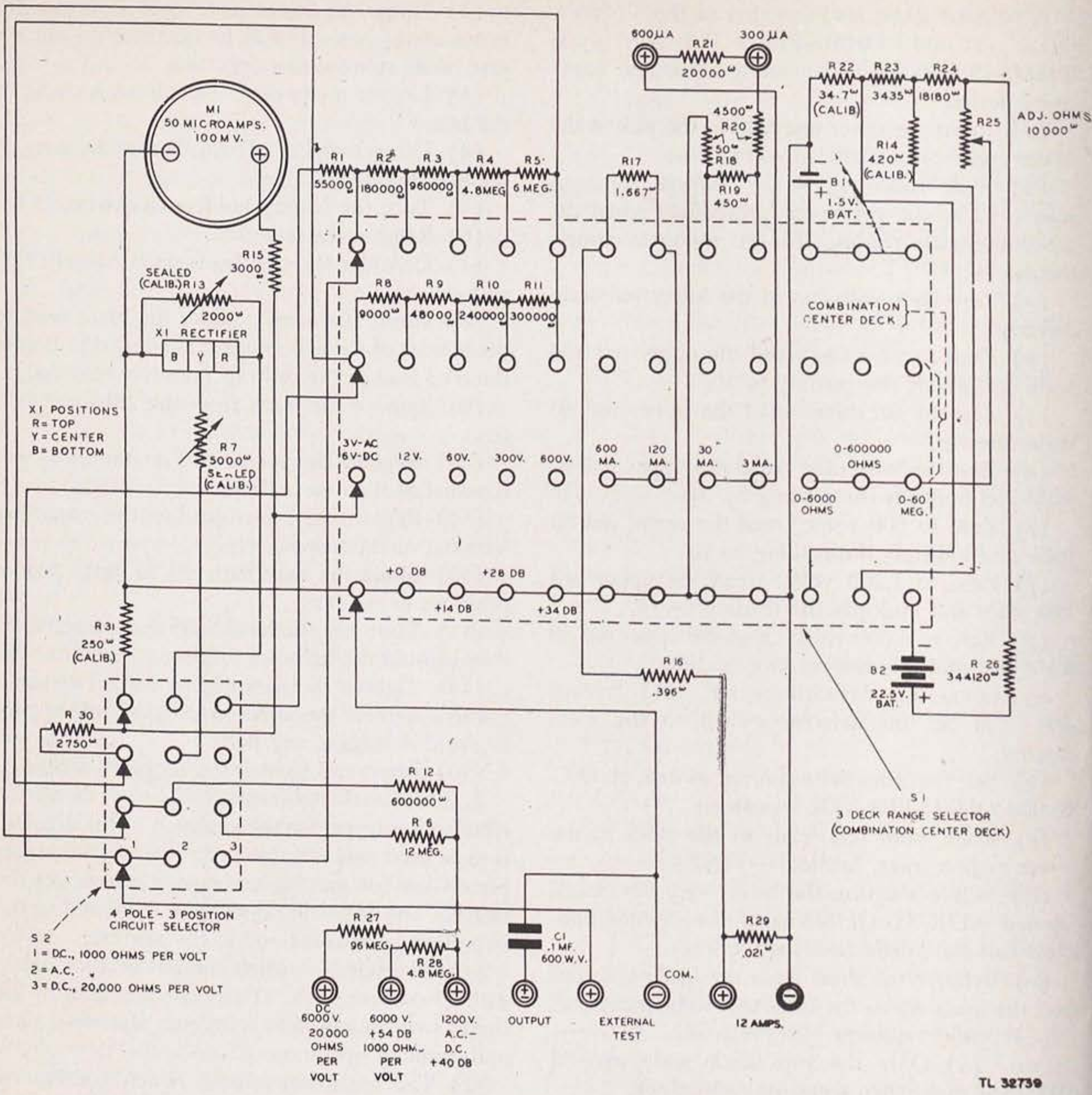


Figure 5. Precision analyzer, series 856, schematic.

1½-volt dry cell as the source of power. It has various scale multipliers: R22, R23, R24, and R14, as well as a zero-adjusting resistor R25.

16. Weston Analyzer, Model 772

a. Function. The Weston analyzer, model 772, is a combination instrument capable of measuring resistance, a-c and d-c voltages, and direct current. It has a sensitivity of 20,000 ohms per volt on all voltage ranges. The current drawn by the meter at full-scale deflection is only 50 microamperes.

b. A-c and d-c Voltage Ranges. Five ranges: from zero-2.5; 10; 50; 250; and 1,000.

c. D-c Ranges. (1) Three ranges: zero-10; 50; and 250 milliamperes.

(2) Two high ranges: zero-1 and zero-10 amperes.

(3) Two low ranges: zero-100 microamperes and zero-1-milliampere.

d. Resistance Ranges. Four ranges: zero-3,000 ohms; 30,000 ohms; 3 megohms; and 30 megohms.

e. Output Ranges. Five ranges: zero-2½; 10; 50; 250; and 1,000 volts.

f. Location and Purpose of Controls. (1)

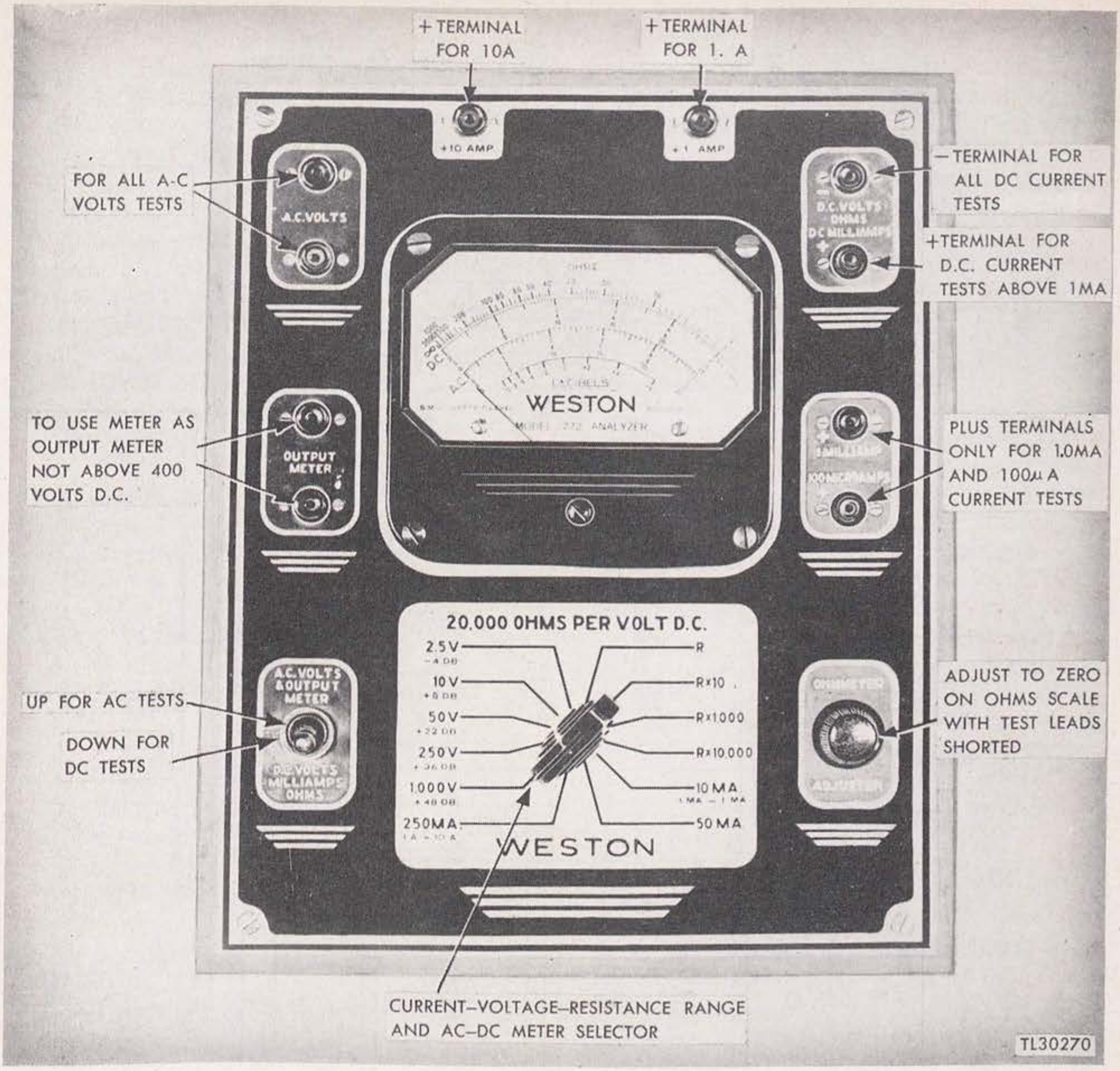


Figure 6. Weston analyzer, model 772.

Switches and jacks (fig. 6). The selector switch, located in the center below the meter, is used for selecting ranges of 2.5 to 1,000 volts, 10 to 250 milliamperes, and the resistance ranges. The test leads should be inserted in the two jacks in the upper right-hand corner when using these ranges. For testing on other ranges, one test lead should be inserted in the — jack and the other in the proper jack at the top or right side of the meter.

(2) *Ohmmeter adjuster switch.* The *Ohmmeter adjuster* switch is located at the right of the selector switch. It adjusts the meter hand to full-scale deflection, when using the instrument as an ohmmeter.

g. HOW TO USE THE ANALYZER. Before using the analyzer for any measurement, be sure that the pointer is at the zero mark. If it is not, reset the pointer by turning the adjuster screw.

h. D-C MEASUREMENTS. (1) *Medium ranges.* (*a*) Insert test leads in D.C. MILLIAMPS jacks.

(*b*) Set toggle switch to D.C. position.

(*c*) Rotate range switch to milliampere range desired.

(*d*) Connect the meter in the circuit.

Caution: Observe polarity.

(*e*) Take reading on D.C. scale.

(2) *Low ranges.* (*a*) Insert black lead in —jack.

(*b*) Insert red lead in + 1 MILLIAMP or + 100 MICROAMP jack, as required.

(*c*) Set range switch to 10 MA. position.

(*d*) Connect the meter in the circuit.

(*e*) Take reading on D.C. scale.

(3) *Fifty-microampere range.* (*a*) Set toggle switch to the D.C. position.

(*b*) Set range-selector switch to the 2.5V position.

(*c*) Take reading on D.C. scale.

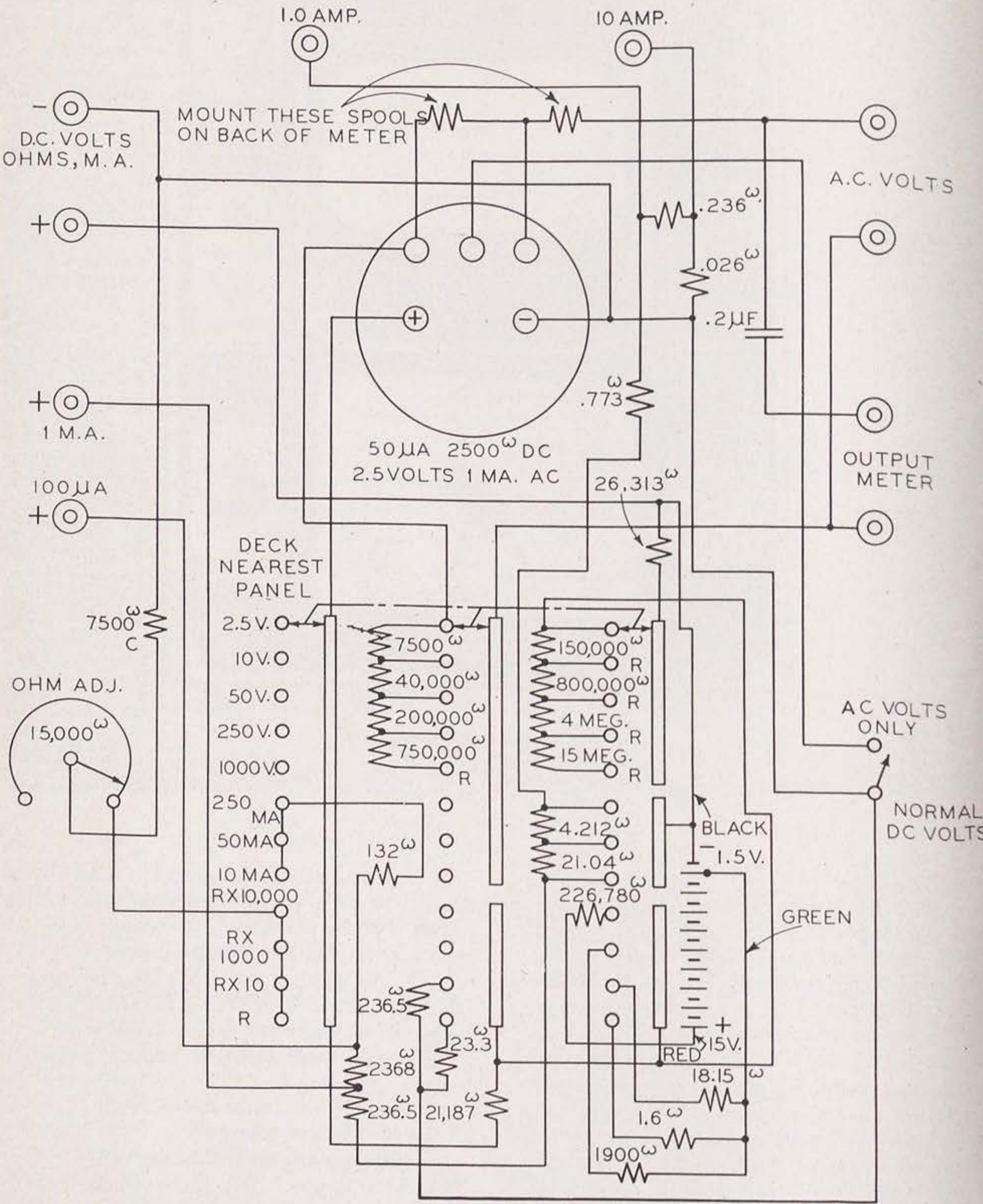


Figure 7. Weston analyzer, model 772, schematic.

Caution: Fifty microamperes is a very small amount of current. Be sure the current is below this value before using this range.

(4) *High ranges.* (*a*) Insert black lead in — jack.

(*b*) Insert red lead in + 10 or + 1 AMP jack, as required.

(*c*) Set range-selector switch to the 250 MA. position.

(*d*) Connect meter in the circuit.

(*e*) Take reading on D.C. scale.

i. D-C VOLTAGE MEASUREMENTS. (1) Insert red test lead in D.C. VOLTS + jack.

(2) Insert black test lead in D.C. VOLTS — jack.

(3) Rotate range-selector switch to 1,000-volt range, then decrease range switch until a reading is obtained.

(4) Take all voltage readings on D.C. scale, then multiply reading in accordance with range being used.

j. A-C VOLTAGE MEASUREMENTS. (1) Insert both test leads into A. C. VOLTS jacks.

(2) Set toggle switch to the A. C. VOLTS position.

(3) Rotate range-selector switch to the proper voltage range.

(4) Take readings on A. C. scale for all ranges.

k. USE AS OUTPUT METER. (1) Insert both test leads into OUTPUT METER jacks.

(2) Set toggle switch to the OUTPUT METER position.

(3) Rotate range-selector switch to the voltage range desired.

(4) Take readings on A. C. scale.

NOTE. Output readings will be relative, as a capacitor in the meter circuit will cause an error on low ranges. This capacitor is limited to 400 volts. Do not use the output meter on circuits which exceed this rating.

l. RESISTANCE MEASUREMENTS. (1) Insert both test leads in OHMS jack.

(2) Set toggle switch to the OHMS position.

(3) Rotate range-selector switch to the range desired.

(4) Short the test leads together and adjust to zero ohms by rotating OHMMETER ADJUSTER knob.

(5) Take resistance readings on top scale, then multiply using factor in accordance with selector switch position.

m. BATTERY REPLACEMENT. If it is impossible to zero adjust on any range, the batteries should be examined. To do this, remove the four corner panel screws and lift the complete panel from the case. Remove the two 7½-volt batteries. If the pointer will not adjust on the three low ranges, but will adjust on the two higher ranges, the batteries may be exchanged in position. In this way it is possible to use the same batteries a while longer. This can be done because only one 1½-volt cell is used on the three lower ranges. After exchanging or replacing batteries, make the proper wiring connections and replace the panel on the case.

n. SCHEMATIC ANALYSIS. Figure 7 shows the schematic diagram of this analyzer. This diagram is to be used only when it is necessary to make emergency repairs on the meter which have been authorized by the officer in charge. The following discussion will be limited to the most important parts of the analyzer.

(1) The selector switch consists of three gangs with 12 contacts each. These contacts control the selection of ranges employed for voltmeter, ohmmeter, and milliammeter operation.

(2) The a-c toggle switch is used when measuring any a-c circuit.

(3) The ohmmeter circuit is of the common type with two 7½-volt batteries as a source of power, and various series resistors. The current adjustment for the different ranges is accomplished by setting the 15,000-ohm potentiometer at the proper point, for full-scale deflection when the test prods are shorted together.

Section III. TEST SET I–180–A

17. Hickok Tube Tester, Model 540

a. FUNCTION. The Hickok tube tester, model 540, is used for testing tubes by the electron-emission test or mutual-conductance test. The instrument provides the following four tests for most tubes:

(1) Electron emission.

(2) Mutual conductance.

(3) Shorts.

(4) Gas.

b. LOCATION AND PURPOSE OF CONTROLS (fig. 8). (1) *Sockets.* Grouped around the top and sides of the meter are sockets for testing 4-prong,

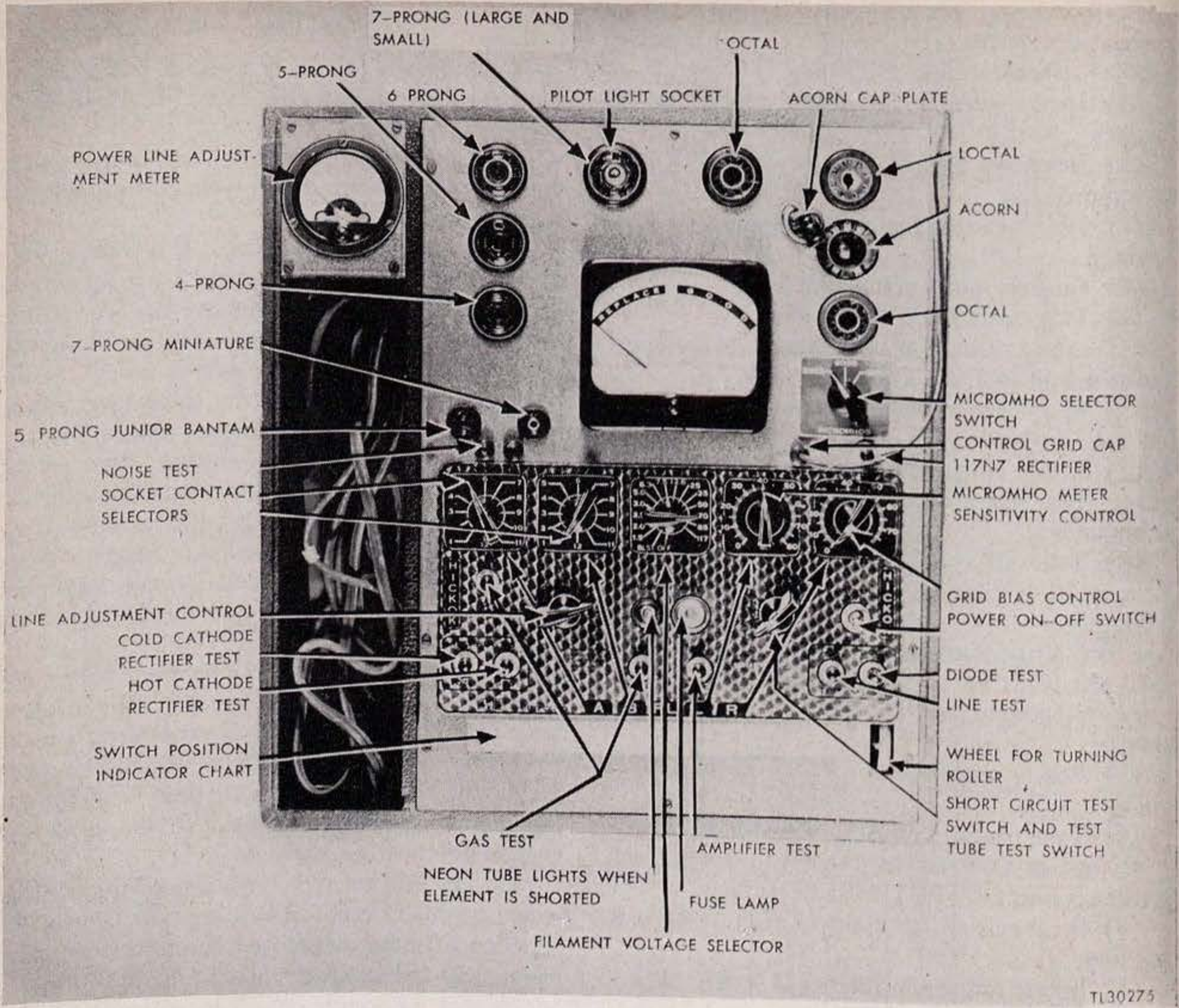


Figure 8. Hickok tube tester, model 540.

5-prong, 6-prong, 7-prong, octal or loctal, acorn, Junior Bantam, and miniature tubes. The proper color-coded socket to be used when testing octal, Junior Bantam, or miniature tubes is stated on the tube chart. Unless otherwise specified on the tube chart, select a black socket to take the proper number of prongs.

(2) *Switches.* (*a*) Located directly below the meter are five switches labeled A, B, FIL, L, and R. For testing purposes, these switches are turned to the positions specified on the tube chart for the particular tube being tested.

Caution: Before and after each test always turn the A- and B-switches to the No. 1 position and the FIL, L-, and R-switches to the maximum counterclockwise position.

Before depressing any test button check the FIL switch for proper setting. This switch controls the filament voltage. Careless adjustment of this switch may burn out a valuable tube.

(*b*) The LINE ADJUSTMENT switch is located at left center of the switch panel. This switch controls the line voltage, and its position is varied to adjust the pointer of the line-voltage meter located at the left top corner of the instrument to the red mark labeled TEST.

(*c*) The TUBE TEST switch, located at right center of the switch panel, is used in the testing of shorts (positions 1 through 5), electron emission, and mutual conductance (TUBE TEST position).

(*d*) The MICROMHOS switch, located at the right of the meter, is used to select ranges beyond the meter scale. When the tube chart indicates a mutual conductance below 3,000, set the MICROMHOS switch at the 3,000 position and read the scale directly. Before testing for gas, always turn the switch to 3,000. For mutual conductance readings between 3,000 and 6,000, set the switch to the 6,000 position. Multiply the scale readings by 2. For mutual conductance values above 6,000, set the switch to the 15,000 position and multiply the readings by 5.

(*e*) The POWER ON-OFF switch, located at the right center of the switch panel, is used to apply power to the instrument.

(3) *Buttons.* (*a*) The two RECTIFIER TEST buttons, located in the lower left corner of the switch panel, are used in testing rectifier tubes. The button marked STD (standard) is used for all filament or heater-type rectifier tubes. The button OZ4 is used when testing cold cathode tubes. Separate tests for each plate in full-wave rectifier tubes can be made.

(*b*) The button marked AMPL, which is at center bottom of the switch panel, is used when designated under the heading of NOTATIONS on the tube chart.

(*c*) The LINE TEST button, located at the lower right corner, is used for testing the amount of voltage being supplied to the instrument.

(*d*) The DIODE TEST button, located at the lower right corner, is used when testing only the diode of a tube.

Caution: Do not press AMPL button or RECTIFIER button when testing a diode.

(*e*) The buttons marked GAS NO. 1 (left center of switch panel) and GAS NO. 2 (bottom center of switch panel) are used when making gas tests.

(*f*) The button located directly below the MICROMHOS switch is used only for testing special 117-volt tubes.

(4) *Tube chart.* (*a*) Directly below the switch panel is the tube chart which is controlled by a dial knob at the right of the chart.

(*b*) Tube numbers are listed in numerical and alphabetical order in the first left-hand column. When testing a tube, turn the chart until the numbers and letters of the tube to be tested are located between the parallel red lines.

(*c*) The second column on the chart indicates the mutual conductance of the particular tube. The next five columns indicate the positions for switches A, B, FIL, L, and R.

(*d*) The last column (right) indicates whether the AMPL, DIODE, or RECTIFIER TEST buttons are to be used and supplies special directions for testing particular tubes.

c. How to Set Up the Tube Tester. (1) Plug the instrument into a 110- or 115-volt a-c power source.

(2) Turn the POWER switch to the ON position.

(3) Check to see that the A- and B-switches are turned to the No. 1 position and that the FIL, L-, and R-switches are turned to a maximum counterclockwise position.

(4) Vary the LINE ADJUSTMENT switch until the pointer on the small meter is on the red line marked TEST.

d. How to Test for Electron Emission. (1) Observe the tube number and turn the tube-chart knob until that number is located between the parallel red lines.

(2) Insert the tube in the socket of the proper size and number of prongs. Use the black sockets unless red sockets are specified in the first column of the tube chart. Allow the tube to warm up for a few seconds.

(3) Again vary the LINE ADJUSTMENT switch until the pointer on the small meter is on the red line marked TEST.

(4) Turn the TUBE TEST switch to the maximum clockwise position.

(5) Turn each of the five upper switches marked A, B, FIL, L, and R to the positions designated on the tube chart. Check to see that the FIL switch is turned to the proper position.

(6) Depress the AMPL button unless the RECTIFIER or DIODE buttons are specified on the tube chart. Never use the AMPL button when testing rectifier tubes. Note the dial reading (top red and green).

(*a*) If the pointer comes to rest at any place on the red (REPLACE) scale, or near the center question mark, the tube must be replaced.

(*b*) If the pointer comes to rest at any place on the green (GOOD) scale, it is an indication that the electron emission of the tube is satisfactory. Proceed with the next test.

e. How to Test for Shorts. (1) Check to see that the A-, B-, FIL, L-, and R-switches are in the positions designated on the tube chart.

(2) Turn the TUBE TEST switch to the 5 position.

(3) Tap the tube and observe whether the lamp marked SHORTS emits a flash.

(4) Turn the TUBE TEST switch to positions 4, 3, 2, and 1, each time tapping the tube and observing whether the SHORTS lamp emits a flash.

(*a*) If the SHORTS lamp emits a flash at any position of the TUBE TEST switch, the tube should be replaced.

(*b*) If the SHORTS lamp does not flash, proceed with the next test.

f. How to Test for Mutual Conductance.

(1) Check to see that the A-, B-, FIL, L-, and R-switches are in the positions designated on the tube chart.

(2) Turn the L-switch to the 60 position (G_m).

(3) Press the AMPL button.

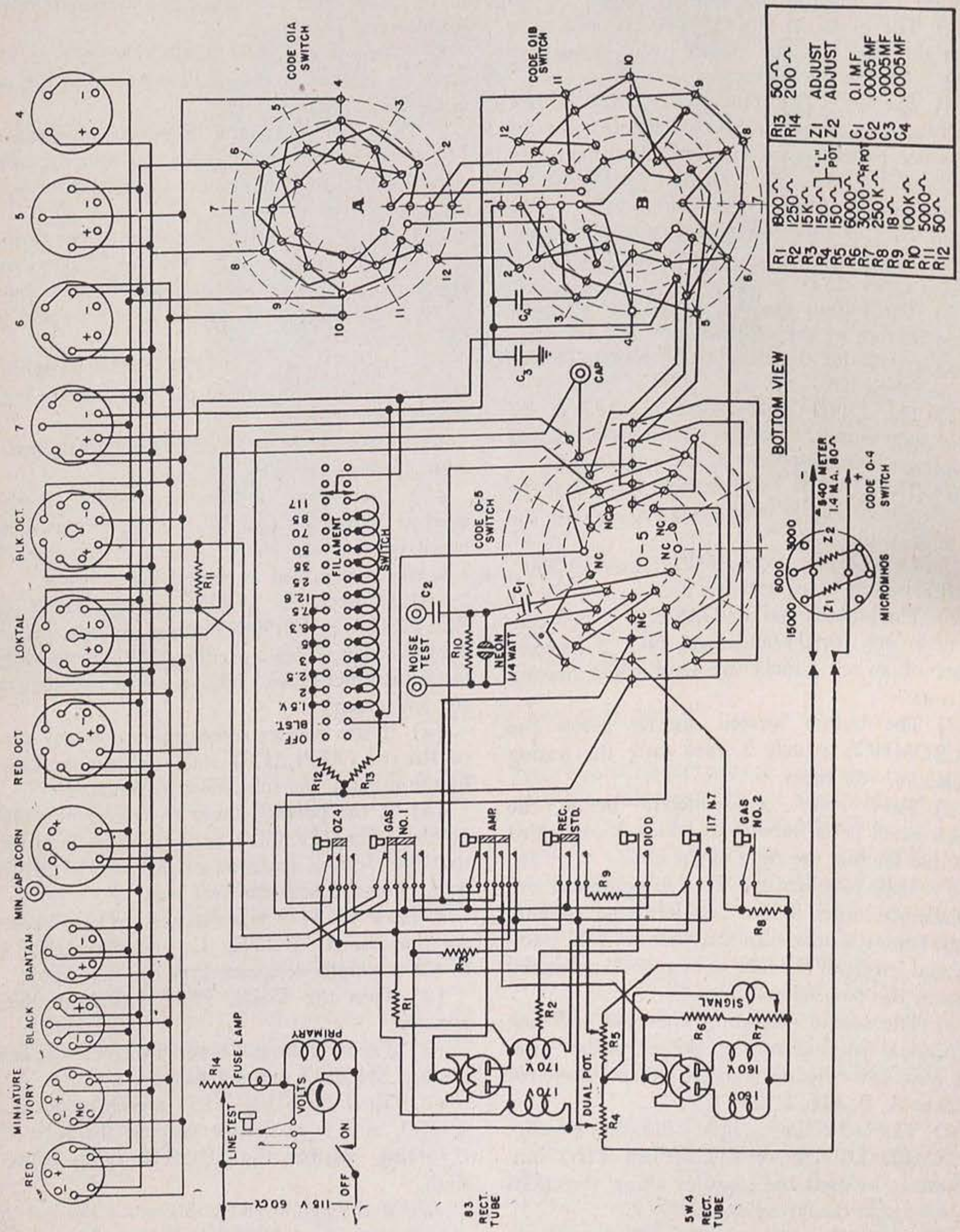


Figure 9. Hickok tube tester model 540, schematic.

(4) Note the scale reading in micromhos and compare the reading to the mutual-conductance figure given in the second column of the tube chart.

(*a*) If there is a wide deviation from the chart figure in the scale reading, the tube should be replaced.

(*b*) If the reading approximates the chart figure, proceed with the next test.

Caution: Do not use the mutual-conductance test on rectifier or diode tubes.

g. How to Test for Gas. (1) Check to see that A-, B-, FIL, L-, and R-switches are in the positions designated on the tube chart.

(2) Turn the R-switch completely clockwise.

(3) Turn the MICROMHOS switch to the 3,000 position.

(4) Depress the button marked GAS NO. 1.

(5) While keeping the GAS NO. 1 button depressed, slowly turn the R-switch counterclockwise and observe the meter reading.

(6) When the meter pointer reaches 100, stop turning the R-switch.

(7) Still keeping the GAS NO. 1 button depressed, depress the GAS NO. 2 button and watch the meter reading. If the meter pointer moves more than one scale division, the tube should be replaced.

Caution: After completing the tests for electron emission, shorts, mutual conductance, and gas, remove the tube from the tester, turn A- and B-switches to position 1 and turn FIL, L-, and R-switches to maximum counterclockwise position.

h. Replacement of Instrument Bulbs. If either the FUSE bulb or the SHORTS bulb should burn out, it should be replaced in the following manner:

(1) *Replacing the fuse bulb.* (*a*) Remove the FUSE bulb from the bayonet-type socket by gently pressing the top of the bulb and turning the bulb in a counterclockwise direction. The bulb may then be lifted out.

(*b*) Secure a new bulb of the same type. The legend on the base of the new bulb and the color of the bead should be identical with that of the defective bulb.

(*c*) Insert the new bulb in the bayonet-type socket. Press on the bulb and turn in a clockwise direction until the bulb is secure.

(2) *Replacing the shorts bulb.* (*a*) Unscrew the bulb in a counterclockwise direction and lift the bulb from the socket.

(*b*) Insert a new bulb of the same type in the socket and turn in a clockwise direction until the bulb is secure.

i. Adjusting the Meter Dials. The pointers on the small a-c voltmeter and on the micromhos meter should both point to zero when the instrument is not in use. If the pointer on either meter is not at zero, use a screw driver to adjust the meter by turning the screw at the base of the meter in a counterclockwise direction until the pointer is in the zero position.

j. Schematic Analysis. Figure 9 shows the schematic diagram of the circuit used in the tube tester. This diagram is to be used only when the officer in charge grants permission for emergency repairs to be made on the tester. The following discussion is limited to the important parts contained in the tube tester.

(1) *Terminal connections.* The terminals of the various test sockets are connected to contacts on the selector switches. These in turn are connected to filament-transformer power-supply circuits and other controlling switches.

(2) *Line voltmeter.* The line voltmeter is always connected across the primary of the transformer except when the exact voltage on the power source is measured by pressing the LINE TEST button.

(3) *Fuse lamp.* The fuse lamp is connected in the primary of the transformer to protect the instrument.

Section IV. TEST SET I–151–A

18. Signal Generators

There are two types of signal generators used in radar trouble shooting, an audio-signal generator and a radio-frequency signal generator. Both of these instruments are used in signal tracing and signal substitution tests on the various components of the unit. The application of these generators is discussed in chapter 1 of the text.

a. An audio-signal generator generates a signal covering the audible spectrum from 20 to 15,000 cycles per second. It is applicable only to circuits which handle these frequencies.

b. The radio-frequency signal generator covers two bands: 15 to 25 megacycles per second, and 90 to 125 megacycles per second. The first band is used to test and align the intermediate-frequency (i-f) circuit of the receiver; the second band is used for the same purpose in the radio-frequency (r-f) circuits of the receiver.

19. Basic A–F Signal Generator

a. Although there are many forms of audio-frequency (a-f) generators, basically they all consist of a means of generating an a-f signal with vacuum tubes. This signal is fed to an amplifier stage which is transformer-coupled to the output terminals. The output terminals provide various impedance taps to match the circuits being used. Included within the signal generator is an associated power supply for these tubes.

b. To provide accurate frequency control, some form of indicator (usually a neon bulb) is used to calibrate the instrument. By means of the neon bulb, the 60-cycle line frequency is compared with the 60-cycle frequency generated by the oscillator. A calibration-adjusting control is used to set the oscillator to the point where the neon bulb flickers at an extremely slow rate. At this point, the frequency generated by the oscillator is the same as the line frequency.

20. Hickok A–F Signal Generator, Model 198

a. FUNCTION. The Hickok a-f signal generator supplies frequencies which are to be used for trouble shooting in the audio- and video-frequency circuits of the keyer and oscilloscope.

b. RANGES. (1) 20 to 200 cycles.

(2) 200 to 2,000 cycles.

(3) 2,000 to 20,000 cycles.

c. LOCATION AND PURPOSE OF CONTROLS (fig. 10). (1) *Switches.* Across the center of this

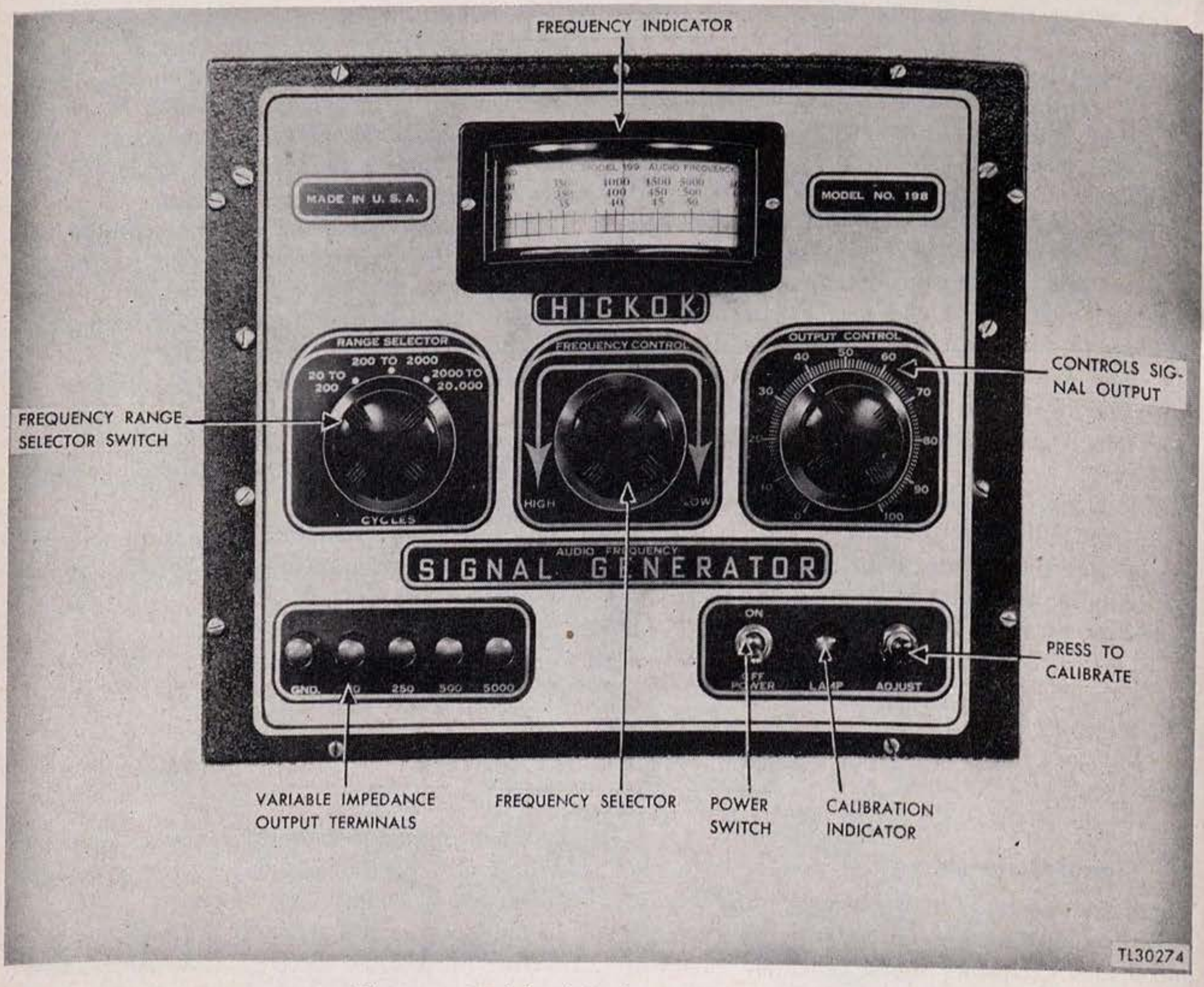


Figure 10. Hickok a-f signal generator, model 198.

instrument are three switches: The RANGE SELECTOR switch at the left of the instrument panel, the FREQUENCY CONTROL switch in the center, and the OUTPUT CONTROL switch at the right. The three ranges mentioned above are selected by the RANGE SELECTOR switch. The FREQUENCY CONTROL switch is used to obtain frequencies between the limits set by the range-selector switch. The OUTPUT CONTROL switch varies the amplitude of a signal at the output terminals in the lower left corner of the signal generator. The POWER ON-OFF switch is used to turn the supply of power on or off.

(2) *Buttons*. The ADJUST button located in the lower right corner is used for calibration purposes.

d. HOW TO CALIBRATE THE A-F SIGNAL GENERATOR. (1) Remove the cover from the instrument.

(2) Plug the power cord into a 110-volt, 50-to-60-cycle receptacle.

(3) Turn the POWER switch to the ON position. Application of power is indicated by a glow from the neon lamp.

(4) Wait approximately 5 minutes to allow the generator to reach operating temperature. In extremely cold climates this warm-up period should be extended to 15 minutes.

(5) Set the RANGE SELECTOR to the 20-to-200-cycle position.

(6) Set the FREQUENCY CONTROL so that the scale hairline is over the 60 mark.

(7) Advance the OUTPUT CONTROL to maximum output (100).

(8) Press the ADJUST button. The neon bulb should stay lit or partially dark if the calibration is exact.

(9) If the neon bulb flickers, vary the FREQUENCY CONTROL slightly clockwise and counterclockwise. Watch the neon bulb. If the flicker becomes less frequent or stops between 59 to 61 cycles, the generator is properly calibrated.

(10) The above test depends, of course, on the power generator supplying the 110-volt power. If the source of power is not exactly 60 cycles, then the signal generator can be adjusted within 1 cycle on either side of the frequency generated by the power source. For example: if the power source is 63 cycles, the FREQUENCY CONTROL might be turned to show a scale reading of 62, 63, or 64 to keep the neon bulb steadily glowing.

(11) If the calibration is off by an amount greater than 1 cycle on either side of the frequency generated by the power source (that is, if the scale reading shows 61 or 65 when the power-source frequency is 63), check the dial adjustment as follows:

(*a*) Turn the FREQUENCY CONTROL to maximum clockwise position. Do not force the control.

(*b*) Note whether the hairline on the dial lens lines up with the red line printed on the scale.

e. DIAL ADJUSTMENTS. If the hairline does not line up with the red mark, the dial must be adjusted.

(1) Turn the power switch to the OFF position.

(2) Remove the power supply plug from the receptacle.

(3) Remove the 10 screws from the outer edge of the instrument case.

(4) Slide the instrument from its case.

(5) Remove the 6X5GT/G tube.

(6) Using stubby long-nose pliers, loosen the two setscrews on the tuning dial shaft.

(7) Turn the tuning dial by hand until the hairline lines up with the red mark. Do not touch the FREQUENCY CONTROL switch.

(8) Tighten the setscrews while holding the shaft.

(9) Vary the FREQUENCY CONTROL switch, and observe whether the hairline lines up with the red mark when the switch is at the maximum clockwise position. If it does not, repeat steps (5) through (8) until an exact adjustment is made.

(10) Replace the 6X5GT/G tube.

(11) Replace the instrument in the case.

(12) Replace the 10 panel screws.

(13) Place the power supply plug in the receptacle.

(14) Turn the POWER switch to the ON position.

f. CALIBRATION PROCEDURE. If the hairline does line up with the red mark and the calibration is still incorrect, notify the officer in charge if it is necessary to secure exact calibration of the signal generator. The calibration procedure outlined below is very difficult and should be avoided if it is at all possible. It is included here only for cases of emergency.

(1) Allow the instrument to heat up for at least ½ hour.

(2) Set the FREQUENCY CONTROL so that the hairline is at the 180-cycle mark on the frequency indicator scale.

(3) Remove the metal plug from the left side of the instrument.

(4) Insert a screw driver in the case opening, and adjust the trimmer capacitor until the neon bulb shows the greatest amount of flicker. The instrument is then correctly calibrated at 180 cycles.

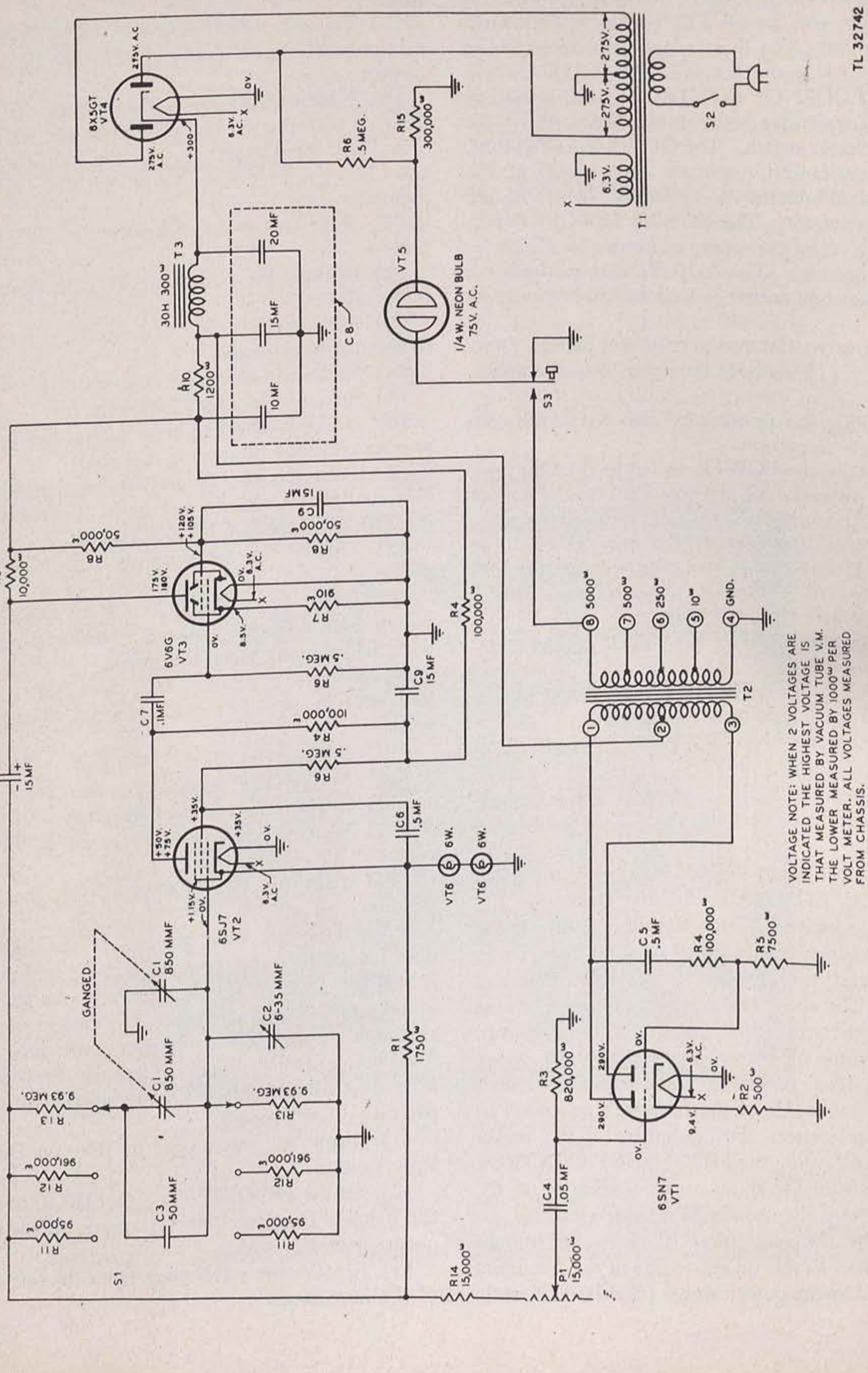


Figure 11. Hickok a-f signal generator, model 198, schematic.

g. PRELIMINARY CONNECTIONS. Once the signal generator is properly calibrated, test leads can be connected to the output terminals. Since the application of this signal generator will be in grid and plate circuits of various stages in the keyer and oscilloscope, the terminals most likely to be used are those labeled GND. and 5000. Proceed as follows for preliminary connections:

(1) Connect a 5,000-ohm resistor across terminals GND. and 5000.

(2) Connect to the 5,000 tap one terminal of a paper capacitor having a capacity of 0.1 microfarad (μf).

(3) Connect one test lead to the free terminal of the paper capacitor.

(4) Connect the other test lead to the GND. terminal.

Caution: In using the signal generator, turn the OUTPUT CONTROL counterclockwise until there is just sufficient output to provide the desired amplitude. If the output control is turned on for maximum output, the distortion caused within the oscilloscope, as well as in the circuit being tested, will lead to erroneous conclusions.

h. HOW TO READ SCALES. (1) When the range selector is set for the 20-to-200-cycle range, read the lowest scale on the indicator. Each scale division equals 0.5 cycle.

(2) When the range selector is set for the 200-to-2,000-cycle range, read the center scale. Each scale division equals 5 cycles.

(3) When the range selector is set for the 2,000-to-20,000-cycle range, read the top scale. Each scale division equals 50 cycles.

i. REPLACEMENT OF TUBES AND LAMPS. The most probable failure in electronic test equipment will occur in the vacuum tubes. All the tubes can be replaced easily without affecting the calibration frequency or voltage characteristics. It would be wise, however, to check the frequency calibration if a new 6SJ7 tube should be inserted. The neon tube on the front panel should be replaced if it becomes defective. The 66-watt biasing lamps can be tested with an ohmmeter, and each lamp should indicate about 300-ohms resistance. If any of these lamps should not show this resistance, it should be replaced.

j. SCHEMATIC ANALYSIS. Figure 11 shows the schematic diagram for this a-f signal generator. These diagrams are to be used only when the officer in charge grants permission to make emergency repairs on the signal generator. The following discussion is limited to the important parts contained in the instrument.

(1) *Oscillator circuit.* The signal is generated by two tubes operating in a resistance-capacitance (RC) oscillator circuit. This circuit is so arranged that the audio-frequency voltage generated by these tubes has little distortion and high stability. Two ganged, variable capacitors are used to set the frequency output of the oscillator. The capacitors form part of the RC network which bridges the output and input of the amplifier and selects the desired operating frequency. One other variable capacitor is used to adjust the frequency over a small range for calibration purposes.

(2) *Amplifier circuit.* The oscillator output is obtained from a variable resistor (P1) and is fed to the push-pull 6SN7 amplifier tube (consisting of two amplifier tubes within one envelope). The signal from the oscillator is fed for amplification to the grid of the first amplifier. The output signal from the plate is fed to the grid of the second tube for inversion. The plate outputs of both tubes form a push-pull signal which is fed to the output transformer. The secondary of the transformer has four taps to allow various impedances to be connected.

(3) *Power supply.* Power is supplied to the oscillator and amplifier tubes by a power transformer, a full-wave rectifier tube (6X5GT), and its associated filter. The power supply is regulated to maintain constant potentials on the tubes used in the circuit so that no variations can enter into the signal generator output signal.

(4) *Neon bulb circuit.* A neon bulb is connected across one-half of the high-voltage secondary on the power transformer. The bulb glows when power is supplied to the transformer primary. A switch (S3), with a normally closed position, is connected between the neon bulb and ground. When calibration is needed, the switch can be closed to its other position so that it connects the neon bulb to the 5,000-ohm tap of the output transformer. In this way, one plate of the neon bulb is connected to the high-voltage secondary of the power transformer, and the other plate to the secondary of the output transformer. During calibration, when the oscillator is set for 60 cycles, the 60-cycle outputs of the transformers will beat against each other. As a result, the neon bulb will flicker according to the beat. When both sources are of the same frequency and of the same phase, the bulb will remain dark; but if they are 180° out of phase, the bulb will remain lit. When there is only a slight difference of frequency, the bulb will flicker accordingly.

21. Basic R–F Signal Generator

a. An r-f signal generator is a source of continuous-wave radio-frequency oscillations. These are generated in some form of oscillator circuit which is coupled by the transformer to the output terminals and their leads.

b. To provide a signal which can be used for various tests, and especially for alignment of a receiver, the continuous wave is modified by some form of modulation. This modulation is at an audio-frequency rate generated in an a-f oscillator contained within the signal generator. The percentage of modulation is 30 percent.

22. Measurements Corporation R–F Signal Generator, Model 78C

a. FUNCTION. The model 78C standard signal generator generates r-f signals which are used in signal tracing and alignment of receivers.

b. RANGES. (1) 15 to 25 mc.

(2) 90 to 125 mc.

c. LOCATION AND PURPOSE OF CONTROLS. (1) *Switches* (fig. 12). (*a*) The POWER switch, located directly below the output meter, is used to turn on or off the power supply to the instrument.

(*b*) The MODULATION switch, located below the meter, is used to turn the modulation on or off, and to select either 400 or 625-cycle modulation.

(*c*) The RANGE SWITCH, located below the scale, is used for range selection. The lower range (15 to 25 mc) can be selected by pushing the switch in. The highest range (90 to 125 mc) can be selected by pulling the switch out.

(2) *Controls.* (*a*) The tuning control is located on the left side of the instrument and is used to select the desired frequency between the range limits.

(*b*) The OUTPUT control, located directly beneath the output meter, is used to adjust the pointer on the output meter. The output coupling can be varied by means of a sliding attenuator control on the right side of the instrument. Attached to this control are the output cable and output terminals. The amount of output is indicated on a scale engraved on the sliding tube. When the tube is all the way out, the output is 1 microvolt, the lowest obtainable. When the tube is all the way in, the output is at a maximum of 100,000 microvolts (fig. 13).

(3) *Frequency calibration chart.* The correct dial setting for the frequency desired is chosen from the frequency calibration chart (fig. 12).

d. HOW TO USE THE SIGNAL GENERATOR. (1) Insert the power cord into a 117 volt line having a frequency of 25 to 60 cycles.

(2) Throw the POWER switch to the ON position and wait 5 minutes before proceeding.

(3) Determine which range is desired and adjust the RANGE SWITCH accordingly. Push switch all the way in for the 15-to-25-mc range; pull switch all the way out for the 90-to-125-mc range.

(4) Turn the MODULATOR switch to the ON position.

(5) Consult the scale chart for scale adjustment. For example, if the desired range is 200, read down the left side of the chart until the 200 mark is reached. Then read across the chart to the intersection of the curved black line. The figures at the bottom of the chart will show the scale reading at the intersection point. This final reading is the designated scale division. If the desired range is on the lower scale, follow the same procedure but carry the range figure across to the intersection of the curved red line.

NOTE. The lower range (15 to 25 mc) is designated as RED. For this range, the RANGE SWITCH should be pushed in, and the chart reading should be carried to the red line. The higher range (90 to 125 mc) is designated as the BLACK. For this range, the RANGE SWITCH should be pulled out and the chart reading should be carried to the black line.

(6) Rotate the tuning-control knob until the black hairline on the scale cover glass is directly over the designated scale division.

(7) Vary the OUTPUT meter control knob until the meter pointer is on the red line. If no reading is obtained, inspect the fuses by unscrewing them from the front of the instrument. If the fuses are defective, replace them.

(8) Pull out the attenuator control to the 1-microvolt position.

(9) Connect the output plug to the receiver trombone.

NOTE. Leads from the plug must not exceed 4 inches in length.

(10) Connect a ground wire from the GROUND terminal to the receiver chassis.

(11) Set the sliding tube to the desired signal level.

(12) Vary the OUTPUT meter control knob until the meter pointer is on the red line.

e. REPAIRING THE SIGNAL GENERATOR. (1)

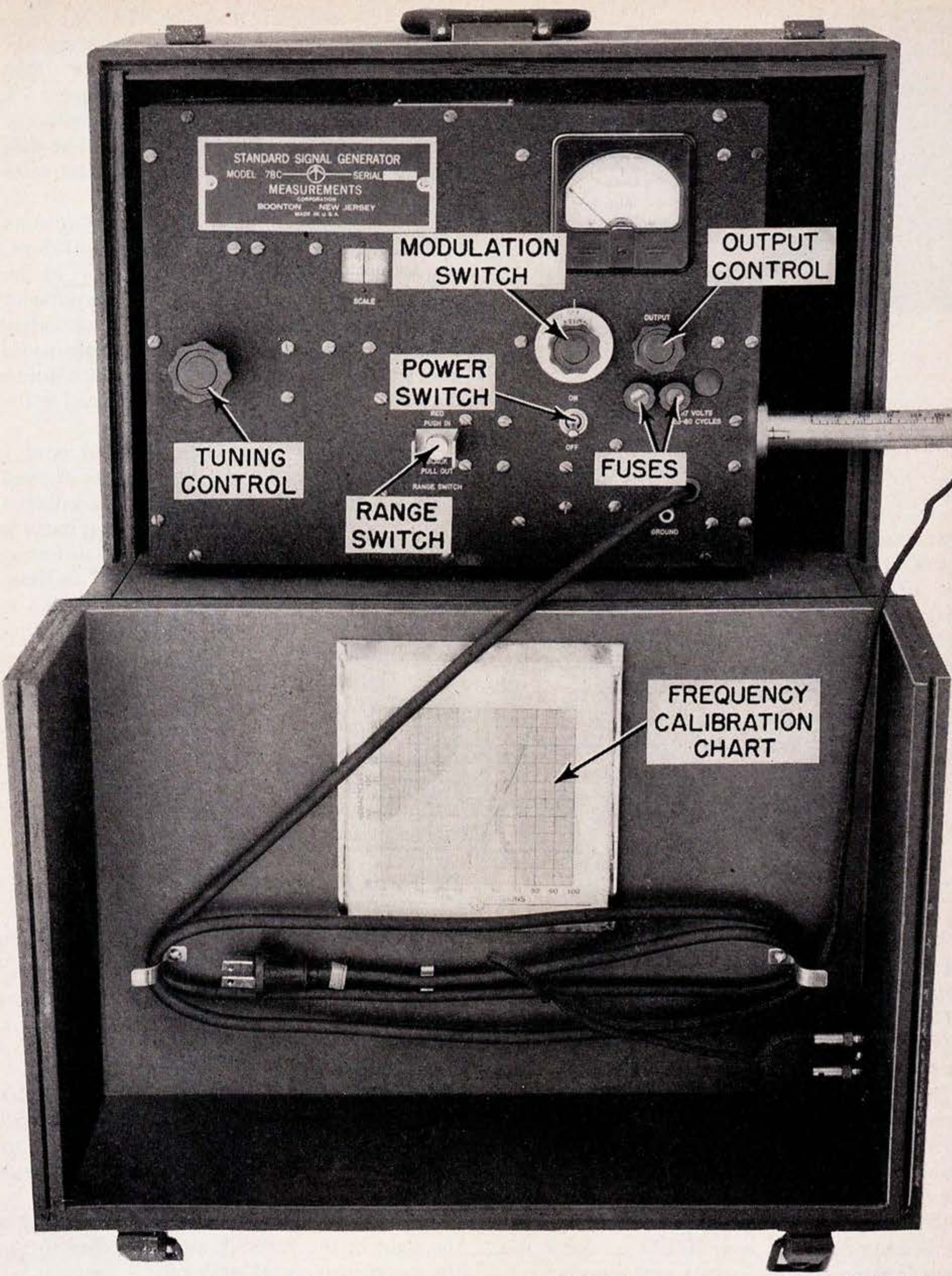


Figure 12. Measurements Corporation r-f signal generator, model 78C.

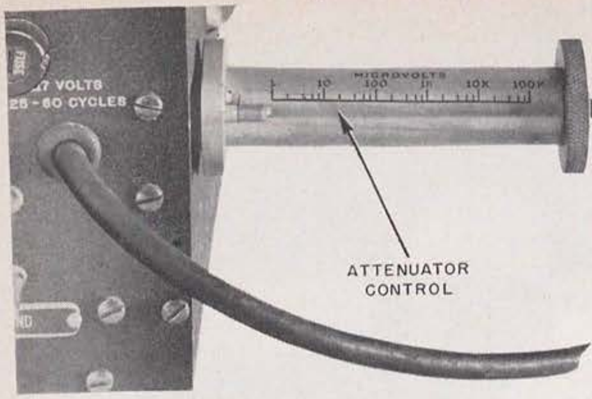


Figure 13. Measurements Corporation r-f signal generator, model 78c, attenuator control.

Blown fuses must be replaced with a standard 1-ampere, type 3AG fuse. If the fuses continue to blow after replacement, inspect the VR-150/30 voltage-regulator tube which is visible through the louvres on the right side of the instrument. The absence of a purple glow in this tube indicates trouble in the rectifier tube, power transformer, filter capacitors, or line filter. If the VR-150/30 tube glows and the proper indication cannot be obtained in the output meter, the trouble may be in the radio-frequency oscillator unit or the supply leads.

NOTE. Permission of the officer in charge must be obtained before any repairs are attempted.

(2) To make repairs inside the instrument, proceed as follows:

(*a*) Pull out the power supply plug from the proper source.

(*b*) Place the instrument on its back.

(*c*) Remove the 12 screws around the edge of the panel.

(*d*) Lift the front panel from the case. All components are attached to the front panel.

(3) To inspect the radio-frequency unit, proceed as follows:

(*a*) Place the panel face down on a bench.

(*b*) Remove the bolt and washer which hold the black r-f shield cover in place. After this cover is removed, the various supply voltages to the oscillator can be checked and the 9002 tube can be removed and tested. The 9002 tube should have a mutual conductance of 1,800 micromhos if measured on a mutual-conductance meter. It may be well to replace the tube, since the tube checker may not show whether the tube is capable of operating as a high-frequency oscillator.

Caution: Do not disturb the adjustment of the three variable rheostats under any conditions.

f. SCHEMATIC ANALYSIS (fig. 14). The following discussion is limited to the important parts of the signal generator.

(1) *R-F oscillator.* The r-f oscillator consists of a Colpitts oscillator in a shielded compartment, using a type 9002 tube (V3). The output of the oscillator is transformer-coupled by the amount of coupling between the primary and secondary of this transformer. The oscillator is plate-modulated by the output of 7C5 (V2) which forms part of the audio oscillator and is contained in the generator.

(2) *Audio oscillator.* This oscillator is of a resistance-capacitance type with two sets of fixed values which can be switched to allow oscillation at either of two frequencies. The output meter is connected to the secondary of the transformer which is coupled to the r-f oscillator. This meter indicates the amount of grid current flowing in the circuit. The plate voltage of the r-f oscillator can be adjusted to keep the oscillation at a set value. Output control T10 controls the amount of voltage supplied to the r-f oscillator.

(3) *Power supply.* The power supply for the signal generator is of the full-wave regulated type. Included in the primary of the power transformer is the filter network which prevents noise from affecting circuit operation.

23. Ferris Microvolter, Model 18B

a. FUNCTION. The microvolter generates an r-f signal which is used in signal-substitution tests and alignment of the receiver.

b. RANGES. (1) 18 to 34 megacycles.

(2) 32 to 60 megacycles.

(3) 55 to 105 megacycles.

(4) 100 to 155 megacycles.

c. LOCATION AND PURPOSE OF CONTROLS. (1) *Switches* (fig. 15). (*a*) The POWER switch, located at the lower left corner of the front panel, is used to turn on or off the a-c power to the instrument.

(*b*) The MODULATION switch, located to the right of the POWER switch, is used to turn the modulation signal on or off.

(*c*) The range switch, (COIL) at the upper right of the front panel, selects one of the four frequency ranges of the microvolter.

(2) *Controls.* (*a*) The tuning dial is located

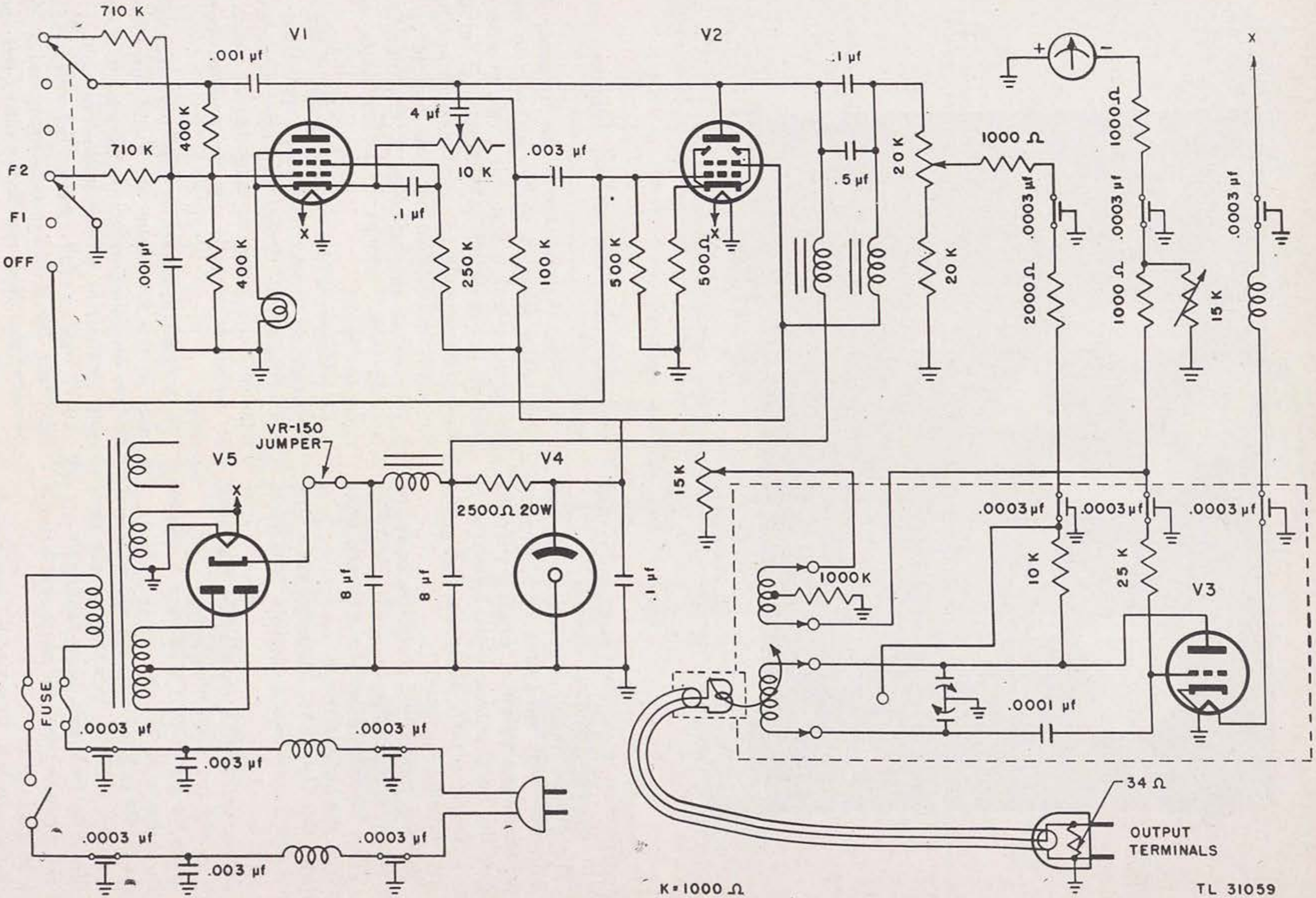


Figure 14. Measurements Corporation r-f signal generator, model 78C, schematic.

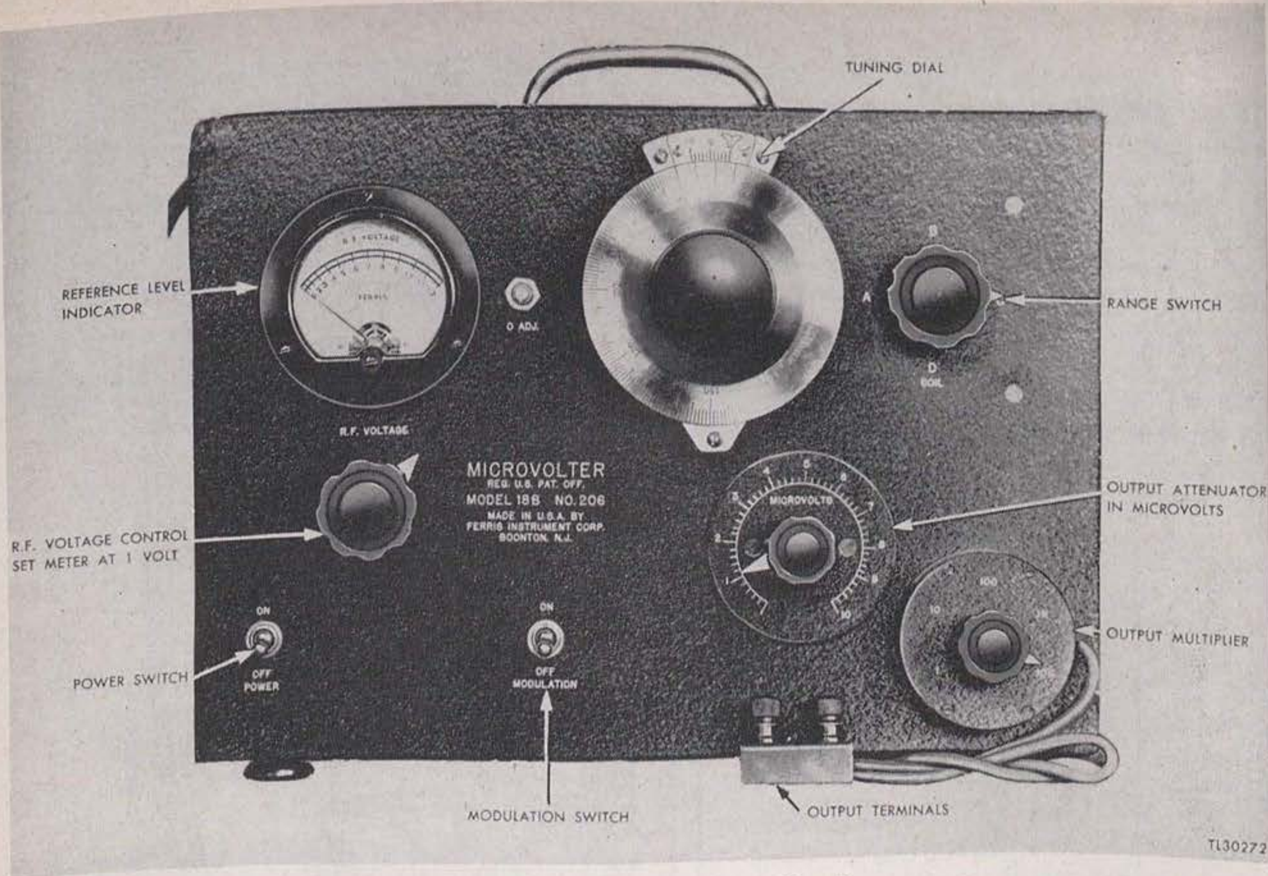


Figure 15. Ferris microvolter, model 18B.

near the top center of the front panel and is used to tune to the exact frequency desired.

(*b*) The output control is made up of two dials. The first is numbered from 1 to 10 microvolts; the second is a multiplier, which is arranged to increase the signal output by the factors of 1, 10, 100, 1,000, or 10,000. These dials are at the lower right of the front panel.

(*c*) The R.F. VOLTAGE control is located to the left of the tuning dial just above the POWER switch. This is used to set the reference level indicated on the meter above it.

d. HOW TO USE THE MICROVOLTER. (1) Plug the power cord into a 110-volt, 50-60-cycle power supply.

(2) Turn the POWER switch ON and allow the unit to heat for a few minutes.

(3) Turn the R.F. VOLTAGE control counterclockwise as far as it will go.

(4) Note the indication on the reference-level indicator meter. If the indication is not zero, adjust the screw for a zero meter reading.

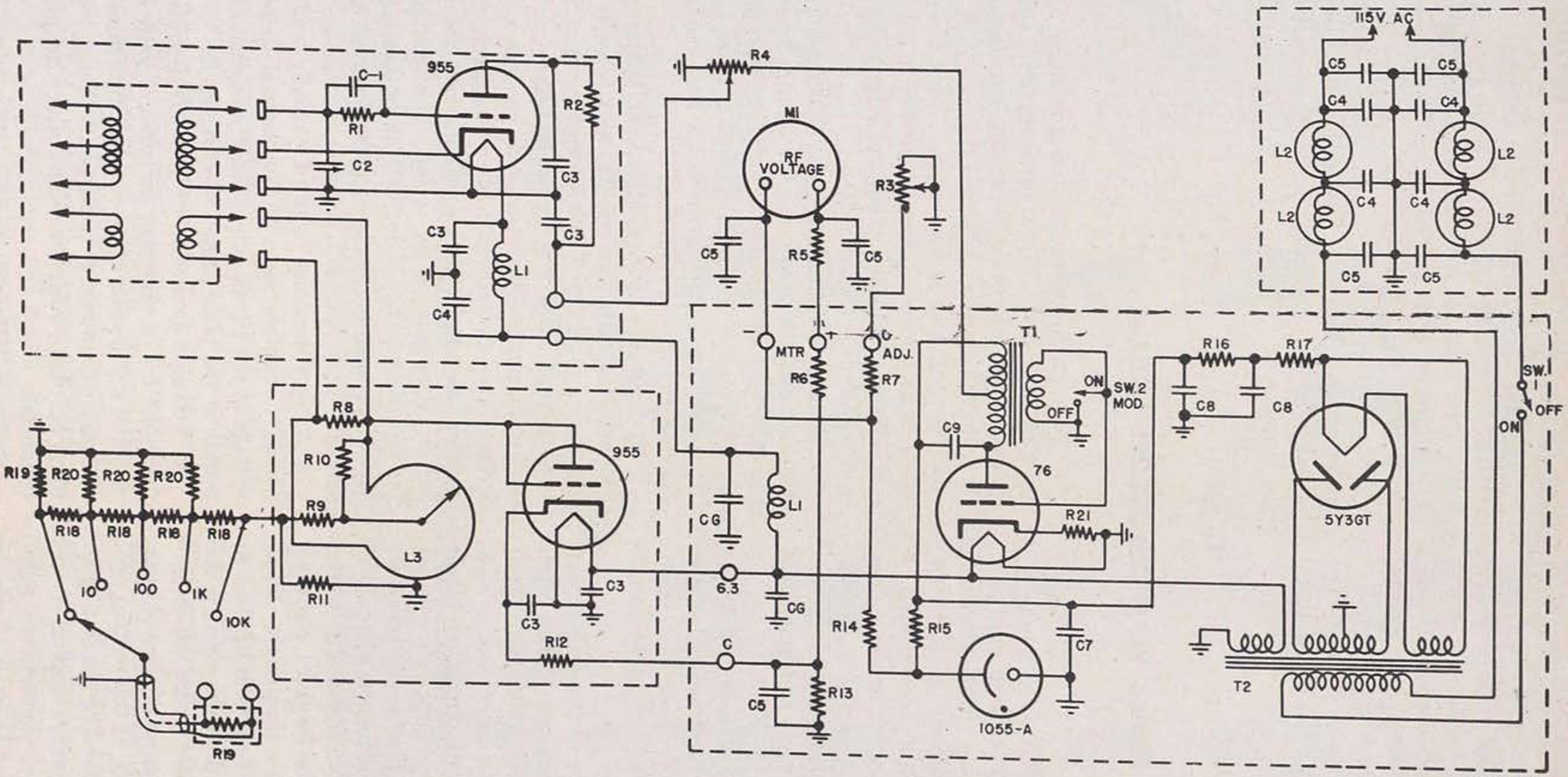
(5) Set the position of the range switch to the band to be used.

(6) Rotate the R.F. VOLTAGE control clockwise, until the reference-level indicator meter reads 1 volt.

(7) Tune the generator to the frequency desired. After tuning, it will be necessary to reset the reference-level indicator to 1 volt, in order to read the output directly in microvolts. If for any reason (for example, aging of the oscillator tube) the reference indication cannot be brought up to 1 volt, reduce the indication to 0.5 volts, and multiply output settings of the attenuator and multiplier by 0.5.

(8) Because of the low output impedance of the generator (about 30 ohms), application of the instrument to circuits of higher impedance requires the insertion of compensating resistors or capacitors to make up the required impedance.

e. SCHEMATIC ANALYSIS (fig. 16). (1) The tubes in this instrument are a 955, used in a Hartley oscillating system; a 76, used as a 400-cycle oscillator to develop modulating voltage; a 5Y3GT, used as a full-wave rectifier with a 1055A neon tube for B-voltage regulation; and a 955, connected as a diode rectifier for the r-f reference-level indicator.



CONDENSERS	RESISTORS	RESISTORS	
C1-25 μμf	R1-20KΩ	R11-43Ω	L1-RF CHOKE
C2-VARIABLE	R2-1000Ω	R12-500Ω	L2-FILTER CHOKE
C3-300 μμf	R3-200Ω	R13-35KΩ	L3-SLIDEWIRE
C4-.1 μf	R4-20KΩ	R14-20KΩ	
C5-.01 μf	R5-3000Ω	R15-10KΩ	T1-AUDIO OSC. TRANSF.
C6-.5 μf	R6-5000Ω	R16-4000Ω	T2-POWER TRANF.
C7-.25 μf	R7-100Ω	R17-2000Ω	
C8-8 μf	R8-100Ω	R18-270Ω	SW-1 TOGGLE SWITCH
C9-.1 μf	R9-100Ω	R19-30Ω	SW-2 TOGGLE SWITCH
	R10-200Ω	R20-33Ω	
		R21-1000Ω	M1-METER

Figure 16. Ferris microvolter, model 18B, schematic.

(2) The attenuator system consists of two controls: a continuously variable resistance calibrated from 0.1 microvolt to 10 microvolts; and the multiplier unit which is a five-position voltage-divider unit with ranges of 1, 10, 100, 1,000, and 10,000 times the setting of the variable attenuator. The maximum output from the generator is 100,000 microvolts.

(3) The output cable terminates in a 30-ohm load, a fixed resistor contained in a small metal housing, which also mounts the two output terminals.

(4) The r-f reference-level indicator is a vacuum-tube voltmeter of the diode type, using a 955 tube with the grid and plate tied together. The reference level on this meter for proper application of the attenuator calibrations is 1 volt.

(5) Tuning is done by a variable capacitor with vernier adjustment. Calibration of the device is indicated on calibration curves furnished with the instrument.

Section VI. OSCILLOSCOPE I–134–A

24. Cathode-ray Oscilloscope

a. The cathode-ray oscilloscope is an electronic instrument which is used to plot electrical changes visually. This instrument is of great value in trouble shooting, for it can be used in signal tracing and signal substitution to show what is taking place in a circuit. It consists of a cathode-ray tube, amplifiers for producing the deflection voltages, a linear-sweep generator, and associated power supply.

b. The screen seen through the opening in the front of the instrument is the flattened end of the cathode-ray tube. This is coated on the inside with a substance which will emit light when struck by electrons.

c. Within the glass envelope of the cathode-ray tube there are a number of elements which form a narrow pencil-like beam of electrons. This beam can be moved in any direction by means of voltages placed on the two sets of deflection plates contained in the tube. One of these sets consists of horizontal or *X* deflection plates; the other set is composed of vertical or *Y* deflection plates.

d. When a sweep voltage is impressed on the horizontal deflection plates, the beam of electrons is moved from left to right at a linear rate. If, at the same time, an alternating current is applied to the vertical deflection plates, the total effect is the reproduction of a picture on the screen which corresponds to the electrical variation of the voltages.

e. The intensity or brilliance of the pattern produced on the screen is determined by the setting of an intensity control. This control applies a voltage to the control electrode to regulate the number of electrons being emitted from the cathode of the tube.

f. To form the electrons into a beam, a focusing control is used. This control applies a voltage to the focusing electrode in the tube to concentrate all scattered electrons.

g. Next in line is the anode. This electrode has a high positive potential applied to it. Its main purpose is to accelerate and attract the electrons emitted by the cathode.

h. Beyond the anode are the deflection plates which control the position of the beam. To center the trace or to move it to any desired position on the screen, a d-c voltage is applied to these plates. This operation is performed by the horizontal and vertical positioning controls.

i. A frequency control adjusts the frequency of the sweep circuit, thus producing a trace on the oscilloscope screen. If the sweep frequency is the same as that of the voltage applied to the vertical deflection plates, one cycle will be seen on the screen. Any sweep which is a submultiple of the applied voltage frequency will increase the number of cycles seen on the screen. For example, if the sweep frequency is one half of the applied voltage frequency, two cycles will be observed on the screen.

j. A synchronizing control, usually called a SYNCH, applies some of the vertical deflection voltage to the sweep generator, causing it to begin a trace at the same instant in every cycle.

k. Voltages used for cathode-ray oscilloscope operation are of very high potential, usually in the range of 2,000 volts or more. For this reason, any internal adjustments required for maintenance must be made with the high-voltage supply disconnected.

Caution: Voltages used in the oscilloscope are dangerous. Be careful when replacing tubes or

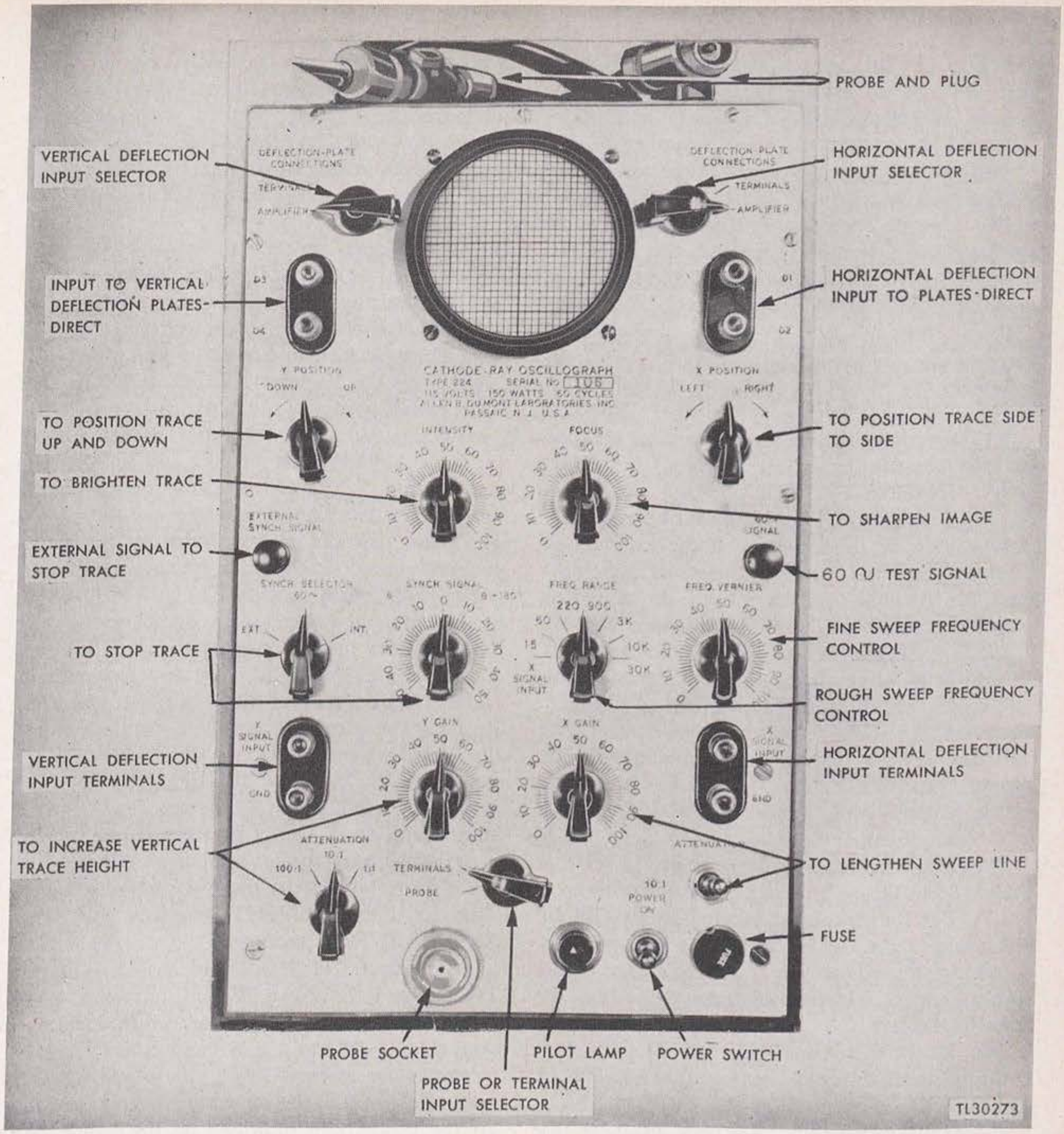


Figure 17. Du Mont oscilloscope, type 224.

making measurements within the oscilloscope. If it is necessary, at any time, to replace the cathode-ray tube, use extreme caution in handling the tube. This tube has a very high vacuum. If there should be any slight defect or flaw in the glass envelope, a slight tap may fracture the glass, causing the tube to explode. The small fragments of glass resulting from the explosion will travel at a high rate of speed and can cause considerable damage. The operator making the tube replacement should wear heavy gloves and shatterproof glasses. He must handle the tube very gently, paying particular attention to the way he lays the tube down.

25. Du Mont Oscilloscope, Type 224

a. FUNCTION. The Du Mont oscilloscope, type 224, is used to observe the waveforms in the various components of Radio Sets SCR–270–(*) and SCR–271–(*).

b. LOCATION AND PURPOSE OF CONTROLS (fig.

17). (1) At the top of the panel, and on either side of the screen opening, are two switches labeled DEFLECTION-PLATE CONNECTIONS. These switches are set for the type of operation desired. If the signal is of sufficient amplitude for special application, the input is applied to the *D* terminals directly below the switches. The switches must be set to the TERMINALS position for this type of operation. When the signal is weak, and amplification is desired, the switch is set to the AMPLIFIER position and the terminals marked SIGNAL INPUT are used.

NOTE. The controls and terminals on the left side of the front panel are used for the vertical deflection (Y) plates; those on the right side of the front panel are used for the horizontal (X) deflection plates.

(2) Directly below the screen opening are four controls labeled (from left to right) *Y* POSITION, INTENSITY, FOCUS, and *X* POSITION. The *Y* POSITION is used to set the vertical position of the baseline on the cathode-ray screen. When this control is turned counterclockwise, the baseline can be moved down; when turned clockwise, the baseline can be moved up.

(3) The INTENSITY control is used to adjust the brilliance of the trace on the screen. Clockwise movement increases the brilliance. Counterclockwise movement decreases the brilliance. The brilliance of the pattern or trace must not be greater than is necessary. If it is too great, the screen material will be burned and will require tube replacement.

(4) The next control in line, labeled FOCUS, is used to focus the electron beam to form a fine spot.

(5) The fourth control, labeled X POSITION, also moves the trace, but in a horizontal position. Clockwise movement will adjust the trace to the right; counterclockwise movement will adjust the trace to the left.

(6) Below these controls is another set of four controls, labeled (from left to right), SYNCH. SELECTOR, SYNCH. SIGNAL, FREQ. RANGE, and FREQ. VERNIER. The first of these, the SYNCH. SELECTOR, is a switch with three positions labeled EXT., 60 ∼, and INT. This switch selects the desired type of synchronization to be used to obtain a stationary pattern on the screen. The EXT. (external) position allows the application of the external signal to the sweep generator through the terminals labeled EXTERNAL SYNCH. SIGNAL and GND. This external signal is applied to the sweep generator, causing it to begin a sweep at exactly the same instant of every cycle. The 60 ∼ position connects some of the voltage from the input line which is a 60-cycle waveform. This voltage allows synchronization at 60 cycles, which can be used for audio-oscillator calibration. No external connection is needed, but extra signal can be applied to the terminals marked 60 ∼, SIGNAL, and GND. The extreme right position of this switch, labeled INT., is used when synchronization with the waveform on the Y-plates is desired.

(7) The next control, labeled SYNCH. SIGNAL, is used to control the phase relationship of the synchronizing signal with respect to the waveform being observed. This control can be used to observe any portion of the waveform.

(8) The third control, FREQ. RANGE, has eight switch positions and serves as a rough frequency selector. The frequency ranges are: 0; 15; 60; 220; 900; 3,000; 10,000; and 30,000. The first position, X SIGNAL INPUT, is used when a signal other than the internal sweep is to be used. The other positions of the switch set the sweep generator into operation over the ranges indicated.

(9) The fourth control, FREQ. VERNIER, is used to adjust the sweep to any frequency between the limits set by the range control. The range control is usually set for a range which will include the frequency of the waveform being observed. The vernier control is then adjusted until the waveform is stationary on the screen.

(10) Directly below the SYNCH. SIGNAL and FREQ. RANGE controls are the Y GAIN control and the X GAIN control. These controls are used to vary the amount of amplification of the signals applied to their respective terminals (the *X* SIGNAL INPUT terminals and the *Y* SIGNAL INPUT terminals).

(11) An ATTENUATION control is located below the *Y* SIGNAL INPUT terminals. This control is a three-position switch which operates in conjunction with the *Y* GAIN control. The three positions are marked 100:1; 10:1; and 1:1. By using this control, the input signal can be reduced by the proportions indicated on the switch positions. The *Y* GAIN control will then vary the signal between zero and that fraction of the input signal which is indicated on the ATTENUATION control.

(12) Next to this switch is a control which will permit the use of either the input terminals or a test probe. This switch has two positions marked TERMINALS and PROBE. The probe is held in clips on the inside of the oscilloscope cover and when used is connected to the test-probe terminals located below the probe switch.

(13) On the right side of the panel and below the *X* SIGNAL INPUT terminals is located an ATTENUATION toggle switch of two positions marked 10:1 and 1:1. These serve the horizontal-deflection input terminals in the same way as the *Y*-ATTENUATION switch serves the vertical-deflection input terminals.

(14) Below, and to the right of the probe switch, is a POWER toggle switch. When this is thrown to the ON position, the green light to the left of the switch will glow to indicate that power is being supplied to the oscilloscope.

c. HOW TO SET UP THE OSCILLOSCOPE.

Caution: Before and after using the test oscilloscope, turn all controls counterclockwise and turn the power switch to the OFF position. This precautionary measure will extend the life of the screen on the cathode-ray tube.

(1) Insert the line-cord plug into a power source of 115 volts, 60 cycles.

(2) Throw the power switch to the ON position and wait about a minute for the tubes to warm up.

(3) Turn the *Y* and *X* positioning controls to an approximate midway point.

(4) Turn the INTENSITY control clockwise until a green glow appears on the screen.

(5) Turn the FOCUS control until the glow becomes a spot.

(6) Continue turning the FOCUS control until the spot becomes a point of light. It may be necessary, at this time, to readjust the INTENSITY control to cut down the brilliance of the light.

(7) Turn the FREQ. RANGE switch to any one of the ranges.

(8) Turn the *X* GAIN control clockwise to make the trace on the screen the desired length.

(9) Readjust the positioning controls to set the trace in the desired position.

(10) The scope is now ready to receive input signal for observation.

d. HOW TO USE THE OSCILLOSCOPE. Assuming that the waveform in the plate circuit of one of the tubes in the keyer component is to be observed, the following procedure will be used:

(1) Connect the test leads to the *Y* SIGNAL INPUT terminals.

(2) Connect the ground lead to the chassis of the keyer.

(3) Turn the DEFLECTION-PLATE CONNECTIONS switch (at the top left corner of the panel) to the AMPLIFIER position.

(4) Set the PROBE switch to the TERMINALS position.

(5) Set the SYNCH. SELECTOR switch to the INT. position.

(6) Turn the SYNCH. SIGNAL control to the zero mark.

(7) Turn the FREQ. RANGE control to the 900 mark.

(8) Apply the free test lead from the *Y* SIGNAL INPUT terminal to the plate of the tube being tested.

(9) Turn the *Y* GAIN control clockwise until vertical deflection is obtained. If no deflection can be obtained, turn the *Y* GAIN control to the zero mark. Then turn the ATTENUATION switch (at the lower left corner) to the next position and once more turn the *Y* GAIN control clockwise. If no deflection can be obtained with these new settings, turn the ATTENUATION control to the last position and repeat the procedure.

(10) After the vertical deflection is obtained, adjust the FREQ. VERNIER control to "stop" the waveform.

NOTE. Originally, the FREQ. RANGE switch was set at the 900 mark because the frequency of 621 cycles found in the keyer unit was covered by this range. When the FREQ. VERNIER control was turned, the frequency of the sweep generator was readjusted until the point was found where the sweep frequency was equal to the frequency of the input signal. This is the point at which the waveform on the screen was stopped.

(*a*) If the waveform continues to move slightly, turn the SYNCH. SIGNAL control until the waveform is stationary.

(*b*) Any other applications of the scope are carried out in the same manner but with slight changes in the control setting.

e. FREQUENCY-COMPARISON TEST. If a frequency-comparison test is to be used, such as a test of the oscillator frequency in the oscilloscope component, proceed as follows:

(1) Insert the line-cord plug into a power source of 115 volts, 60 cycles.

(2) Throw the POWER switch to the ON position and wait about a minute for the tubes to warm up.

(3) Turn the *Y* and *X* POSITION controls to an approximate midway point.

(4) Turn the INTENSITY control clockwise until green glow appears on the screen.

(5) Turn the FOCUS control until the glow becomes a spot.

(6) Turn the FOCUS control until the spot becomes a point of light. It may be necessary, at this time, to readjust the INTENSITY control to cut down the brilliance of the light.

(7) Leave the FREQ. RANGE selector switch in the X SIGNAL INPUT position (fully counterclockwise).

(8) Connect a pair of test leads with a Plug PL–55 at one end to the Y SIGNAL INPUT terminals.

(9) Insert the plug into the jack marked KEYER on the oscilloscope component.

(10) Connect a pair of test leads between the 5,000-ohm terminals of an audio-frequency signal generator and the X SIGNAL INPUT terminals of the test oscilloscope.

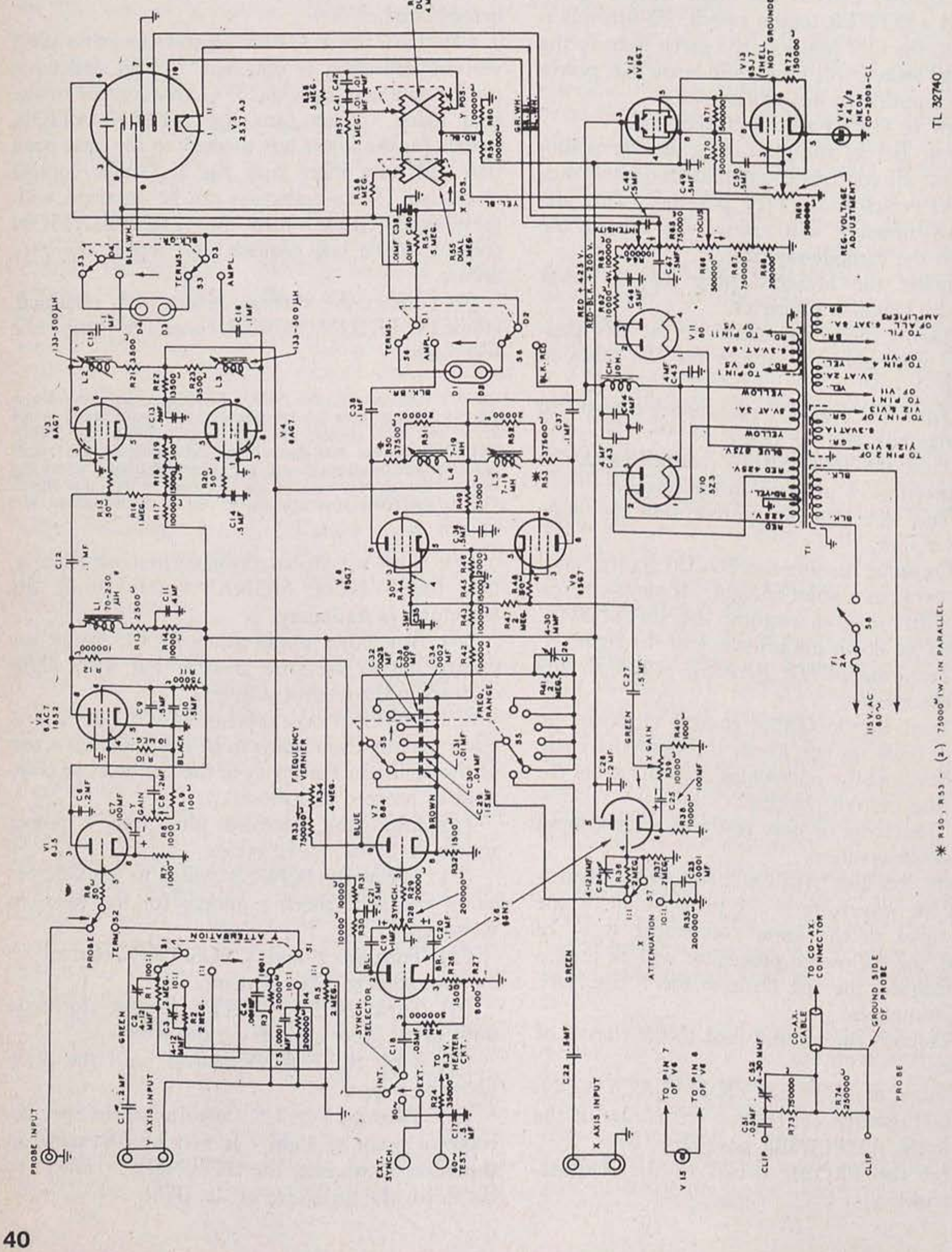


Figure 18. Du Mont oscilloscope, type 224, schematic.

(11) Turn the SEN. control on the oscilloscope component clockwise until the POWER switch snaps on.

(12) Adjust the *Y* GAIN control on the test oscilloscope until a vertical line approximately 2 inches in length appears on the screen.

(13) Turn on the signal generator.

(*a*) Calibrate the signal generator (par. *c*, above).

(*b*) Adjust the frequency to approximately 621 cycles.

(*c*) Turn the OUTPUT control to the midway point.

(14) Turn the *X* GAIN control on the test oscilloscope clockwise until some figure appears on the screen. If the figure is not stationary, adjust the FREQUENCY CONTROL on the signal generator until the figure on the screen is either a slanting straight line, a circle, or an ellipse. At this point, the frequency of the signal generator is the same as that being generated in the oscilloscope component.

f. SCHEMATIC ANALYSIS (fig. 18). The following discussion is limited to the important parts contained in the test oscilloscope.

(1) *Amplifier and control circuits.* V1, V2, V3, and V4 form the amplifier circuit of the *Y*-axis signal. V1, a type 6J5 tube is cathode-coupled to the amplifier V2, a type 6AC7 tube. V2 feeds V3, a 6AG7 amplifier-output tube which has a common cathode circuit with V4, another 6AG7 type tube. This cathode circuit forms a phase converter.

(*a*) Since the grid of V4 is at ground potential to ac because of C14, any variation in the cathode will cause amplification in the tube. As a result, the two tubes operate in a push-pull circuit which is coupled to the vertical deflection plates of the cathode-ray tube.

(*b*) The horizontal deflection plates receive their operating voltages from the horizontal-output amplifier V8 and V9, both type 6SG7 tubes. These two tubes receive a signal from either the cathode circuit of the type 6SN7 tube, which is the *X*-axis input amplifier, or from the sweep generator, a type 6Q5G tube.

(*c*) V6, the type 6SN7 tube, actually consists of two amplifier tubes in one envelope. One of these tubes is used as the *X*-axis input amplifier; the other tube is part of the synchronizing circuit which trips the sweep generator.

(2) *Power supply.* Power is supplied to the operating circuits from two sources. One of these sources is a 400-volt supply with a regulator made up of a type 6V6GT tube (V12), and a type 6SJ7 tube (V13), which supplies regulated 200-volt dc. The other source forms the high-voltage supply for operation of the cathode-ray tube. This supply has the positive side at ground potential. All negative voltages are taken with respect to the ground.

26. RCA Oscilloscope, No. 155A

a. Function. Like the Du Mont Type 224, the RCA 155A is used to observe the waveforms in the various components of the radar unit.

b. SWITCHES AND CONTROLS (fig. 19). (1) The controls and switches of the RCA No. 155A oscilloscope are arranged in three vertical columns marked VERTICAL on the left, HORIZONTAL on the right, and TIMING in the center. The controls will be discussed according to their position in the columns. The INTENSITY control is located at the top of the VERTICAL column. It governs the brilliancy of the trace and serves as an ON–OFF switch. The FOCUS control is located at the top of the HORIZONTAL column, and is used to focus the trace on the screen. Vertical and horizontal centering is accomplished by the two controls above the respective GAIN controls in the VERTICAL and HORIZONTAL columns.

(2) Input to the vertical deflection plates is made through two terminals at the bottom of the VERTICAL column. The vertical deflection amplifier is controlled by the vertical-deflection amplifier selector marked AMPLIFIER. When this control is set to ON position, the amplifier is connected into the vertical-deflection plates system, and the amount of amplification is controlled by the dial marked GAIN. When the AMPLIFIER control is set to the OFF position, the amplifier is cut out of the circuit.

(3) The horizontal-deflection plates circuit is fed by two terminals at the lower right. The length of the time base, as well as any signal fed into the horizontal plates, is controlled by means of the GAIN control in the HORIZONTAL column. The switch governing the horizontal-deflection plates system has five positions. When this switch is set to EXT, the sweep voltage is supplied from an outside source and connected to the horizontal-deflection plates terminals. When the switch is set to 60, it selects a 60-cycle sine wave from the power supply. When set to INT, the regular saw-tooth sweep, generated within the unit and controlled by the two knobs labeled RANGE and FREQUENCY, is used. The length of sweep for sweep-selector switch positions EXT,

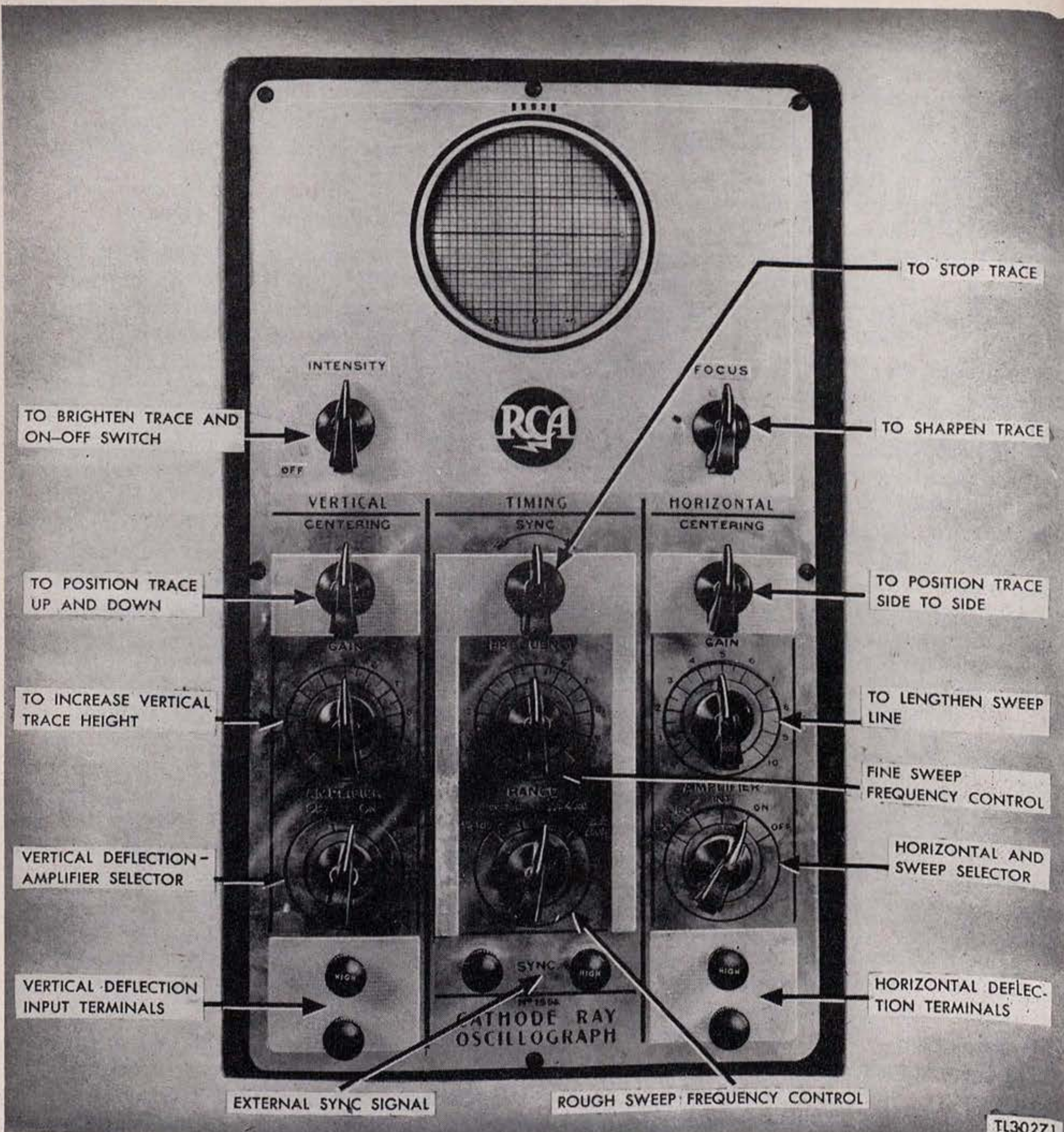


Figure 19. RCA oscilloscope, No. 155A.

60, and INT, is controlled by means of the horizontal gain control. When the switch is set to ON, the horizontal amplifier is in the circuit but the sweep is cut out. Finally, when the selector is set to OFF, both the sweep and horizontal amplifier are disconnected, the horizontal deflection terminals being connected to the horizontal deflection plates through a blocking capacitor in the high side.

c. How to Set Up the Oscilloscope. (1) Insert the line-cord plug into a power source of 115 volts, 60 cycles.

(2) Turn on INTENSITY switch about half way, allowing the tubes to heat up. Wait a few

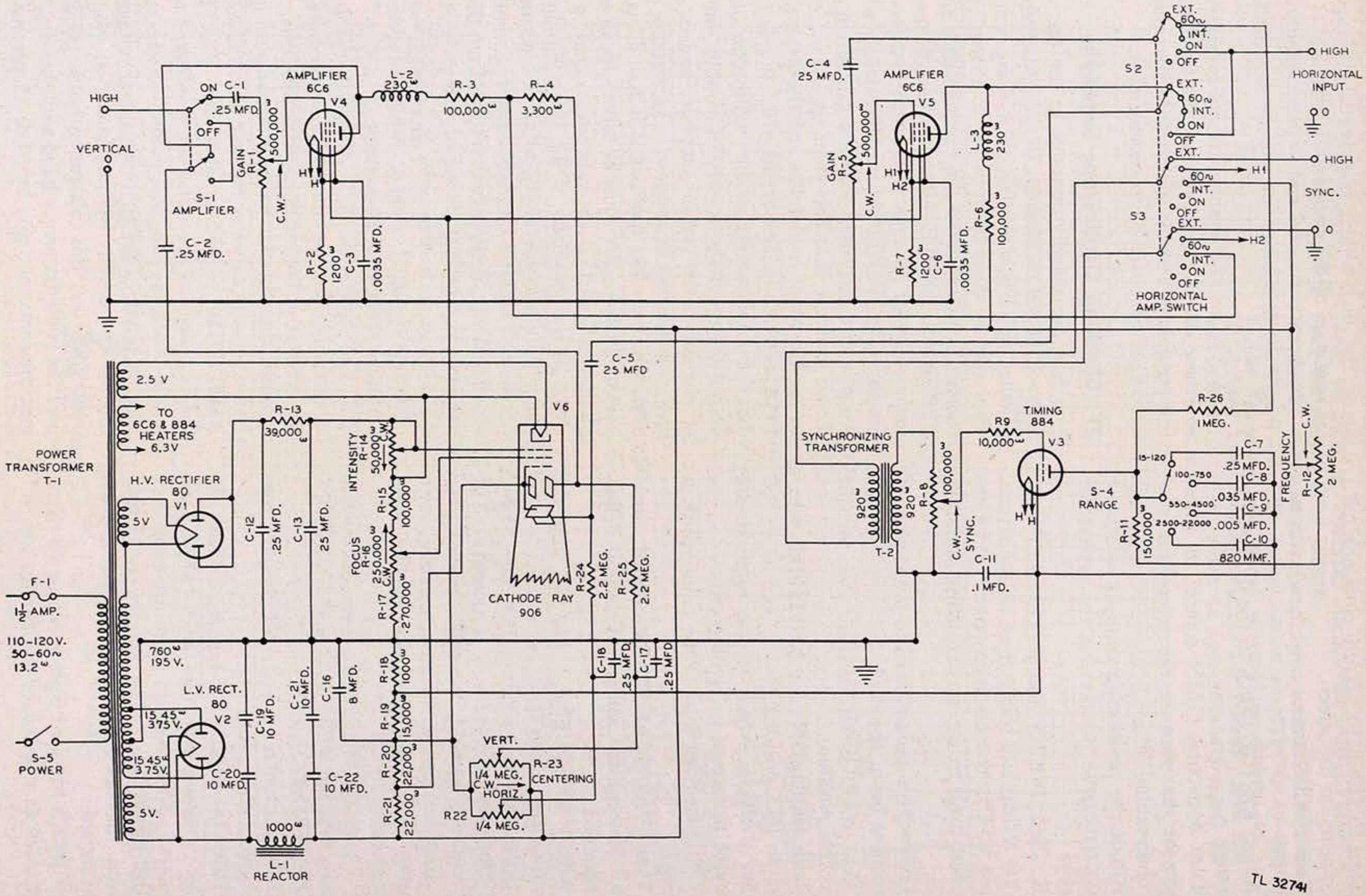


Figure 20. RCA oscilloscope, No. 155A, schematic.

minutes before making any observations.

(3) Turn INTENSITY control clockwise until a glow appears on the screen.

(4) Turn FOCUS control until the glow forms a narrow line.

(5) Adjust RANGE switch to the desired frequency range.

(6) Turn horizontal GAIN control to adjust the length of the trace on the screen for convenient observation.

(7) Adjust the positioning controls to set the trace in a favorable position on the screen for observation.

(8) Readjust FOCUS and INTENSITY controls to get a clear and bright trace on the screen.

d. How to Use the Oscilloscope. (1) Connect the test leads to the vertical-deflection input terminals.

(2) Connect the ground lead to the chassis of the component being observed.

(3) Turn VERTICAL AMPLIFIER selector switch to ON position.

(4) Turn HORIZONTAL AMPLIFIER selector switch to INT position.

(5) Set RANGE switch to the approximate frequency of the signal to be observed.

(6) Apply free test lead to the point which is to be tested.

(7) Turn VERTICAL GAIN control clockwise until the required amount of vertical deflection is obtained.

(8) Adjust FREQUENCY dial to stop the waveform on the screen.

(9) If the waveform tends to drift, turn SYNC control clockwise to hold it stationary. The SYNC control should not be turned any farther than necessary, because excessive synchronization will cause distortion of the wave being observed.

(10) Locate the image at a convenient portion of the screen by the VERTICAL and HORIZONTAL CENTERING controls.

(11) Readjust FOCUS and INTENSITY controls to give a sharp trace.

e. Schematic Analysis. Figure 20 shows the schematic diagram of the RCA 155A test oscilloscope. This diagram is to be used only when the officer in charge permits emergency repairs on the test unit. The important parts and circuits are:

(1) Power is supplied from two type 80 tubes: V2, operating as a full-wave rectifier for low voltage; and V1, as a half-wave high-voltage rectifier. The high-voltage supply furnishes power for operation of the cathode-ray tube.

(2) Both horizontal and vertical amplification circuits use 6C6 tubes for gain control (V4 and V5).

(3) V3, an 884 gaseous triode, furnishes the time base or sweep voltage for the oscilloscope. It is possible to vary the time base by changing the setting of the variable resistance R–8.

27. Checking Oscilloscope Sensitivity

a. It is occasionally desirable to test the sensitivity of the test oscilloscope in order to determine whether the vertical amplifier is working properly. This may be done by applying a known audio-frequency voltage from the test oscillator to the VERTICAL AMPLIFIER terminals of the test scope in order to obtain a 1-inch peak-to-peak image. The VERTICAL GAIN setting of the scope is then compared with the calibration chart shown in figure 21. This chart applies in general to the Du Mont model 224 and the RCA model 155A as found in Test Set RC–70. If it is found that the GAIN setting of the oscilloscope and the known input-voltage readings fall approximately on the curve, the vertical amplifier and its associated circuits may be assumed to be working properly. On the other hand, if it is found that the gain of the test scope must be turned far in excess of that indicated on the calibration chart, a deficiency of the sensitivity of the scope is indicated. Or, putting this differently, after first setting the test scope VERTICAL GAIN control at some convenient setting, if the signal voltage from the test oscillator is greatly in excess of that indicated by the calibration chart in order to produce a 1-inch peak-to-peak signal, a defect exists in the vertical amplifier or its associated circuit.

b. The same principle is utilized if it is desired to determine the magnitude of a signal voltage in the receiver or the oscilloscope components. It is assumed that the test scope is working properly. The unknown signal is fed into the VERTICAL AMPLIFIER terminals, and the VERTICAL GAIN control of the test scope is adjusted to obtain a 1-inch peak-to-peak pattern on the screen. The magnitude of the unknown signal voltage may then be read directly from the chart. It should be understood that this calibration holds good only over the audio-frequency band and also that these measurements may vary by 10 or 15 percent.

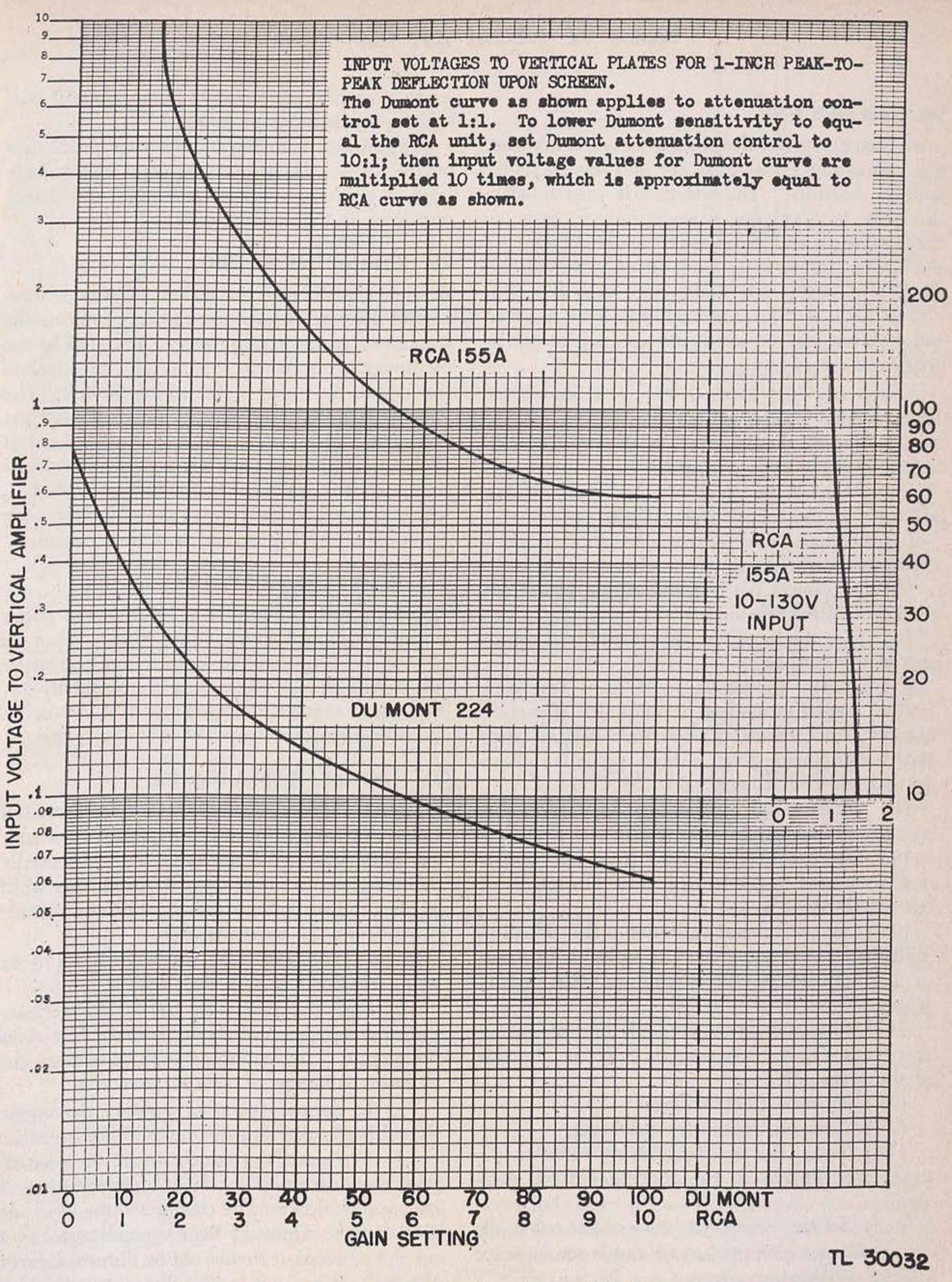


Figure 21. Voltage calibration chart of RCA and Du Mont oscilloscopes.

28. Test Unit I–99

a. DESCRIPTION. Test Unit I–99 is a heavy iron box containing a 1-µf capacitor and several high-wattage resistors. The test box is used to step down the high voltage, when making a check on the waveform and pulse width at the keyer output. This test unit is used on only the earlier models of keyers for Radio Sets SCR–270–(*) and SCR–271–(*). Later models have a keyer pulse output jack, to which the test oscilloscope is connected directly.

b. USE OF TEST UNIT I–99. (1) Shut-down keyer, rectifier, and transmitter.

(2) Remove the side panel of the keyer to gain access to the output terminal.

(3) Short out the panel interlock by connecting a jumper across the interlock switch.

(4) Discharge the output capacitor, using a capacitor-shorting tool.

(5) Disconnect the transmitter-grid lead from the keyer output terminal.

(6) Tape the loose transmitter-grid lead before proceeding further.

(7) Connect the ground lead from Test Unit I–99 to a good ground on keying unit. If a good ground is not made, the test unit and all associated equipment is at a high potential above ground and *contact may cause DEATH.*

(8) Connect the high-voltage lead from test unit to the keyer output terminal.

(9) The braided-cable lead from test unit is now connected to the vertical deflecting plates of test Oscilloscope I–134–A.

(10) Set the vertical deflection-plate control to TERMINALS if using the Du Mont oscilloscope, or to AMPLIFIER OFF if using an RCA oscilloscope.

(11) Plug the power cord of the test oscilloscope into the a-c convenience outlet on the side of the keyer unit.

(12) Turn on the test scope.

(13) Turn on transmitter and keyer.

(14) Turn the synchronization selector on keyer front panel to the INTernal SINE position.

(15) Set the sweep frequency of the test scope to a reading which produces a single square wave on the oscilloscope screen.

(16) Adjust keying voltage to 4,400 volts.

(17) Normal output of the keyer will produce a single, narrow, square-wave pattern about 1 inch high on the oscilloscope screen.

(18) When removing test equipment, first turn off the keyer. Then short the keyer high-voltage lead to ground. This is to remove any charge remaining in the output capacitor.

29. Resistor Unit RS–280

Resistor Unit RS–280 is a 500-ohm, 20-watt, wire-wound resistor, which is used when measuring the amount of synchronizing voltage delivered by the oscilloscope component. It is used to simulate the load of the keyer while making the test. The two connections on one end of Cord CD–627 are connected across the resistor, and the other end of the cord is plugged into the output jack on the oscilloscope component. Analyzer I–153–A is also connected across the resistor. Approximately 36 volts alternating current is normal output.

30. Resistor Panel BD–109

Resistor Panel BD–109 is a 200,000-ohm potentiometer equipped with binding posts. When the receiver is being tested or aligned on a test bench, Resistor Panel BD–109 is used as a sensitivity control, as the regular control is a part of the oscilloscope component.

31. Test Set I–149–A (fig. 22)

a. USE. Test Set I–149–A is a field strength meter, designed to measure the relative transmitted field strength of the radio set. Essentially, the instrument is a half-wave diode rectifier which rectifies the r-f voltage and indicates the rectified current on a d-c microammeter.

b. INSTALLATION AND OPERATION. (1) Install each dipole in its proper position.

(2) Place the instrument 400 to 500 feet away from the antenna and about 10 to 20 feet above the ground. The position should be unobstructed by trees, buildings, or metallic structures.

(3) In normal operating position the dipoles should be parallel to the dipoles of the antenna.

(4) The sensitivity switch should be set at the least sensitive position. If it reads less than 25 microamperes, it may be changed to the more sensitive range. Once the field strength meter is set up and adjusted, it should not be disturbed during the test. When not in use, the switch should be turned to OFF to avoid drain on the battery.

(5) The field strength meter may be used to

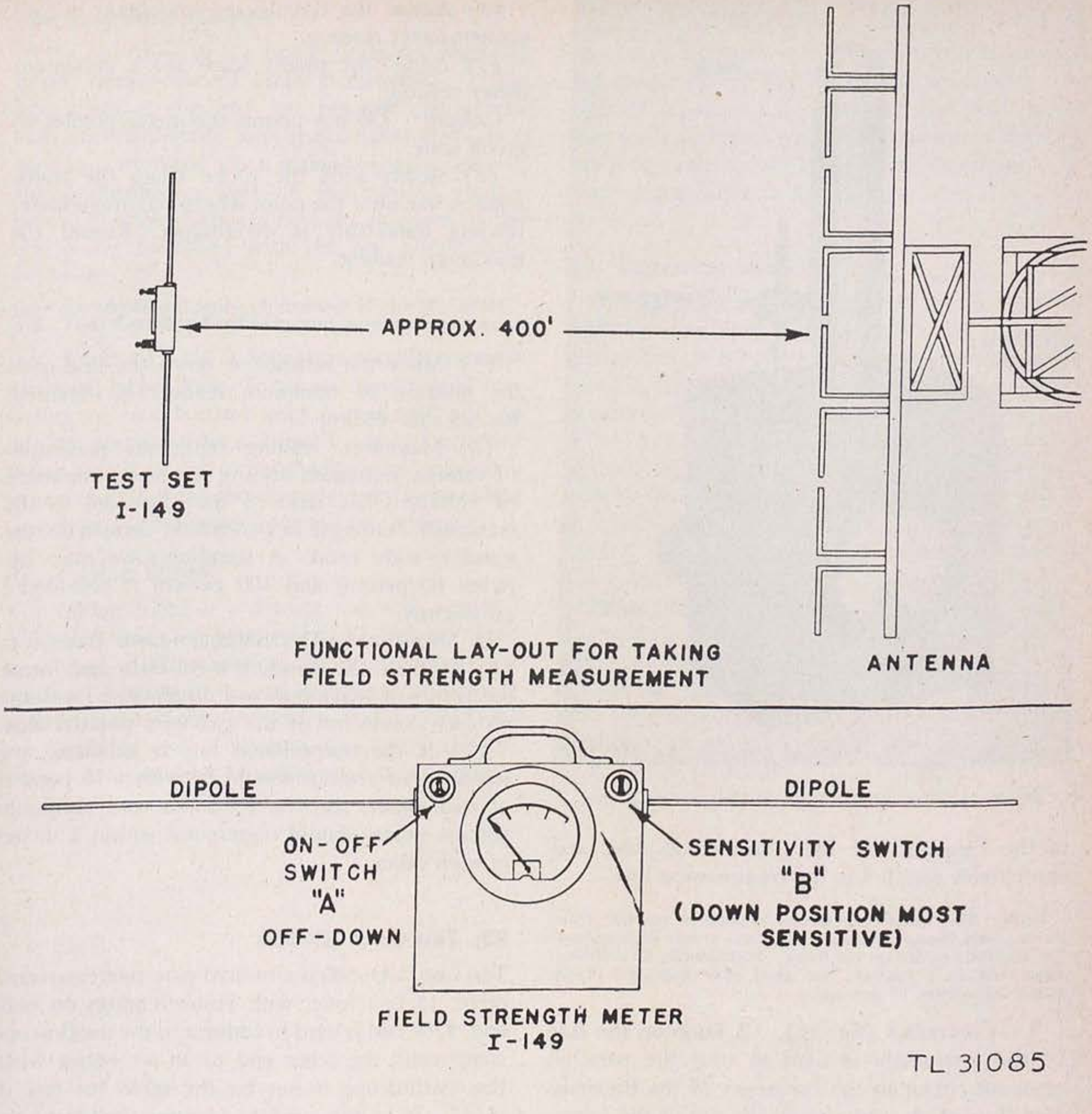


Figure 22. Functional diagram showing use of field strength meter.

make a horizontal antenna pattern. For this purpose the antenna is pointed directly at the field strength meter. Obtain a maximum reading on the meter and record it. Then rotate the antenna, recording readings on the meter at intervals of 5° in azimuth.

NOTE. The field strength meter is not intended for use in tuning or adjusting an antenna array.

32. Test Set I–148–A

a. FUNCTION. Test Set I–148–A is a standing-wave indicator. It is used to measure the standing-wave ratio of the r-f voltage along a nonresonant transmission line. It may also be used to check the balance to ground of a parallel two-wire, open, nonresonant transmission line. The instrument consists of a parallel-resonant circuit tuned

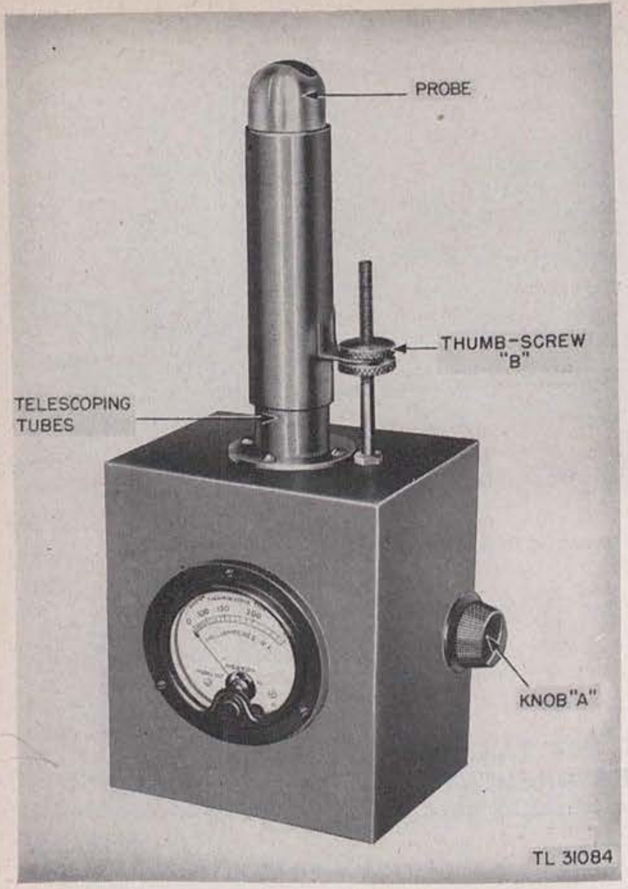


Figure 23. Test Set I–148–A, standing-wave indicator.

to the frequency of the transmission line, and capacitively coupled to the transmission line.

NOTE. This test set should not be used on resonant transmission lines, because the high r-f voltages present on a resonant line are likely to damage the meter. Furthermore, the standing-wave ratio on a resonant line gives little indication of the proper adjustment of the line.

b. CONTROLS (fig. 23). A knob on the side of the instrument is used to tune the parallel-resonant circuit to the frequency of the transmission line. A thumbscrew on the top of the instrument is used to adjust the capacity coupling to the line. Adjustment is necessary to obtain a suitable meter reading.

c. MEASURING THE STANDING-WAVE RATIO. (1) Place the insulated probe of the test set at a convenient point on the transmission line. Be certain that the instrument is held at an exact right angle to the transmission line, and that this position is maintained during all successive readings. Furthermore, the instrument should be grasped with the same degree of firmness throughout the series of measurements.

(2) Adjust the thumbscrew to obtain a convenient meter reading.

(3) Adjust the tuning knob for a maximum meter reading.

Caution: Do not permit the meter pointer to go off scale.

(4) Slowly slide the probe along the transmission line until the point where maximum meter reading obtainable is determined. Record the maximum reading.

NOTE. It may be necessary to adjust the thumbscrew again to prevent the pointer from moving off scale.

(5) Move the instrument down the line until the position of minimum reading is obtained. Record this reading.

(6) Maximum reading represents maximum r-f voltage; minimum reading represents minimum r-f voltage. The ratio of the minimum to the maximum readings, in percent, is defined as the standing-wave ratio. A standing-wave ratio between 60 percent and 100 percent is considered satisfactory.

d. MEASURING TRANSMISSION-LINE BALANCE. (1) Measure the standing-wave ratio and locate the points of maximum and minimum r-f voltage on each conductor of the two-wire parallel line.

(2) If the transmission line is balanced, the standing-wave ratios should be within 10 percent of each other, and the maximum and minimum voltage points should correspond within 2 inches of each other.

33. Test Cord CD–666

Test Cord CD–666 is a twisted-pair, rubber-covered cable, 15 feet long, with Hubbell plugs on each end. One end is used to connect to the oscilloscope component, the other end to an a-c outlet when the oscilloscope is out on the table for test or repair. It is also used to transmit power to the receiver when it is on the bench for testing or alignment.

34. Test Cord CD–627

Test Cord CD–627 is a single conductor, shielded and rubber-covered, 10 feet long with a Plug PL–55 at one end and two spade lugs at the other end. This cord is used to connect the jackets on the receiver or oscilloscope components to any of the test instruments. Two Test Cords CD–627 are furnished with Test Equipment RC–70–A.

35. Test Cord CD–719

Test Cord CD–719 is a single-conductor, shielded-braid, rubber-covered cable, 6 feet long. It has one alligator clip and one pee-wee clip at one end, and two spade lugs at the other end. It is used as a test cord when making signal-tracing or signal-substitution tests on the various components. It should always be used in place of the test probe furnished with the test Oscilloscope I–134–A.

36. Test Cable CD–710

Test Cable CD–710 is four-strand, rubber-covered cable, 10 inches long. It has an adapter plug consisting of four banana jacks at one end, and an adapter plug consisting of four banana plugs at the other end. It is used in the check of the horizontal-sweep chassis of the oscilloscope component, when this chassis is removed from the component.

37. Tuning Wand

The tuning wand is a flexible rod with one end of loaded brass, the other end of loaded-core steel. It is used in alignment of the r-f stages of the receiver. The wand is used in testing the amount of inductance in the first and second r-f coils and the oscillator coil. Optimum adjustment is indicated when insertion of either end of the tuning wand will cause a decrease of amplitude in the sine wave on the test oscilloscope screen. If the sine wave increases when the brass end is inserted, the inductance of the coil should be decreased by slightly separating the turns of the coil. If the sine wave increases when the iron end is inserted, the inductance should be increased by compressing slightly the turns of the coil.

38. Capacitor-Shorting Tool

a. The capacitor-shorting tool is not supplied with the unit and must be made by the radar repairman. It is used to short-circuit high-voltage charges remaining in capacitors after the power is turned off.

b. To make a capacitor-shorting tool, cut a wooden stick about 30 inches long. Shellac the stick to keep out moisture. Cut an 8-inch length of metal rod, not less than $\frac{1}{4}$-inch outside diameter. Dipole tubing is preferable. Drill a hole through the center of the tubing and attach it at right angles to the stick with a wood screw. Thoroughly insulate the handle of the stick by winding two layers of friction tape around it.

c. When shorting a capacitor, lay the tubing from one terminal of the capacitor to the other, touching the ground terminal first and then the high-voltage terminal.

CHAPTER 3

NORMAL SET, START-STOP PROCEDURE

Section I. PRELIMINARY ADJUSTMENTS

39. Introduction

a. This section describes in detail the step-by-step procedure required to start and stop the units referred to in this manual. Since each step is directly related to the preceding and following steps, the order of procedure should not be changed. If the set is in normal operating condition, the unit should be on the air when the final step of the start sequence has been completed.

b. Each step in this procedure consists of a specific action or a series of related actions. Each of these actions should produce certain definite results in a normal set, many of which can be seen or heard as in the case of panel lamps, meter readings, switches, relays, etc. In some cases, the result of an action cannot be checked by immediate visual or audible means. An abnormal condition present in one step will, however, often affect the results of the action in the following step and can thus be detected in short order.

c. To simplify trouble shooting, each step in the start procedure is described on the basis of the action taken and the normal visual, audible, and electrical results of the action. In each step, the particular component and parts are listed. If an abnormal condition becomes evident, the trouble shooter should note the component, part, and part number affected and then refer to chapter 4 for the probable causes and remedy of the defect. For example, if in Step 4 of the Start Procedure, the red light 6–1 on the transmitter panel does not glow when the transmitter circuit breaker is thrown to the ON position, the trouble shooter should see paragraph 79. There he will find the probable causes for the abnormal condition and the methods to be used for locating and repairing the defect. By following this system throughout the start procedure, any defects detected can be remedied before they cause serious damage to the set.

40. Procedure

The following preliminary starting adjustments are to be made before starting the radio set for the first time after installation or change of location, or if the set has been shut down for a period of time.

a. GENERAL. (1) All controls checked throughout their range of movement for any mechanical defect.

(2) Entrance switch in operating van in OFF position.

NOTE. On fixed stations, entrance switch on Power Panel BD-99 in OFF position.

b. COMPONENTS. (1) *Keyer unit.* (*a*) CIRCUIT BREAKER to OFF position.

(*b*) BLOWER toggle switch to OFF position if ambient temperature is below 50°.

(*c*) KEYING SUPPLY VOLTAGE CONTROL completely counterclockwise to zero position.

(*d*) BIAS VOLTAGE CONTROL completely clockwise to maximum position.

(*e*) PULSE WIDTH control fully counterclockwise (narrow pulse).

(*f*) SYNCHRONIZATION SELECTOR switch set to the center position (EXTernal SINE).

(2) *Receiver.* Toggle switch in OFF position.

(3) *Oscilloscope.* All four controls fully counterclockwise.

(4) *Transmitter.* (*a*) A-c power switch in OFF position.

(*b*) Filament voltage control in zero position (completely counterclockwise).

(5) *Rectifier.* (*a*) Control lock and key switch in OFF position (key removed).

(*b*) MAIN LINE circuit breaker in OFF position.

(*c*) OUTPUT VOLTAGE CONTROL completely counterclockwise.

(*d*) FILAMENT VOLTAGE CONTROL completely counterclockwise.

(6) *Antenna position control.* (*a*) RATE CONTROL rheostat at zero.

(*b*) Selector switch in the ANTENNA 1 position (on units using Control Unit BC–1012–A).

(*c*) RATE CONTROL Switch SW–197 in the HAND position.

(*d*) AUTOMATIC SWEEP Switch SW–184 in the OFF position.

(*e*) Toggle Switch SW–197 in the MANUAL AND RATE position.

(*f*) CONTROL SYSTEM Switch SW–198 in the SINGLE position.

(*g*) Rate control levers to the right-hand position.

(7) *Le Roi power plant.* (*a*) Commercial entrance switch on wall of van to OFF position.

(*b*) On Le Roi power panel: Circuit breaker in OFF position and field rheostat in the counterclockwise position. Any other position of this control does not allow Silverstat enough movement to compensate for loads.

(*c*) Check gasoline supply. Gravity tank full (20 gallons). Supply on hand should be sufficient for 24-hour operation (approximately 75 gallons).

(*d*) Sediment bowl on gasoline engine should be free of sediment and water. If necessary, clean out before starting engine.

(*e*) Oil level in crank case should not be over ½ inch below full mark.

(*f*) Fill grease cup on water pump with hard grease and screw until back pressure is felt.

(*g*) Check condition of fan belt and tension. One inch of play is maximum.

(*h*) Water level in radiator of Le Roi engine should be not lower than 2 inches below the top.

(8) *Water cooling unit.* (*a*) Water level should be not lower than 2 inches below the top.

(*b*) Check water pump packing gland for leakage.

(*c*) Valves must be open (turned counterclockwise).

c. ANTENNA SYSTEM. (1) Ground connections to all units secure.

(2) Ground stakes firmly imbedded in the ground, and ground wire connections to same secure.

(3) Antenna guy cables removed from the ground anchors.

(4) All cables properly and carefully arranged on the turntable.

(5) Antenna mount turntable level.

(6) Antenna elements correctly aligned and free from broken tubing, missing or broken insulators, loose joints, and loose connections.

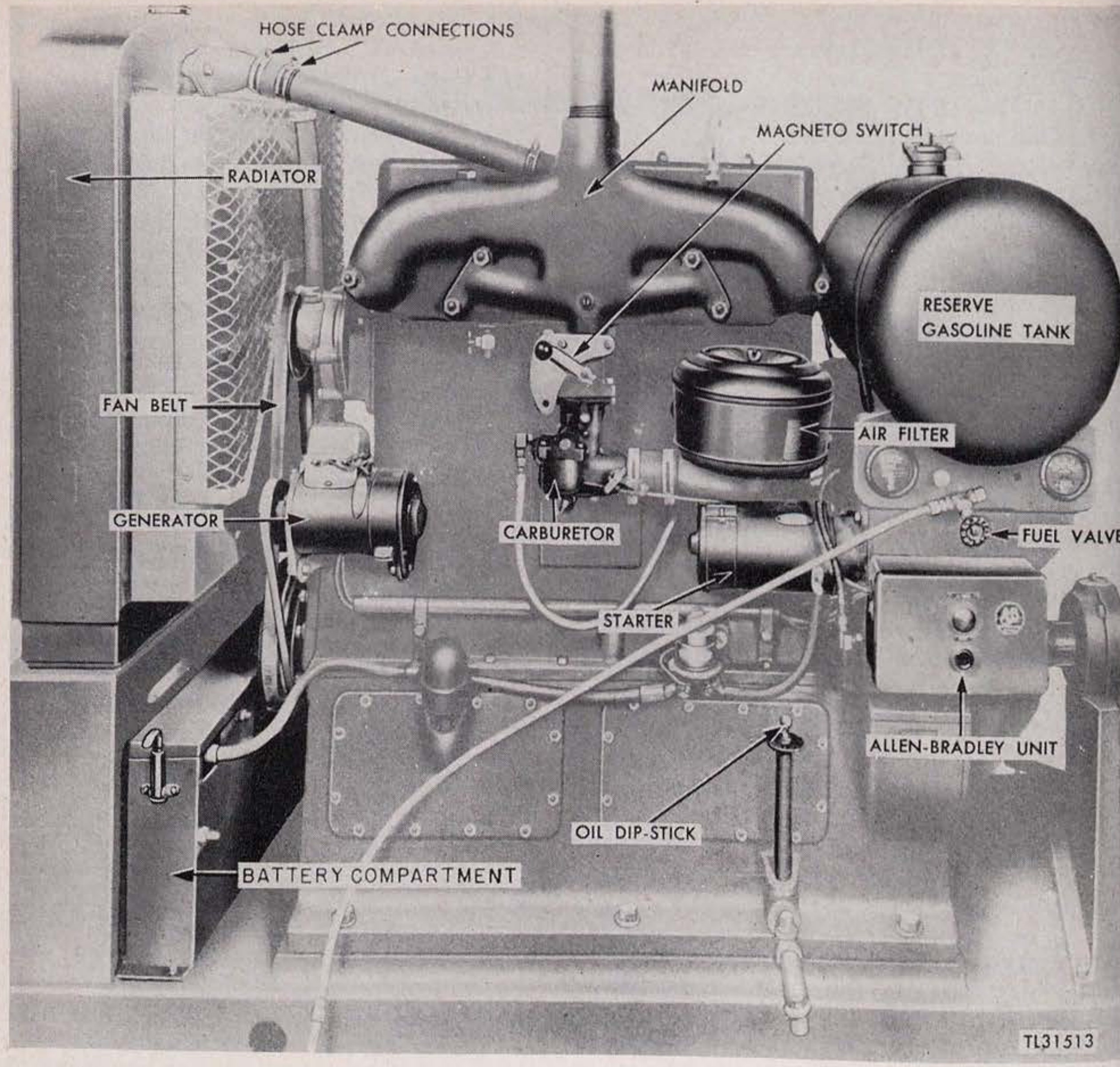


Figure 24. Le Roi gasoline engine.

STEP 1.

41. Start Power Unit, PE–74

Caution: The circuit breaker on the generator power panel must be in the OFF position before starting the engine.

a. ACTION. (1) *Open valve to gasoline tank.*

(2) *Turn ignition on.* Move the throttle lever down about 1/4 inch to the start position.

(3) *Pull out choke.* If the engine temperature is below 70°, pull out the control marked CHOKE to about 1 inch. After the engine turns over a few times, return the choke to the normal position.

(4) *Use start button.* Pull the control marked START and hold the control out. Release the control after the engine fires. If engine does not fire after continued holding of the start control for 30 seconds, release the control. Wait for 30 seconds and repeat the procedure.

(5) *Set throttle.* When the engine is running smoothly, bring throttle down to RUN position.

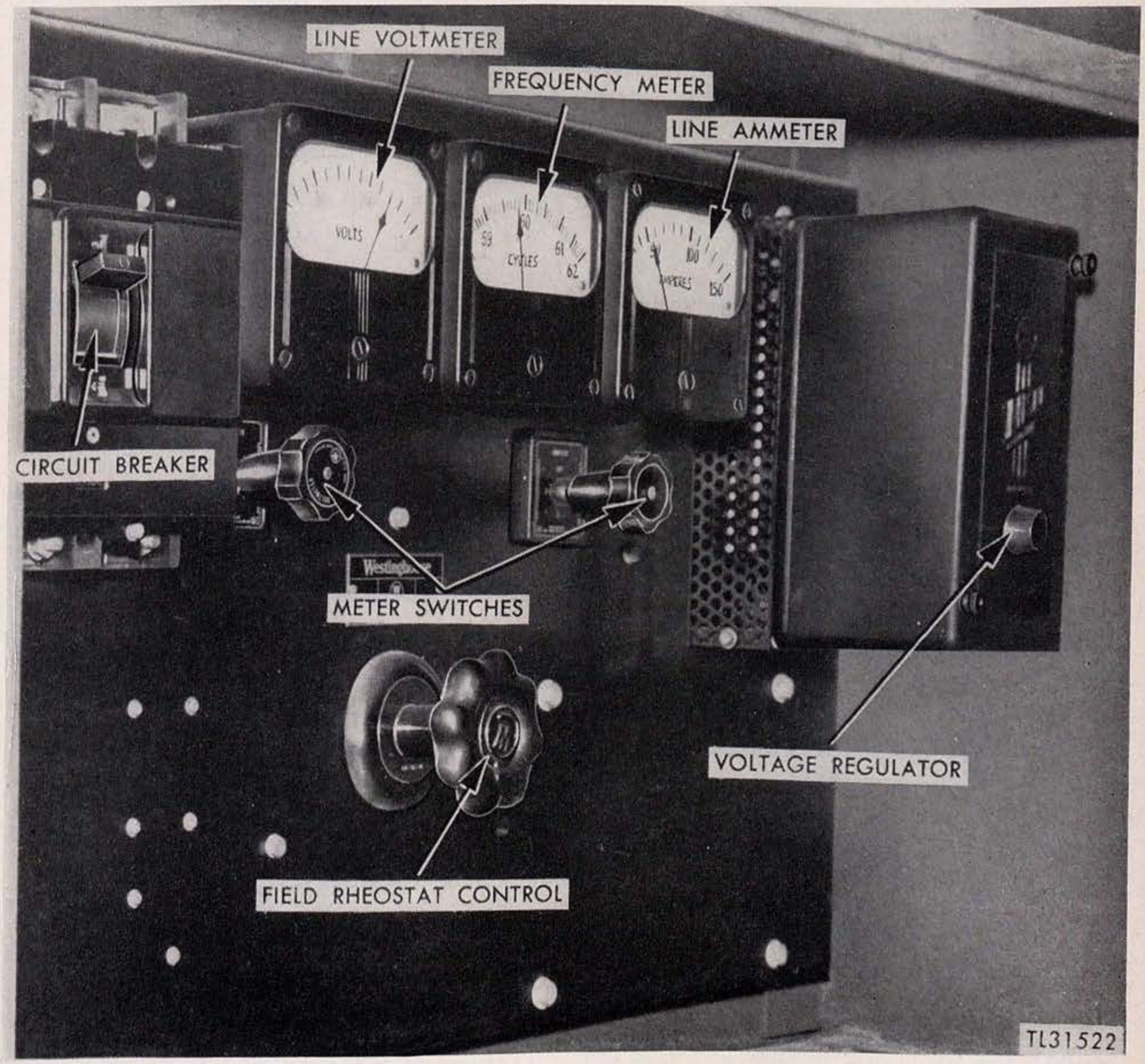


Figure 25. Power panel of Power Unit PE-74, showing controls.

b. Normal Results of Action. (1) *Visible.* (*a*) Engine fan turning.

(*b*) Generator armature turning.

(*c*) Instrument-panel meters indicating.

(2) *Audible.* Engine noise.

(3) *Electrical.* The generator is supplying power to the panel.

STEP 2.

42. Adjust Controls On Generator Power Panel (fig. 25)

Caution: The field rheostat must be in the full counterclockwise position.

a. Action. (1) *Adjust phase voltages.* Set the control marked VOLTMETER to select any one of the three phases. The voltmeter, directly above the switch, will indicate the voltage on that phase. Adjust the voltage regulator marked SILVERSTAT so that the meter reads 120 volts on phase 1. Set the phase-selector switch to the other two positions and check to see that each will give a reading of 120 volts on the voltmeter.

(2) *Circuit breaker On.* Throw the circuit breaker on the generator power panel to the ON position.

b. Normal Results of Action. (1) *Audible.* Circuit breaker is heard closing.

(2) *Electrical.* Power is supplied to:

(*a*) The entrance switch in the operating van.

(*b*) The main-line circuit breaker on the rectifier unit.

(*c*) The ceiling light switches.

Note. In fixed stations, power is supplied to the main power switch on Panel BD-99 or BD-111 (fig. 26).

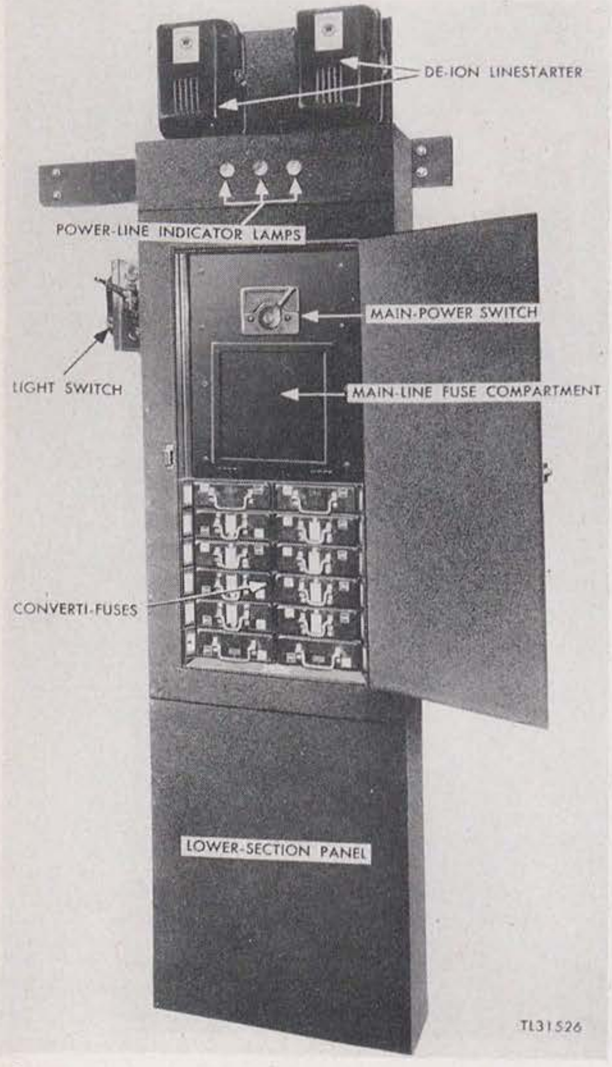


Figure 26. Power Panel BD-111.

STEP 3.

43. Throw Operating Van Entrance Switch On

a. Action. Throw the operating van entrance switch to the ON position. This switch is located on the end wall of the operating van over the plotting table.

Note. In fixed stations, close the main power switch on Panel BD-99 or BD-111.

b. Normal Results of Action. (1) *Visible.* (*a*) White lamp 43-4 on the keying unit, labeled HEATER ON, lights.

(*b*) In fixed stations, the three meters at top of Panel BD-99 will each indicate approximately 208 volts.

(2) *Audible.* Entrance switch is heard closing.

(3) *Electrical* (fig. 27). (*a*) Heating elements 32–1 and 32–2 in the keyer are energized.

(*b*) Heating elements 5–1 and 5–2 in the transmitter are energized when the individual switches at their sockets are closed.

(*c*) The heating element 15–1 in the oscilloscope is energized.

(*d*) The heating element 25–1 in the receiver is energized.

(*e*) Power is supplied to the azimuth motors switch.

(*f*) In fixed stations, power is supplied to the main circuit breaker on Rectifier RA–60–A.

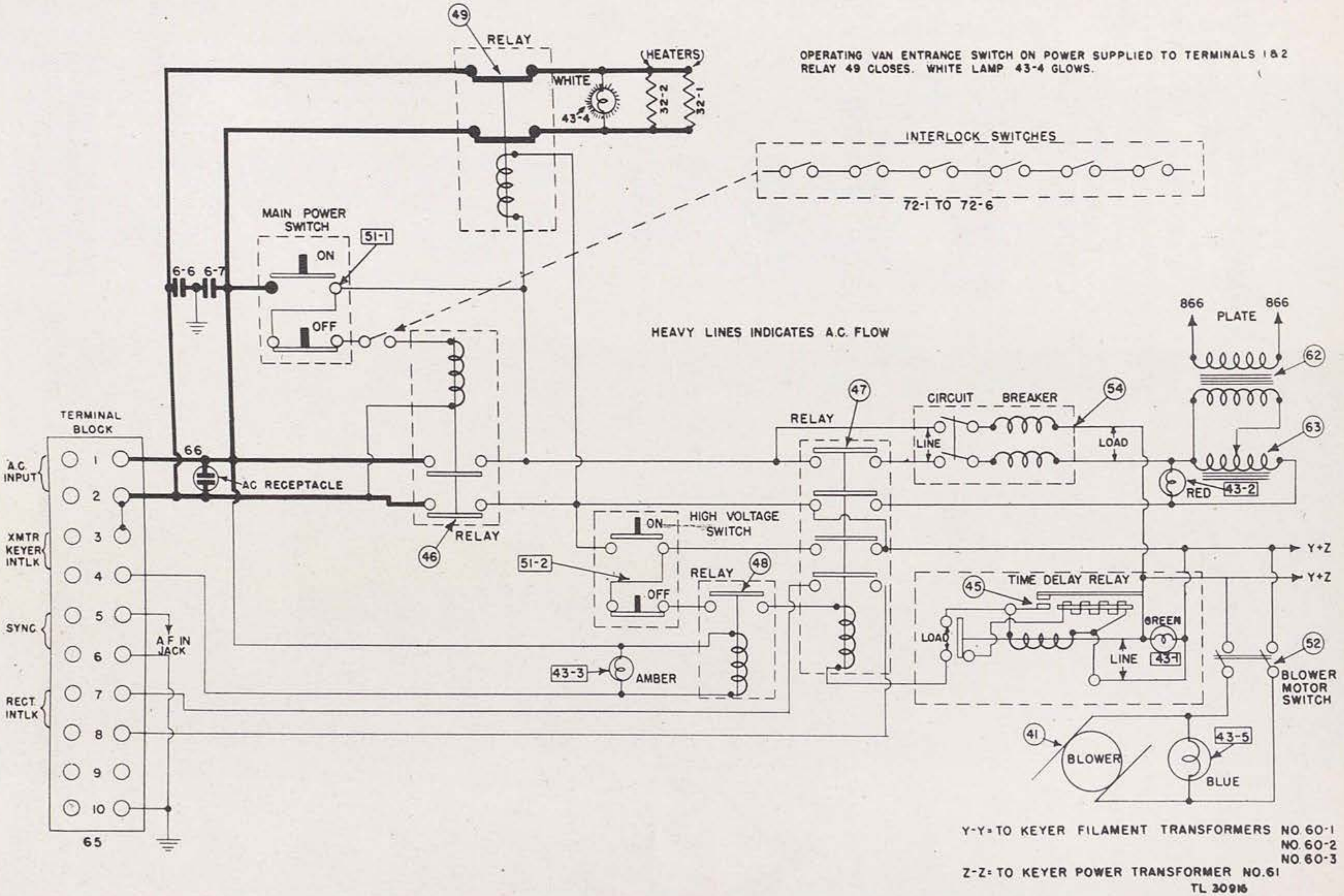


Figure 27. Keyer BC–758–A, relay circuit, entrance switch ON.

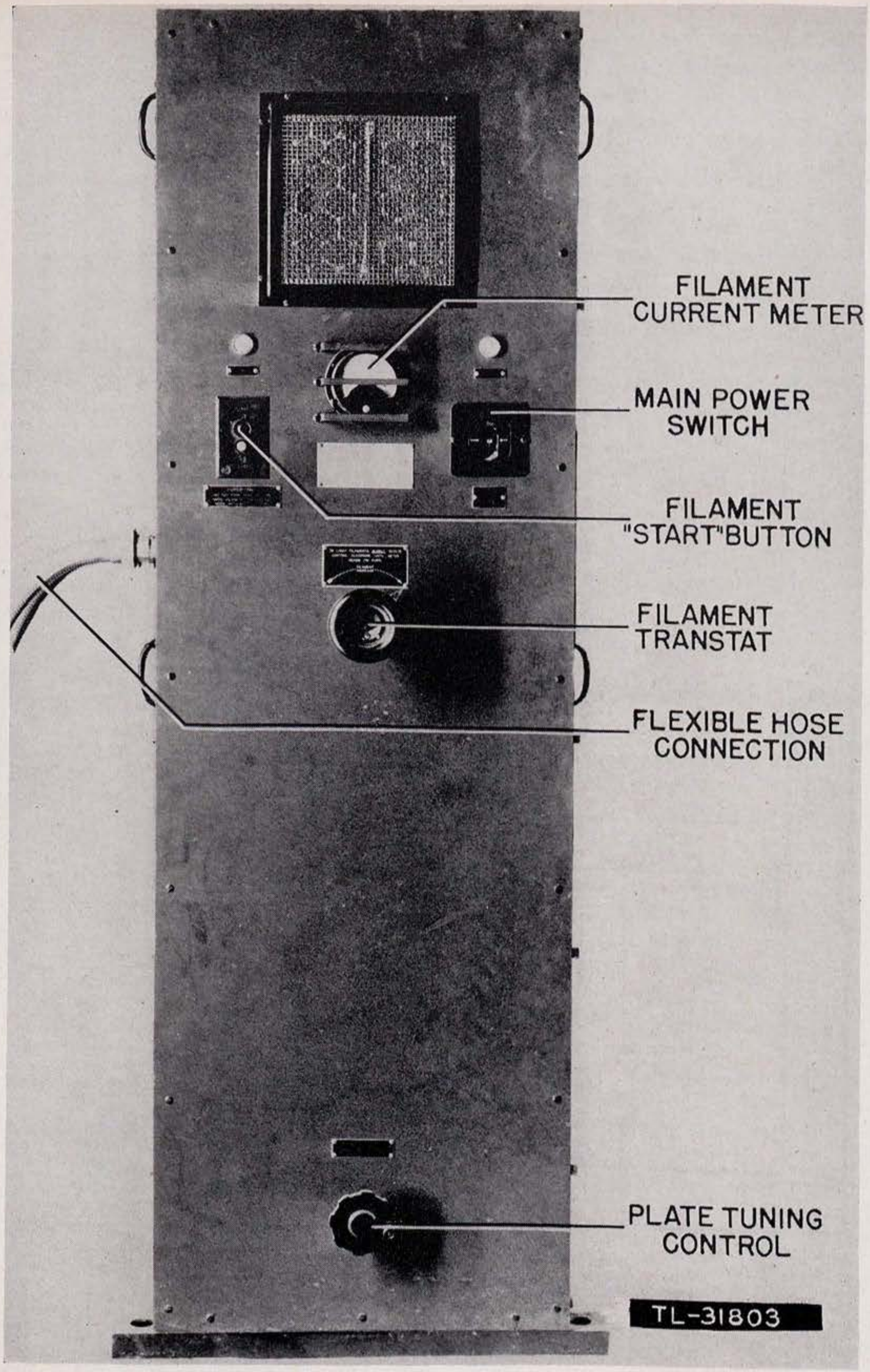


Figure 28. Transmitter BC-785-A, showing controls.

STEP 4.

44. Throw Transmitter Main Power Switch On (fig. 28)

a. Action. Throw transmitter circuit breaker 12, labeled MAIN POWER SWITCH, to the ON position.

b. Normal Results of Action. (1) *Visible.* (*a*) Red light 6–1, labeled A–C POWER, lights.

(*b*) Light 5–1 back of the water flow indicator on the water cooler lights.

(*c*) Panel light 5–2 on the water cooler lights.

(*d*) Red jewel light 1 above the high pressuretrol switch on the water cooler lights.

(*e*) Streamers on blower fans 19, 20, and 21 in the transmitter can be seen moving when observed through the viewing windows on the side of the unit.

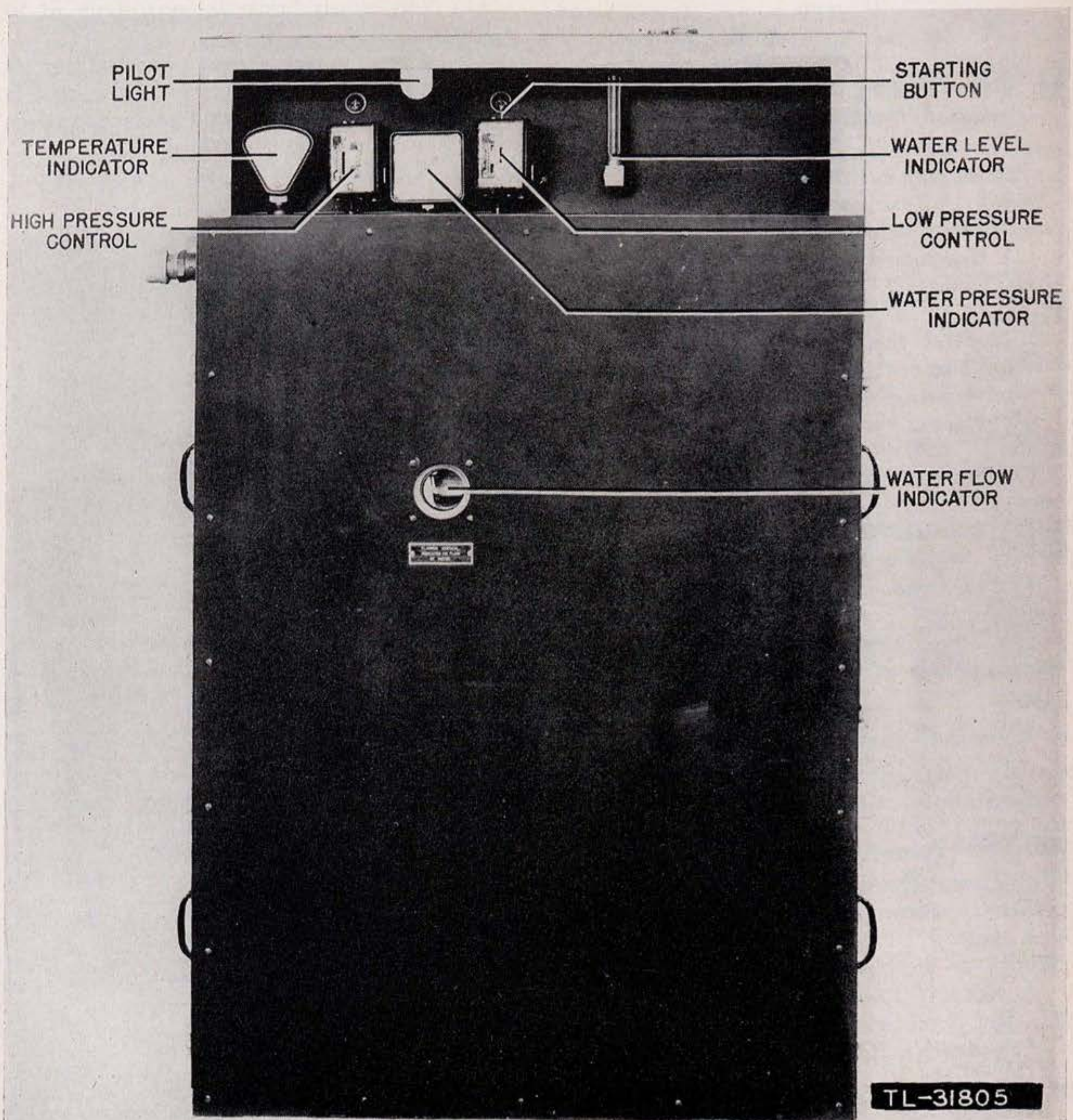


Figure 29. Water Cooler RU–4–A, showing controls.

(2) *Audible.* (*a*) Relay 7 can be heard closing.

(*b*) Blower and exhaust fans 19, 20, and 21 can be heard.

(3) *Electrical.* (*a*) The circuit to heating elements 5–1 and 5–2 in the transmitter unit is opened.

(*b*) Power is supplied to the water cooler.

(*c*) Relay 7 is energized. Heater contacts are open.

STEP 5.

45. Press Starting Button On Low Pressuretrol 6 in Water Cooler (fig. 29)

a. ACTION. Press the button on the top of the low pressuretrol switch 6.

b. METER READINGS. (1) *Pressure gauge.* Approximately 8 pounds.

(2) *Generator power panel.* Line voltage: phase 1, phase 2, and phase 3: 118 volts (± 2 volts).

c. NORMAL RESULTS OF ACTION. (1) *Visible.* (*a*) Red jewel light 2 above the lower pressuretrol switch glows.

(*b*) Flapper valve in the water flow indicator opens.

(*c*) Pressure gauge reading (see subpar. *b* above).

(2) *Audible.* Pump and fan motor 4 are heard.

(3) *Electrical.* (*a*) Transmitter relay 9 is energized.

(*b*) Power is applied to filament switch 13 on the transmitter unit through the closed contact of relay 9.

STEP 6.

46. Press Transmitter Filament Button 13 On

Caution: The filament control must be in the full counterclockwise position.

a. ACTION. Press the black button marked START on the filament switch 13.

b. NORMAL RESULTS OF ACTION. (1) *Visible.* Red jewel light 6–2 above the button glows.

(2) *Audible.* Relay 8 is heard closing.

(3) *Electrical.* (*a*) Relay 8 is energized.

(*b*) The circuit to the filament autotransformer 18 is closed through contacts of relay 8.

STEP 7.

47. Adjust Transmitter Filament Transtat 18

a. ACTION. Increase the filament current very slowly at a constant speed between stops by turning the filament current control on the front of the transmitter. The filament current will be indicated on meter 22 directly above the filament current control.

(1) Very slowly bring the current up to 50 amperes.

(2) When the meter reads a constant current of 50 amperes, gradually increase the current in 10-ampere steps with 15-second intervals between steps until 90 amperes is obtained.

(3) Wait 5 minutes.

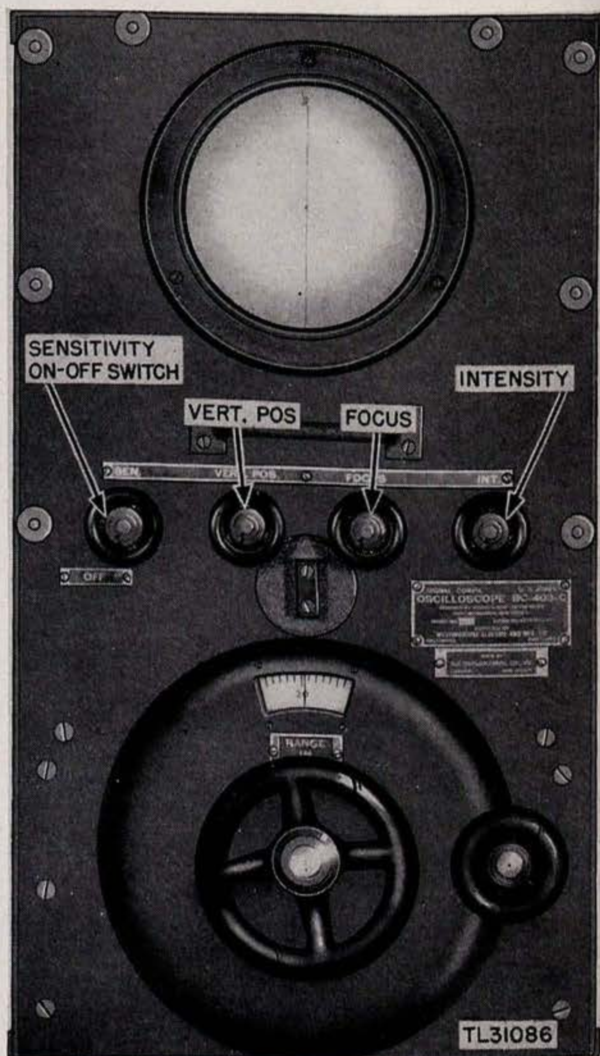


Figure 30. Oscilloscope BC–403–C, showing controls.

(4) Continue in 10-ampere steps every 15 seconds until 170 amperes is obtained.

NOTE. In locations where temperature ranges are from —10° to 40°, take from 20 to 30 minutes total time between zero and 170 amperes. In tropical locations, the total time necessary is about 10 minutes.

b. METER READINGS, GENERATOR POWER PANEL. (Transmitter filament current 22: 170 amperes.)

(1) *Line voltage.* Phase 1, phase 2, and phase 3: 118 volts (± 2 volts).

(2) *Line current.* Phase 3: 20 amperes.

c. NORMAL RESULTS OF ACTION. (1) *Visible.* (*a*) When the transmitter filament current reaches a value of 150 amperes, the amber light on the keyer unit, labeled TRANSMITTER READY, will glow.

(*b*) Meter readings, *b* above.

(2) *Audible.* When the transmitter filament current reaches a value of approximately 150 amperes, relay 10 in the transmitter is heard closing.

(3) *Electrical.* (*a*) Power is applied to the filaments of the transmitter tubes.

(*b*) Transmitter relay 10 and keyer relay 48 are energized. Relay contacts are now closed.

STEP 8.

48. Turn Oscilloscope Power Switch 60–1 On (fig. 30)

a. ACTION. Turn the control 51–1 labeled SEN. clockwise until the power switch snaps on.

NOTE. In fixed stations, adjust the variac on Power Panel BD-99 so that the voltmeter (located to the right of the variac) reads 120 volts.

b. NORMAL RESULTS OF ACTION. (1) *Visible.* Dial light 58–1 on the range indicator will glow.

(2) *Audible.* (*a*) Within about 30 seconds after the power switch 60–1 is closed, the thermal time-delay relay 54 is heard closing.

(*b*) After the time-delay relay closes, blower motor 55–1 will be heard operating.

(3) *Electrical.* (*a*) The circuit to heating element 15–1 is opened.

(*b*) Power is applied to the low-voltage transformers 46–1 and 46–2.

(*c*) Power is applied to the thermal unit of relay 54–1.

(*d*) When the time-delay relay 54–1 closes, power is applied to the high-voltage transformer 47–1 and relay coil 55–1.

(*e*) Blower motor relay 55–1 is energized. Relay contacts are now closed. Power is supplied to the blower motor.

STEP 9.

49. Adjust Oscilloscope Intensity Control 21

a. ACTION. Turn control 21, labeled INT., clockwise until a baseline appears on the oscilloscope screen.

b. NORMAL RESULTS OF ACTION. (1) *Visible.* Screen indication.

(2) *Electrical.* Bias is adjusted on the control grid of the cathode-ray tube.

STEP 10.

50. Adjust Oscilloscope Vertical Positioning Control 52–1

a. ACTION. Turn control 52–1, labeled VERT. POS., counterclockwise to set the baseline in the center of the screen.

b. NORMAL RESULTS OF ACTION. (1) *Visible.* Baseline moves in a vertical direction on the oscilloscope screen.

(2) *Electrical.* A positioning voltage is applied to the vertical deflection plates of the cathode-ray tube.

STEP 11.

51. Adjust Oscilloscope Focus Control 52–2

a. ACTION. Adjust control 52–2, labeled FOCUS, until a clear-cut baseline is obtained.

b. NORMAL RESULTS OF ACTION. (1) *Visible.* Oscilloscope trace is focused.

(2) *Electrical.* Focusing voltage is applied to the focusing electrode in the cathode-ray tube.

STEP 12.

52. Readjust Oscillator Intensity Control 21

a. ACTION. Readjust intensity control 21

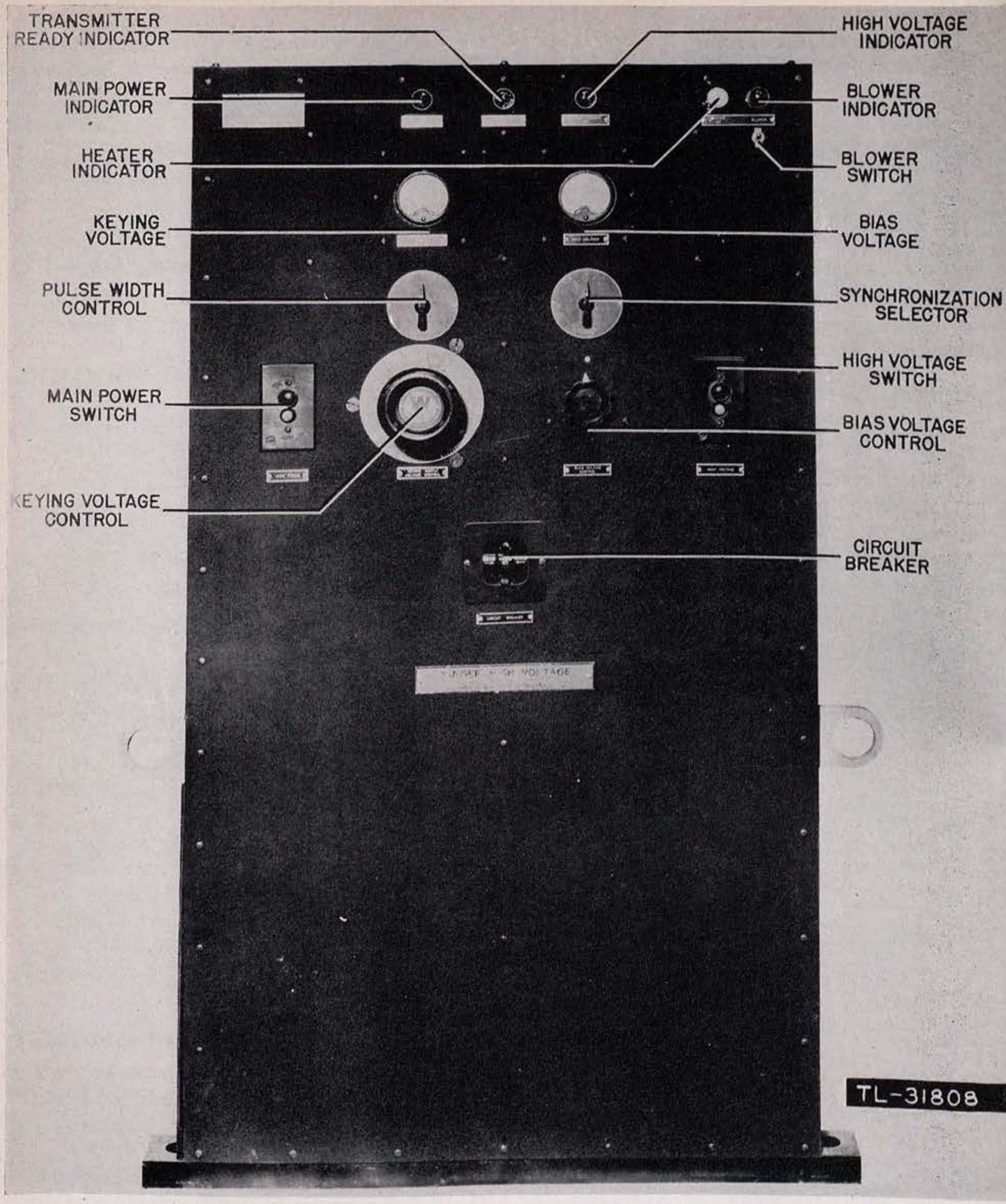


Figure 31. Keyer BC–758–A, showing controls.

(Step 10) to obtain proper brilliance for the trace.

b. METER READINGS ON GENERATOR POWER PANEL. (1) *Line voltage.* Phase 1, 2, and 3: 118 volts (± 2 volts).

(2) *Line current.* Phase 1: zero; phase 2: 5 amperes; phase 3: 20 amperes.

STEP 13.

53. Press Keyer Main Power Switch 51–1 On (fig. 31)

a. ACTION. Press the black button labeled

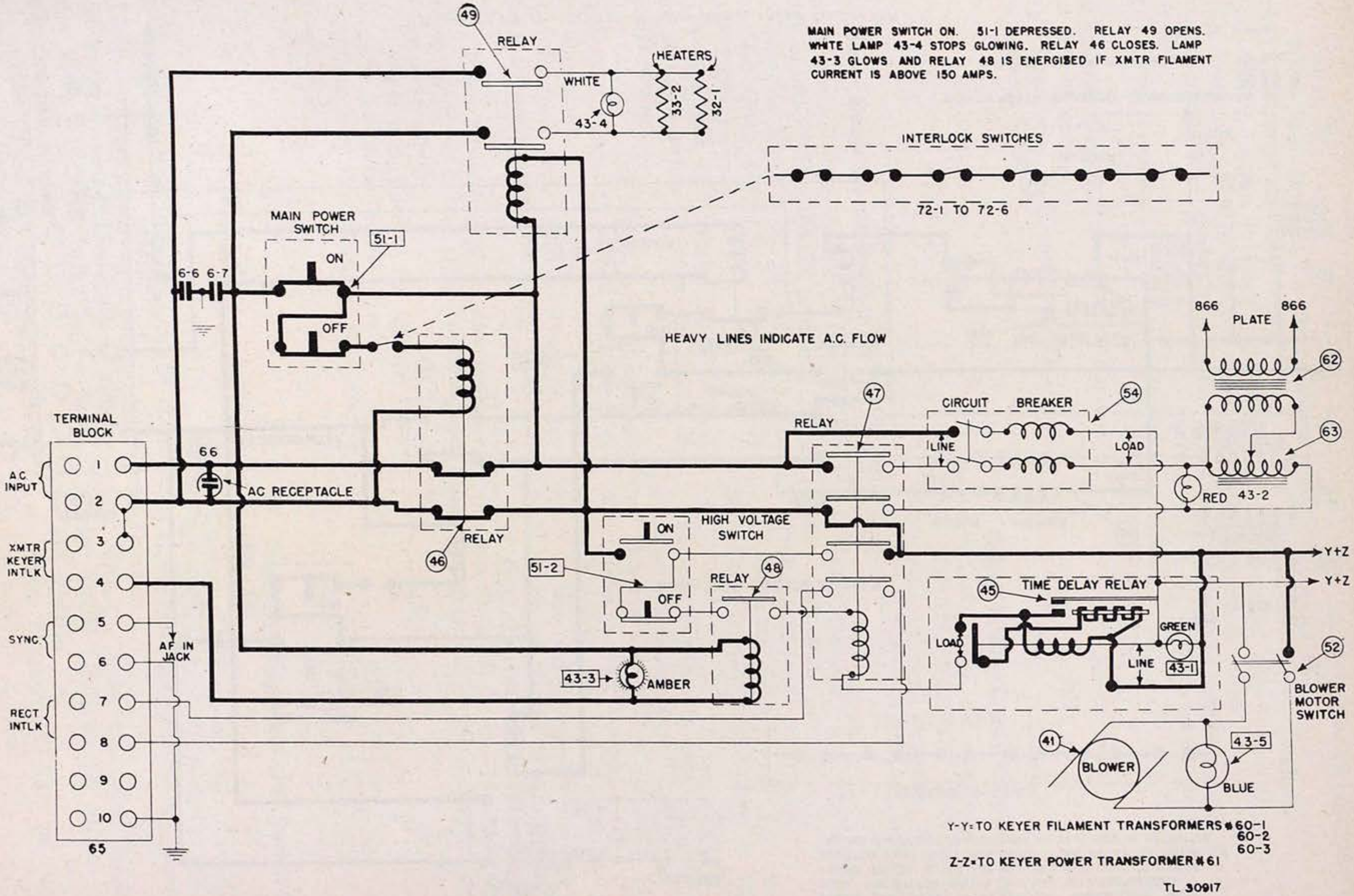


Figure 32. Keyer BC–758–A, relay circuit, main power switch ON.

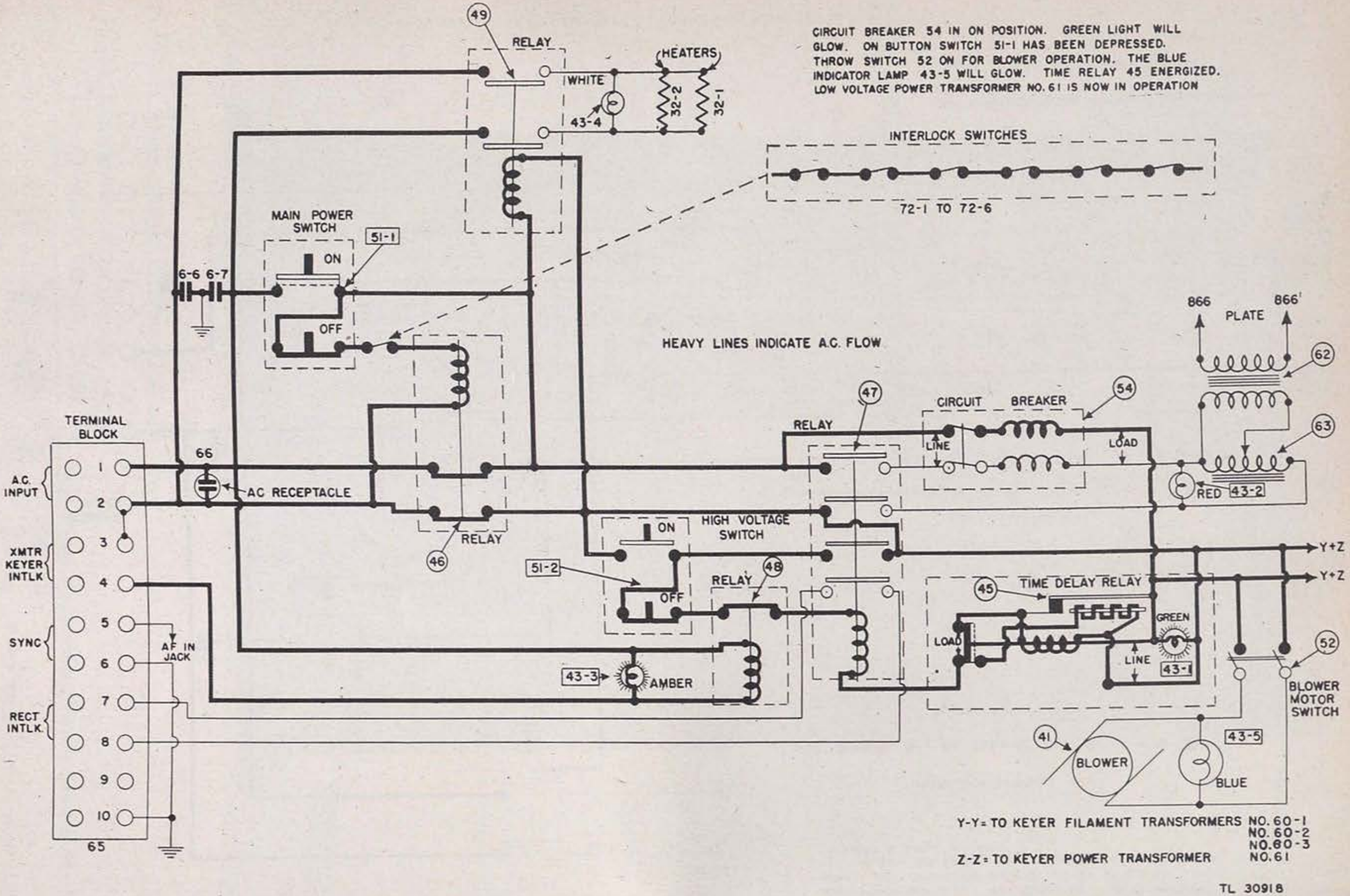


Figure 33. Keyer BC–758–A, relay circuit, circuit breaker ON.

START on the main power switch of the keyer.

b. Normal Results of Action. (1) *Visible.* White light 43–4 on the keyer, labeled HEATER ON, stops glowing.

(2) *Audible.* Relays 46 and 49 are heard.

(3) *Electrical* (fig. 32). (*a*) The circuit to heating elements 32–1 and 32–2 is opened by relay 49.

(*b*) Power is supplied up to the circuit breaker 54.

(*c*) Keyer relay 49 is energized. Relay contacts are now open.

(*d*) Keyer relay 46 is energized. Relay contacts are now closed.

STEP 14.

54. Throw Keyer Circuit Breaker 54 On

a. Action. Throw the switch labeled CIRCUIT BREAKER 54 to the ON position.

b. Normal Results of Action. (1) *Visible.* (*a*) Green light 43–1, labeled MAIN POWER ON, glows.

(*b*) Blue light 43–5, labeled BLOWER, will glow if toggle switch 52 below the light is in the ON position.

(2) *Audible.* (*a*) Blower motor 41 is heard.

(*b*) Within about 30 seconds, the time-delay relay 45 is heard.

(3) *Electrical* (fig. 33.) (*a*) Power is supplied to the low-voltage power supply transformer 61.

(*b*) Power is supplied to the filament transformers 60–1, 60–2, and 60–3 for the high-voltage power supply.

(*c*) Power is supplied to the filament transformers 58 and 59 for the 405TH tubes.

(*d*) Time relay 45 is energized. Relay contact is now closed.

STEP 15.

55. Press Keyer High Voltage Switch 51–2 On

Caution: Keyer keying-supply voltage control must be in extreme counterclockwise position. Keyer BIAS VOLTAGE control must be in extreme clockwise position.

a. Action. Press the black button labeled START on the HIGH VOLTAGE switch 51–2.

b. Normal Results of Action. (1) *Visible.* Red light 43–2, labeled KEYING VOLTAGE ON, will glow.

(2) *Audible.* Relay 47 is heard.

(3) *Electrical* (fig. 34). (*a*) Power is supplied to autotransformer 63.

(*b*) The rectifier interlock is closed.

(*c*) Relay 47 is energized. Relay contacts are now closed.

STEP 16.

56. Adjust Keying Supply Voltage Control 63

a. Action. Turn the control labeled KEYING SUPPLY VOLTAGE CONTROL (63) slowly clockwise until voltmeter 44–2, labeled KEYING SUPPLY VOLTAGE, indicates 5,000 volts.

b. Meter Readings. (1) *Keying supply voltmeter.* 5,000 volts.

(2) *Bias voltmeter.* 5,000 volts.

(3) *Generator power panel.* (*a*) *Line Voltage.* Phase 1, phase 2, and phase 3: 118 volts (± 2 volts).

(*b*) *Line Current.* Phase 2 and phase 3: approximately 20 amperes.

c. Normal Results of Action. (1) *Visible.* Meter readings, *b* above.

(2) *Electrical.* (*a*) Autotransformer 63, adjusted by this control, supplies the high-voltage power supply transformer 62 with power.

(*b*) From the rectifier filter, the rectified high voltage is applied to the 450TH tubes, voltmeters, and output circuit to the transmitter oscillator grids.

STEP 17.

57. Throw Rectifier Main Line Switch 38 On (fig. 35)

Caution: Check to see that the OUTPUT VOLTAGE (27) and FILAMENT VOLTAGE (8) CONTROLS are set to the full counterclockwise position.

a. Action. Throw the circuit breaker 38, labeled MAIN LINE, on the rectifier unit, to the ON position.

b. Meter Reading. Rectifier line voltmeter 33: 118 volts (± 2 volts).

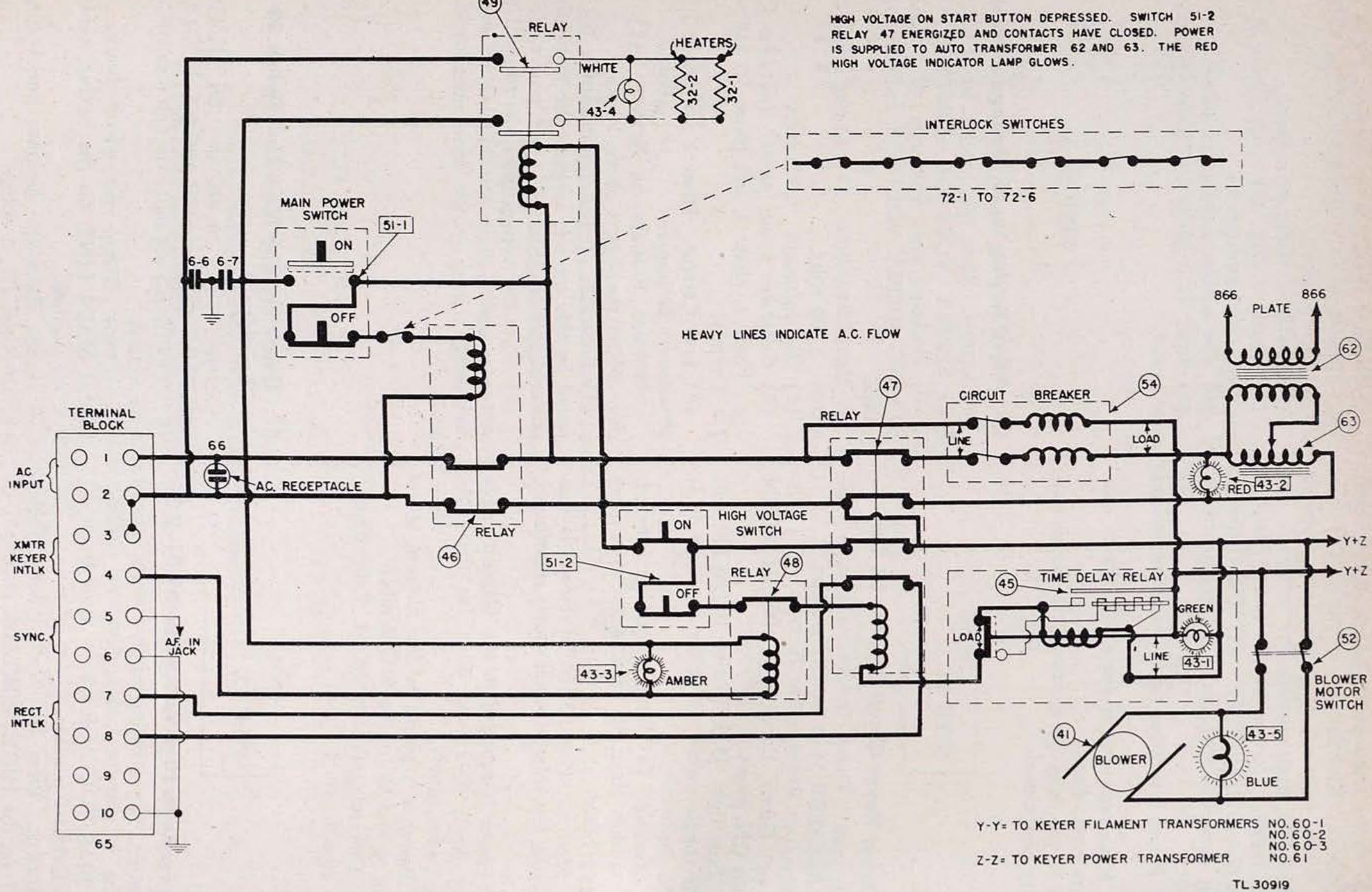


Figure 34. Keyer BC-758-A, relay circuit, high voltage switch ON.

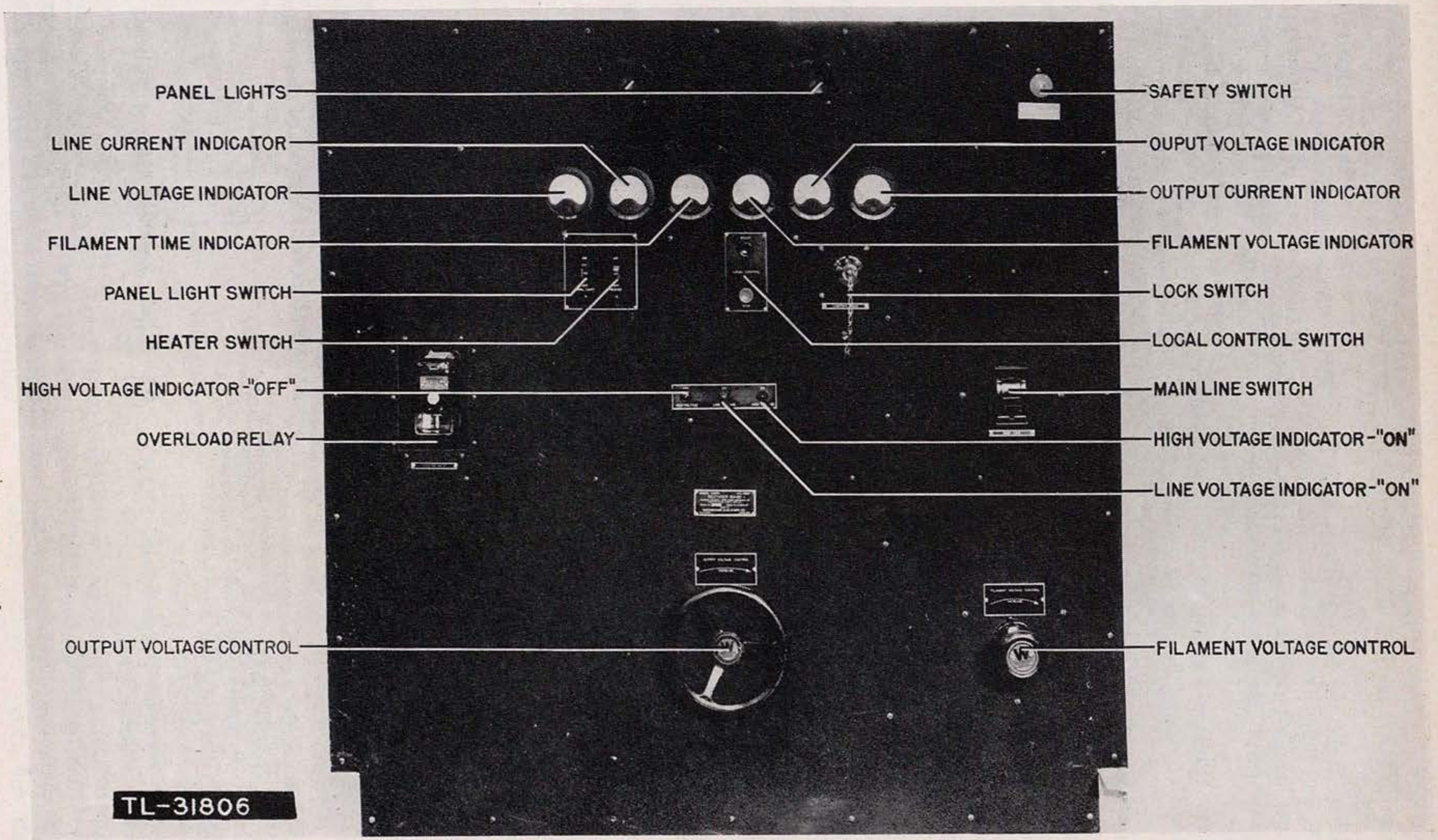


Figure 35. Rectifier RA-60-A, showing controls.

c. NORMAL RESULTS OF ACTION. (1) *Visible*. (*a*) Green light 17, labeled LINE VOLTAGE ON, will light.

(*b*) Amber light 16, labeled HIGH VOLTAGE OFF, will light.

(*c*) Panel lamps 13–1, 13–2, and 13–3 will light when the panel lamp switches 19–1 and 19–2 are closed.

(*d*) Meter readings, *b* above.

(2) *Audible*. Circuit breaker 38 is heard closing.

(3) *Electrical*. The heating elements 17–1, 17–2, 17–3, and 17–4 will operate when switch 19–3, labeled HEATER, is closed. This switch should be in the OFF position when set is in operation.

STEP 18.

58. Turn Rectifier Control Lock 18 On

a. ACTION. Insert the key in the lock labeled CONTROL LOCK (18), and turn clockwise.

b. NORMAL RESULTS OF ACTION, ELECTRICAL. (1) An interlock circuit within the rectifier is completed.

(2) Power is supplied to control switch 22.

STEP 19.

59. Press Rectifier Control Switch 22 On

Caution: The controls labeled OUTPUT VOLTAGE CONTROL (27) and FILAMENT VOLTAGE CONTROL (8) must be in the full counterclockwise position.

NOTE. Depending on the setting of the switch 24, labeled CONTROL SELECTOR, in the back of the rectifier, the start button can be pressed at either of two positions. If the selector is set for LOCAL, the button can be pressed on the rectifier panel. If the selector is set for REMOTE, the button must be pressed at the operator's position.

a. ACTION. Press the button labeled START on the rectifier control switch 22.

b. NORMAL RESULTS OF ACTION. (1) *Visible*. (*a*) When operating on REMOTE, the red light above the start-stop switch on the remote control box will glow.

(*b*) Amber light 16, labeled HIGH VOLTAGE OFF, on the rectifier will stop glowing.

(*c*) Red light 15, labeled HIGH VOLTAGE ON, on the rectifier will glow.

(*d*) Hour meter 32, labeled FILAMENT HOURS, will begin operating.

(2) *Audible*. (*a*) Relay 36 will be heard.

(*b*) Blower motor 39 can be heard.

(3) *Electrical*. (*a*) The ground across the high-voltage output is removed through open contacts at the main contactor 36.

(*b*) Power is supplied to filament voltage control 3.

(*c*) Power is supplied to autotransformer 27 which controls the applied voltage to transformer 25.

STEP 20.

60. Adjust Rectifier Filament Voltage Control 8

a. ACTION. Turn control 8, labeled FILAMENT VOLTAGE CONTROL, slowly clockwise until pointer on filament voltage meter 32 is at the red mark.

b. METER READINGS. (1) *Rectifier*. (*a*) *Filament Voltage*. Pointer at red line.

(*b*) *Rectifier Line Voltage*. 118 volts (± 2 volts).

(*c*) *Rectifier Line Current*. 12 amperes.

(2) *Generator power panel*. (*a*) *Line Voltage*. Phase 1, phase 2, and phase 3: 118 volts (± 2 volts).

(*b*) *Line Current*. Phase 1: 12 amperes; phase 2 and phase 3: 20 amperes.

c. NORMAL RESULTS OF ACTION. (1) *Visible*. Meter readings, *b* above.

(2) *Electrical*. As control 8 is turned clockwise, more voltage is applied to the primary of filament transformer 26. The secondary output is applied to the filaments of the rectifier tubes.

STEP 21.

61. Adjust Rectifier Output Voltage Control 27

a. ACTION. (1) Turn the OUTPUT VOLTAGE CONTROL (27) *slowly* clockwise until a voltage of 10,000 volts is indicated on the output voltage meter.

Caution: Wait 5 minutes.

(2) Raise the output voltage slowly to 15,000 volts.

Caution: Wait 2 minutes before starting the next step.

b. METER READINGS. (1) *D-c output voltmeter.* 15,000 volts.

(2) *Rectifier line current.* 18 amperes.

(3) *Line voltage.* Phase 1, phase 2, and phase 3: 118 volts (± 2 volts).

(4) *Line current.* Phase 1: 18 amperes; phase 2 and phase 3: 20 amperes.

c. NORMAL RESULTS OF ACTION. (1) *Visible.* Meter readings, *b* above.

(2) *Electrical.* As the control is turned, the output voltage from autotransformer 27 is applied to high-voltage transformer 25. The secondary output is applied to the plates of the rectifier tubes.

STEP 22.

62. Adjust Keyer Bias Control 39

Caution: Check toggle switch 27–1 on the receiver. It must be in the OFF position before any adjustments are made with the bias control.

a. ACTION. Turn control 39, labeled BIAS VOLTAGE CONTROL, on the keyer slowly counterclockwise. Watch meter 23, labeled PLATE MILLIAMMETER, at the back of the transmitter. Turn the bias control until the proper operating current is indicated on the meter (165–200 milliamperes).

b. METER READINGS. (1) *Transmitter plate milliammeter.* 165–200 milliamperes.

(2) *Keyer supply voltage.* 5,000 volts.

(3) *Keyer bias meter.* Approximately 3,800 volts.

(4) *Rectifier output current meter.* 165–200 milliamperes.

(5) *Rectifier high voltage.* 15,000 volts.

(6) *Rectifier line current.* Approximately 50 amperes.

(7) *Rectifier line voltage.* 117 volts (± 2 volts).

(8) *Rectifier filament voltage.* Pointer at red line.

(9) *Rectifier hour meter.* Timing.

(10) *Generator power panel.*

(*a*) *Line Voltage.* Phases 1, 2, and 3: 118 volts (± 2 volts).

(*b*) *Line Current.* Phase 1: approximately 50 amperes; phases 2 and 3: 20 amperes.

c. NORMAL RESULTS OF ACTION. (1) *Visible.* (*a*) Meter readings, *b* above.

(*b*) Spark gap on transmission line operating.

(2) *Audible.* A steady 621–cycle note is heard from the transmitter and keyer.

(3) *Electrical.* When this control is adjusted, the bias on the transmitter tube grids is reduced to allow oscillation to take place. The spark gaps should be arcing.

STEP 23.

63. Throw Receiver Toggle Switch 27–1 On

Caution: Never turn on the receiver if the spark gap is not operating. If at any time the spark gap stops operating, turn the receiver off immediately. Once the spark gap is operating, the receiver can be returned to normal operation.

a. ACTION. Throw toggle switch 27–1, labeled POWER ON, to the ON position.

b. NORMAL RESULTS OF ACTION. (1) *Visible.* Signal indication on oscilloscope screen.

(2) *Audible.* Receiver switch 27–1 is heard closing.

(3) *Electrical.* (*a*) The circuit to heating element 25–1 is opened.

(*b.*) Power is supplied to the receiver unit.

STEP 24.

64. Start Antenna Position Control MC–298–A or MC–298–B

a. ACTION.

NOTE. Examine the center control unit to determine whether it is Control Unit BC–1012–A or BC–1012–B. If it is Control Unit BC–1012–A, only the right-hand control can be operated.

Place toggle Switch SW–194 (labeled TOWER NO. 1) to the ON position (fig. 36).

b. NORMAL RESULTS OF ACTION. (1) *Visible.* (*a*) Dial lamps will light if toggle switch labeled DIAL LIGHT is in the ON position.

(*b*) Azimuth dials will rotate slightly.

(2) *Audible.* Induction motor of Motor Generator MG–21 is heard starting.

(3) *Electrical.* (*a*) Switch SW–192–A is actuated.

(*b*) Power is applied to the right-hand control unit, motor generator, synchroties, gyromotor, and remaining switches.

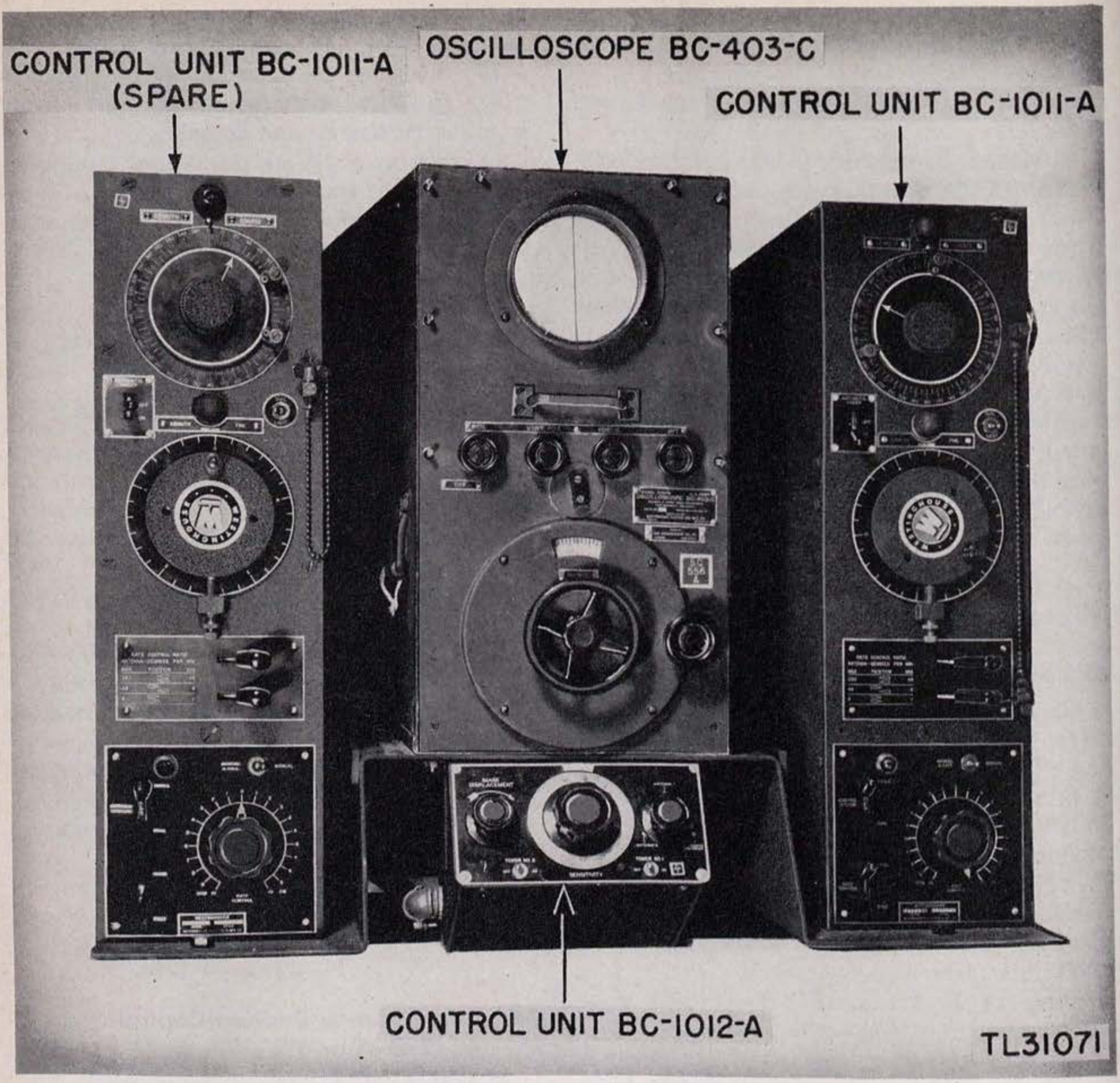


Figure 36. Operating position, showing controls.

c. ACTION. Turn rate control rheostat to the desired position. If foot-controlled operation is desired, RATE CONTROL Switch SW–197 should be placed in the FOOT position. (See fig. 37.)

d. NORMAL RESULTS OF ACTION. (1) *Visible.* Azimuth dials and antenna will rotate.

(2) *Audible.* Rate control motor and gears of speed control will be operating.

(3) *Electrical.* (*a*) Voltage is applied to armature of rate control motor.

(*b*) Synchro-generator begins rotation and electrically transmits its angular variation to the synchro-differential generator in the gyrostat.

(*c*) The Silverstat leaves are closed, shunting out resistance in one leg of the Wheatstone bridge and unbalancing the bridge. Current then flows through the field of the d-c generator in a direction determined by the side of the bridge on which the unbalance occurs. The number of Silverstat leaves which are closed determine the unbalance of the circuit and thereby the armature voltage of the d-c generator and the speed of the drive motor.

(*d*) The drive motor produces rotation of the turntable which is transmitted to the azimuth dial by Synchro-Generator GN–49 (GN–48 on fixed installations) and the synchro-motor. The drive motor also rotates Synchro-Generator GN–47.

(*e*) Rotation of the turntable and drive motor is transmitted electrically to the synchro-differential generator. As a result, the shaft position of the synchro-differential generator corresponds to the difference in electrical angle between the synchro-generator in Control Unit BC–1011–A and Synchro-Generator GN–47 on the trailer or on the tower.

e. ACTION. (1) If automatic sector sweep is desired, place the AUTOMATIC SWEEP Switch SW–184 in the ON position.

Caution: Power should be off while following adjustments are made.

(2) Set the arrow on the azimuth dial on the midpoint of the chosen azimuth sector.

(3) Set the operating arms of the sector-sweeping device at the extreme end of the sector to be searched.

f. NORMAL RESULT OF ACTION. Power is available for operation of ratchet solenoid reversing switch.

g. ACTION. If manual control of the antenna is desired, throw toggle Switch SW–194 to MANUAL position.

h. NORMAL RESULTS OF ACTION. (1) *Visible.* Red indicator lamp alongside toggle switch will go off.

(2) *Electrical.* Power is removed from the rate control motor and associated circuits. Rotation of antenna is controlled only by manual operation of the hand position control on the vernier dial.

i. METER READINGS, GENERATOR POWER PANEL. (1) *Line voltage.* Phases 1, 2, and 3: 118 volts (± 2 volts).

NOTE. The line voltage of phase 1 will be slightly lower than that of phase 2 and phase 3 because of the unbalanced current load caused by the rectifier. This condition is normal.

(2) *Line current.* Phase 1 should be approximately 55 amperes; phase 2 and phase 3 should be approximately 25 amperes each.

STEP 25.

65. Adjustments Required in Later Models of Antenna Control System

a. If Control Unit BC–1012–B is used, follow the steps listed below to operate either the right-hand or the left-hand Control Unit BC–1011–A:

(1) Place the selector switch on Control Unit BC–1012–B in the RIGHT position.

(2) Place Switch SW–198 on Control Unit BC–1011–A in the SINGLE position.

(3) To transfer to the left-hand control unit, throw the selector switch on Control Unit BC–1012–B to the LEFT position.

(4) Place the SINGLE-DUAL Switch SW–198 on both Control Units BC–1011–A in the DUAL position.

b. Later model sets may be supplied with Control Unit BC–1011–B which differs from Control Unit BC–1011–A in the following respects (figs. 37 and 38):

(1) A CONTROL SYSTEM switch is provided for switching the spare control unit in or out of operation. This switch eliminates the transfer relay, Dunco type 58 XDX (mounted in Junction Box JB–61 at rear of operating equipment), previously supplied with kits using Control Unit BC–1011–A.

(2) The rate control ratio clutch (speed control) has been eliminated.

(3) The AZIMUTH COARSE dial and sector limit pins have been located behind a window for added protection.

(4) Illumination has been improved. Unnecsary lights previously located on the front panel have been eliminated. The azimuth dial is indirectly illuminated and a light-dimmer control is provided.

NOTE. The operation, indexing, lubrication, and replacement of Control Unit BC–1011–B is the same as that of Control Unit BC–1011–A. The right toggle switch on Control Unit BC–1012–B (located underneath the operating table) is still used as the main on-off switch for the complete antenna position control system. However, the left toggle switch is no longer needed to switch from the control unit in use to the spare control unit. This switching operation is performed as follows (assume that the control unit at the right of the operating equipment is in use):

(*a*) At the start of the switching operation, the CONTROL SYSTEM switch on the unit in use is in the OPERATE position, and on the unit at the left is in the TRANSFER position.

(*b*) Throw the CONTROL SYSTEM switch on the unit at the right to STOP position.

(*c*) Throw the CONTROL SYSTEM switch on the unit at the left to OPERATE position.

(*d*) Throw the CONTROL SYSTEM switch on the unit at the right to TRANSFER position.

(*e*) The unit at the left is now connected for use and the unit at the right is inoperative.

Caution: Never place the CONTROL SYSTEM switch on both units in the OPERATE position at the same time.

c. Antenna Control MC-391-A has been incor-

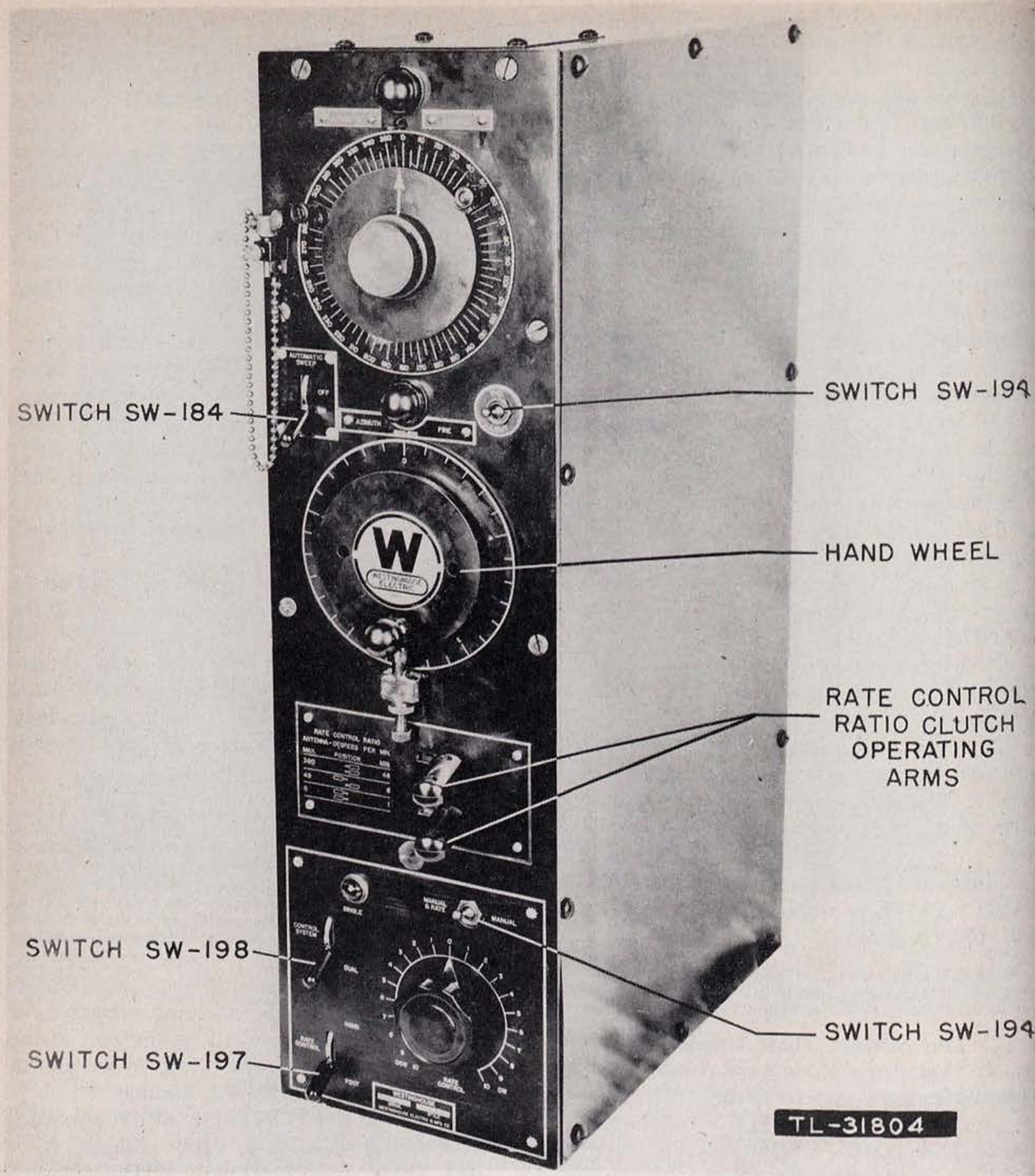


Figure 37. Control Unit BC–1011–A.

porated on later models of Radio Set SCR-270-(*) in order to provide a constant rotation speed of 5 revolutions per minute for use with a plan position indicator (PPI) oscilloscope. To rotate the antenna at this speed, the following procedure is used:

(1) Place the PPI-DIR Switch SW-213 (on the left leg of the operating table) in the PPI position.

(2) Check to see that the interlock switch on the magnetic clutch used with Antenna Position Control MC-298-A is closed. The interlock switch on the magnetic clutch used with Control MC-391-A must be in its operating position.

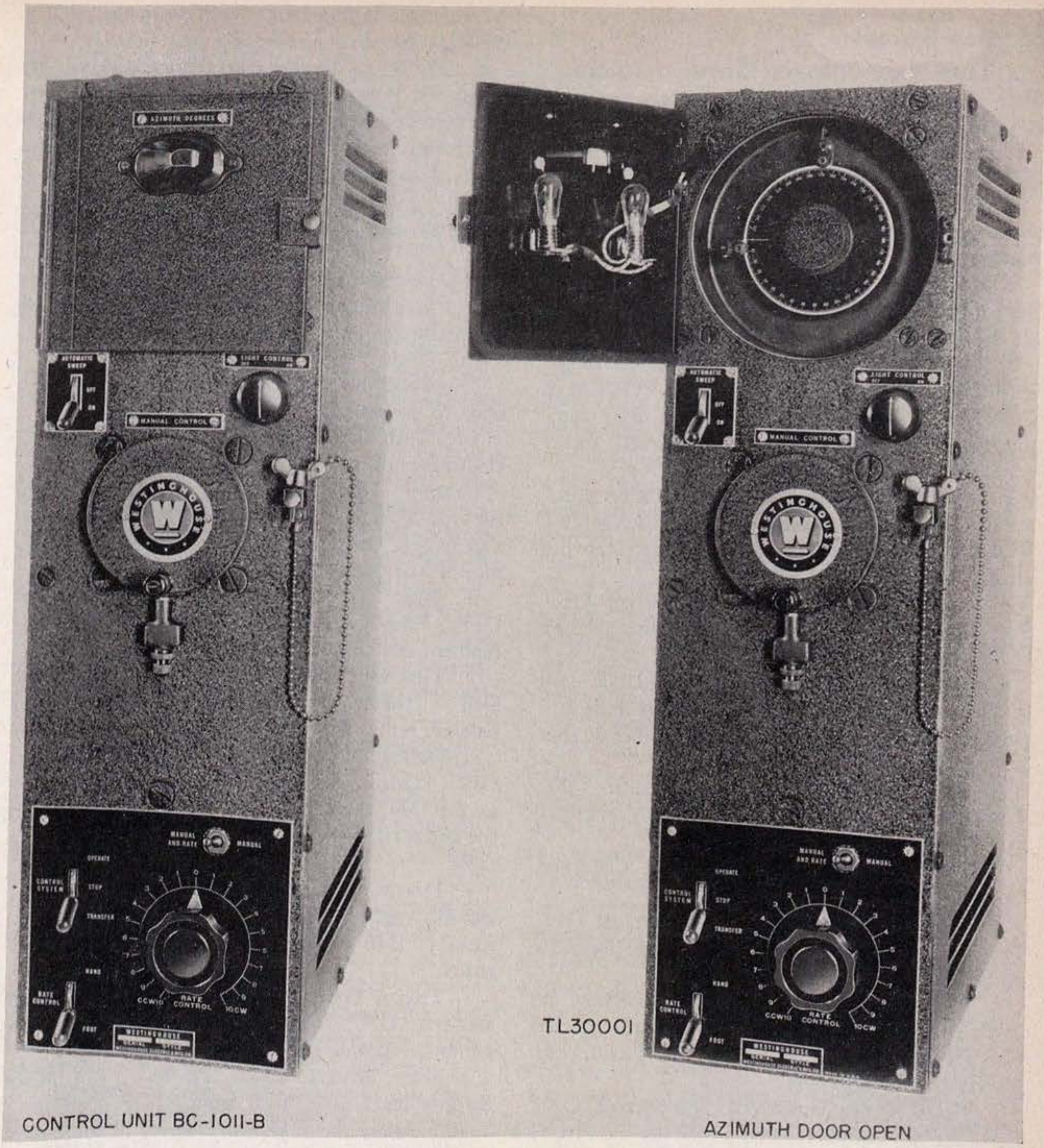


Figure 38. Control Unit BC–1011–B.

(3) If conventional operation with a maximum antenna rotation speed of 1 rpm is desired, place the PPI-DIR switch SW-213 in the DIR position. The following operations should take place in the order named:

(*a*) Time-delay relay SW-205 closes after a 10-second interval.

(*b*) When time-delay relay SW-205 closes, power is supplied to relay SW-211 which operates the magnetic clutch M-342 through switch breaker SW-212.

(*c*) In order to bring the clutch into alignment, it will be necessary to operate the hand position control on the proper control unit in the operating truck until the clutch engages.

66. Stop Procedure

a. TURN RATE CONTROL RHEOSTAT TO ZERO. Turn rate control rheostat on antenna position control system to zero. Throw toggle switch labeled TOWER NO. 1 on Control Unit BC-1012-A to the OFF position.

b. THROW RECEIVER CONTROL OFF. Throw the toggle switch labeled POWER to the OFF position.

c. SET KEYER BIAS CONTROL ON FULL. Turn the control labeled BIAS VOLTAGE CONTROL on the keying unit slowly clockwise to the stop.

d. SET RECTIFIER OUTPUT VOLTAGE TO ZERO. Turn the control labeled OUTPUT VOLTAGE CONTROL slowly counterclockwise until completely off and the OUTPUT VOLTAGE meter reads zero volts.

e. SET RECTIFIER FILAMENT VOLTAGE TO MINIMUM. Turn the control labeled FILAMENT VOLTAGE CONTROL slowly counterclockwise until completely off.

f. PRESS RECTIFIER CONTROL SWITCH OFF. Press the button labeled STOP on the rectifier CONTROL switch.

Caution: If the remote control switch is used to shut down the rectifier, the operator must still perform steps *d* and *e* before the rectifier is shut down.

g. TURN RECTIFIER CONTROL LOCK OFF. Turn the key in the lock labeled CONTROL LOCK counterclockwise.

h. TURN OSCILLOSCOPE INTENSITY CONTROL COMPLETELY COUNTERCLOCKWISE.

i. TURN OSCILLOSCOPE POWER SWITCH OFF. Turn the control labeled SEN. counterclockwise until the power switch snaps "off".

j. TURN KEYER SUPPLY VOLTAGE CONTROL TO MINIMUM POSITION. Turn the control labeled KEYING SUPPLY VOLTAGE CONTROL completely counterclockwise.

k. PRESS KEYER HIGH VOLTAGE SWITCH OFF. Press the red button labeled STOP on the HIGH VOLTAGE switch.

l. THROW KEYER CIRCUIT BREAKER OFF. Throw the switch labeled CIRCUIT BREAKER to the OFF position.

m. PRESS KEYER MAIN POWER SWITCH OFF. Press the red button labeled STOP on the MAIN POWER switch of the keying unit.

n. SET TRANSMITTER FILAMENT CONTROL TO MINIMUM POSITION. Decrease the filament current very slowly at a constant speed between steps by turning the filament current control on the front of the transmitter.

NOTE. In locations where temperature ranges are below 32° F, take 20 minutes total time between 170 to 0 amperes. In tropical locations, the total time necessary is about 10 minutes.

(1) Decrease the current in 10-ampere steps with 15-second intervals between steps until the current meter indicates 90 amperes.

(2) Wait 5 minutes.

(3) Continue in 10-ampere steps every 15 seconds to 50 amperes.

(4) Turn the control slowly to full counterclockwise position.

Caution: The transmitter must be shut down slowly. This permits the transmitter tubes to cool slowly. If the filament voltage is suddenly removed, the tubes may be seriously damaged.

o. PRESS TRANSMITTER FILAMENT SWITCH OFF. Press the red button marked STOP on the filament switch.

p. THROW TRANSMITTER CIRCUIT BREAKER OFF. Throw the transmitter circuit breaker labeled A. C. POWER to the OFF position.

q. THROW OPERATING VAN ENTRANCE SWITCH OFF. Throw the operating van entrance switch to the OFF position. This switch is located on the end wall of the operating van over the plotting table.

r. THROW RECTIFIER MAIN LINE CIRCUIT BREAKER OFF. Throw the circuit breaker labeled MAIN LINE on the rectifier unit to the OFF position.

s. THROW GENERATOR POWER PANEL CIRCUIT BREAKER OFF. Throw the circuit breaker on the generator power panel to the OFF position.

t. STOP POWER UNIT, PE-74. (1) Move throttle lever to 1/4 inch from STOP position.

(2) Allow the engine to idle for about 1 minute.

(3) Set throttle on magneto microswitch (STOP position).

(4) Close valve to fuel tank.

CHAPTER 4

ABNORMAL SET, START PROCEDURE

Section I. SYSTEM TROUBLE ANALYSIS

67. General Information

a. In this chapter, a logical method is presented for analyzing the abnormal operation of an individual component. Although it is impossible to discuss all the faults which may interfere with the proper functioning of the set, the several types of faults which may be expected to occur most frequently can be classified, and an orderly and efficient procedure can be set up for the location of each type. In order to do this, the complete unit may logically be divided into three main systems, namely, the power supply system, the transmitting system, and the receiving system. These systems cannot be considered entirely independently, since some of the components are common to two or all systems.

b. The power supply system consists essentially of the power plant, Power Unit PE–74 or a commercial power source, and Rectifier RA–60–A.

c. The transmitting system consists essentially of the transmitter, the water-cooling unit, the keying unit, and the antenna system.

d. The receiving system includes the antenna system, the receiver, and the oscilloscope.

e. Some units of the power supply, as well as the oscilloscope and the antenna, might be classed properly as parts of both the transmitting and the receiving system since they are common to the two systems. It will be seen later that this fact can sometimes be used to advantage in the isolation of certain types of troubles.

f. Before actually starting to search for trouble, note carefully the exact symptoms of the malfunctioning and the circumstances attending its occurrence. Anything you may have seen or heard occur at the time the trouble appeared may be of considerable importance in deciding upon the most likely cause of the trouble. The action of the set during the interval immediately preceding the trouble should also be considered in the analysis of the probable nature and location of a fault. Weigh all the known factors carefully and then proceed to look for the trouble. In many cases, a trouble which appears in one component may be caused by a fault in some other component. For example, a trouble in the transmitter may cause the rectifier overload relay to trip. In such cases, much time may be wasted in searching for a fault where none exists unless the preliminary trouble analysis is carefully made.

g. When the location and clearance of a trouble require the use of a spare equipment unit, such as a receiver or an oscilloscope, the trouble in the faulty unit should be cleared as promptly as possible so that the spare equipment will always be available for immediate use.

h. The troubles which can appear in the radio set may be divided into three main classifications: complete failure, unsatisfactory performance, and minor troubles which do not, in themselves, seriously impair the operation of the set. Obviously, troubles of the first two classes must be cleared as promptly as possible, while those of the third class may be cleared when a favorable opportunity presents itself. However, the clearance of minor troubles should not be unduly postponed, since they may lead to more serious troubles if neglected.

Section II. POWER SUPPLY SYSTEM

68. General Information

a. The more common troubles to be expected in the power supply system are of such nature that they will be easily identified. Suppose, for instance, that the engine-generator set will not start. If the starter does not spin the engine at all, the battery is probably dead or the relay faulty. If the starter spins the engine but not rapidly enough, the battery is probably discharged. If the starter does spin the engine properly, check to see that the exhaust pipe cover is off, that there is fuel in the tank, and that the fuel supply valve and ignition switch are set to the correct positions. The choke may have been used too much or too little. After waiting 2 or 3 minutes, try the starter again. If the engine still fails to start, check to see if there is water or dirt in the fuel supply, and see that there is a good hot spark at the spark plug terminals while the engine is being cranked by the starter. Check the air filter, the choke, and governor throttle. If these parts are all in proper working order, the engine should start. If it does not, more serious mechanical trouble, such as a broken fuel pump, is indicated.

b. If the engine generator stops, sputters, or runs unevenly, it is likely that the fuel supply is shut off, exhausted, or dirty. If none of these is responsible for the trouble, the air filter may be clogged, the choke may be stuck, or the carburetor may be out of adjustment. Faulty spark plugs, ignition wiring, or distributor points may also cause trouble of this type, but will more likely cause one cylinder or more to miss regularly.

c. If the engine generator runs too fast or too slow or if its speed is unsteady, the trouble may be detected by the reading on the frequency meter on the power panel. This trouble is probably caused by faulty action of the governor.

d. Overheating of the engine will be indicated by too high a reading of the thermometer and may result from a number of causes. First check to see that the fan is running and that the oil pressure is normal. Then be sure that the oil and water levels are normal. If none of these is at fault, the ignition system may need attention or the cylinder head and valves may need cleaning.

e. Failure of the battery-charging generator will be indicated by a discharge or low-charge reading of the ammeter and may be due to a broken or loose fan belt, faulty generator brushes or cut-out, or actual trouble in the generator or charging circuit.

f. Obvious troubles, such as compression leaks or broken parts, are self-explanatory and should be repaired in a manner suited to the particular trouble experienced.

g. If the generated voltage is too high or too low but the frequency is about normal, the trouble is probably in the exciter or field current supply circuit of the alternator. The most likely cause of low voltage is a defective brush in the exciter or the alternator. The most likely cause of high voltage is a short or partial short in the exciter field rheostat circuit.

h. If the alternator generates very little or no voltage with the engine running, it is likely that the exciter circuit is in trouble. Faulty brushes or an open circuit in the wiring may be the cause.

i. If the main circuit breaker on the power panel trips off, it is an indication of a short circuit in the permanent wiring of the power van, or in the cables or junction boxes through which power is supplied to the other units of the set, or in some unprotected unit itself.

j. In some cases it may be found that the rectifier cannot be turned on even though the transmitter, water cooler, and keying unit appear to be operating normally. In such cases, first turn on the main-line circuit breaker in the rectifier and note the lamp indications on the rectifier panel. If the green indicator light is not glowing, it is an indication that the a-c power supply is open at or ahead of the main-line circuit breaker. If the green light is glowing and the panel lamps cannot be turned on, look for a blown fuse in the interlock supply circuit.

If the panel lights glow, the rectifier interlock circuit is probably open. (See fig. 39.) The trouble may be in the transmitter, the keying unit, the remote control station, or the rectifier itself. First check the reset button on the overload relay. Then press the start button at the rectifier remote control station and note whether the associated pilot lamp glows. If it does glow and then goes out when the start button is released, the local-remote switch is probably in the LOCAL position. Try to turn on the rectifier with the local start button. If the unit is still inoperative, trouble is indicated in the main contactor or the associated interlock circuit in the rectifier. If the start button indicator lamp at the remote control station does not glow, check the continuity of the interlock circuit through the transmitter, the keyer, and the rectifier.

k. If the green and amber indicator lights are both lighted and the rectifier high voltage cannot be turned on, it is probable that the protective fuses have blown. If the blower is not operating, fuse 11-2 should be checked. If the red indicator light is not glowing, check fuse 12, and if the filament voltmeter is not energized, check fuse 11-1. If the correct indicator lamps, except the neon lamp, are lighted and the filament voltmeter is energized, the trouble is probably due to faulty tubes. When the trouble is found, be sure that

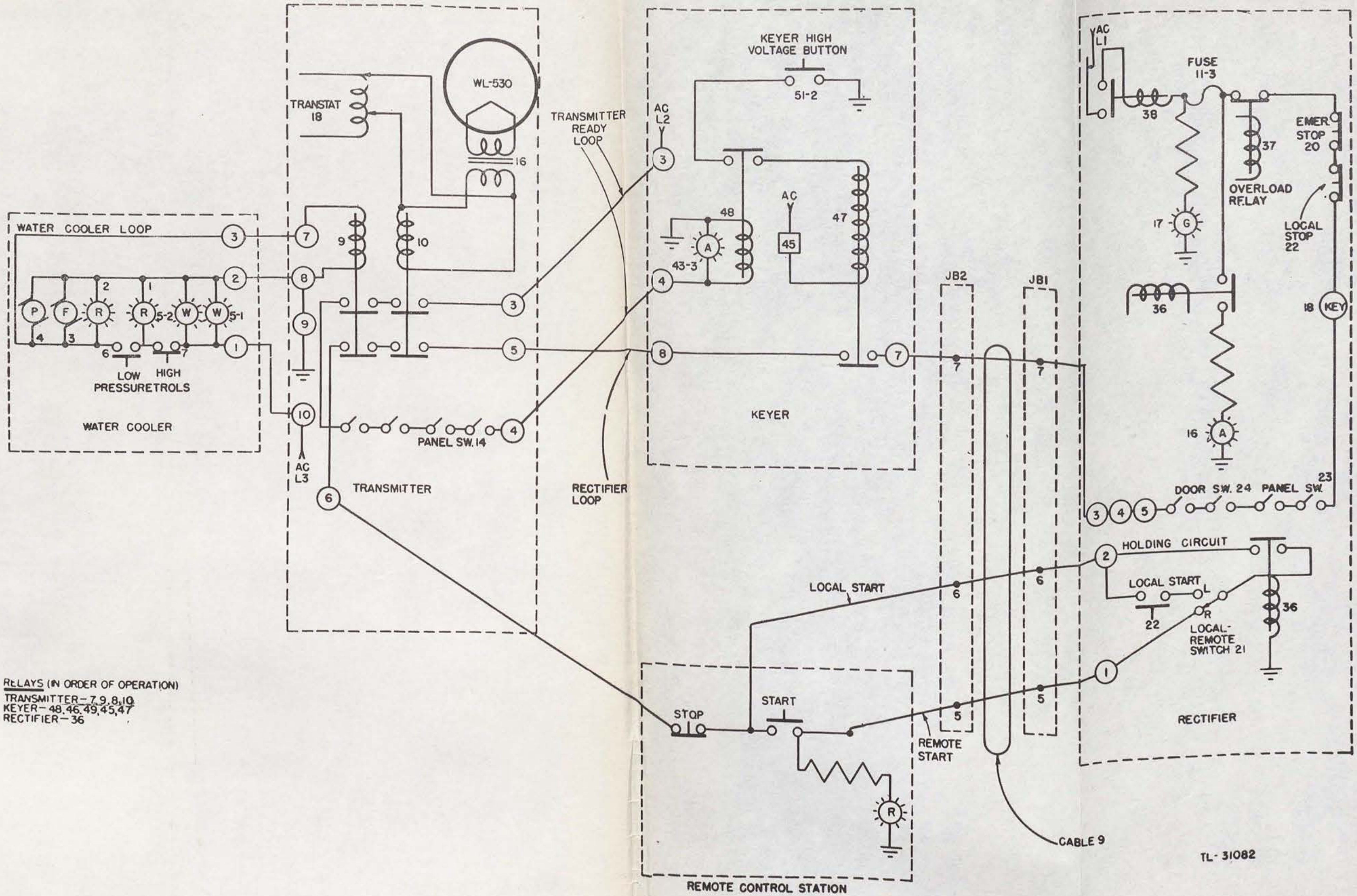


Figure 39. Simplified interlock circuit diagram.

APPARATUS LEGEND FOR RECTIFIER RA-60-A

Part No.	Quantity required	Name of part and description
1	6	Capacitor, 0.010 µf, 1,000 volts test, mica.
2	1	Capacitor, 0.5 µf, 25,000 volts.
3	1	Capacitor, 6. µf, 330 volts.
4	1	Capacitor, 0.010 µf, 2,500 volts test, mica.
5	1	Voltmeter multiplier, 1 (±½%) megohm, 10 watts.
6	20	Resistance tube, 10,000 ohms, 200 watts.
7	4	Heater unit, 150 watts, 115 volts.
8	1	Rheostat, filament, 5 ohms.
9	1	Resistor unit 15 ohms, 100 watts.
10	1	Resistor, relay bypass, 150 ohms, 100 watts.
11	3	Fuse, 10 amp, 250 volts.
12	1	Fuse, 150 amp, 250 volts.
13	3	Panel light, 25 watts, 110 volts ac.
14	1	Neon bulb, 2 watts, 110 volts.
15	1	Indicator light, red (55 volts, with series resistor).
16	1	Indicator light, amber (55 volts, with series resistor).
17	1	Indicator light, green (55 volts, with series resistor).
18	1	Switch, key.
19	3	Switch, light, s.p.s.t.
20	1	Switch, emergency stop.
21	1	Switch, remote-local s.p.d.t. (nonindicating).
22	1	Switch, push-button station.
23	8	Switch, panel interlock.
24	2	Switch, door interlock.
25	1	Transformer (main plate).
26	1	Transformer (filament).
27	1	Transformer (variable auto).
28	1	Transformer (current).
29	1	Reactor (filter).
30	1	Voltmeter, 0-20,000 volt dc (special).
31	1	Milliammeter, 0-800 ma dc (special).
32	1	Voltmeter, ac (special) (fil).
33	1	Voltmeter, ac, 0-150 volts.
34	1	Total hour meter.
35	1	Ammeter 0-150 amp ac.
36	1	Contactor, main.
37	1	Relay, overload.
38	1	Circuit breaker De-ion (special).
39	1	Blower motor.

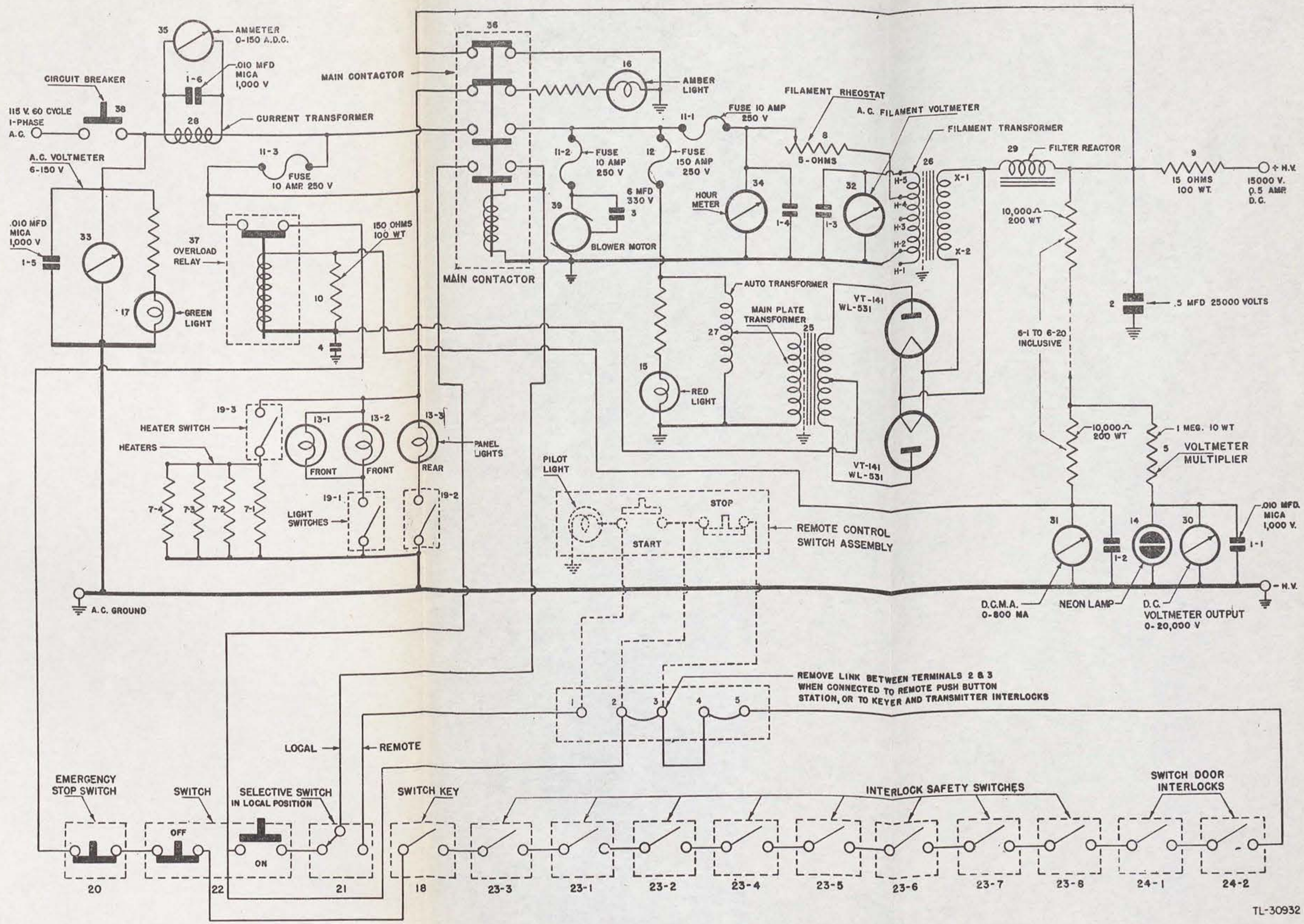


Figure 40. Rectifier RA-60-A, schematic.

its cause has been located and removed before the rectifier is turned on so that further damage will be avoided.

l. If the rectifier trips off erratically at times through the action of the interlock circuit, carefully note the conditions accompanying the interruptions. The trouble is probably due to a poor contact or a faulty relay in the interlock circuit, and can best be located by inspection and manual manipulation of the switches and relays involved. If the rectifier alone is affected, check the rectifier interlock circuit, but if the keyer also trips off, the keyer-transmitter interlock circuit should be investigated. If the transmitter, keyer, and rectifier all trip off simultaneously, the transmitter-cooling unit circuit should be checked.

m. If the rectifier can be turned on at low voltage but the overload relay trips it off when the voltage is raised to normal, a trouble in the transmitting system is probably responsible. See discussion on the transmitting system in section III.

n. If the current output of the rectifier is too high or too low, the trouble is probably in the transmitting system. See discussion on the transmitting system in section III.

o. The remainder of this section deals specifically with a detailed analysis of troubles in Rectifier Unit RA–60–A.

69. Rectifier, Front Panel Lamps 13 (1–2) (fig. 40)

a. ABNORMAL CONDITION. Rectifier front panel lamps do not light when the panel lamp switch is thrown to the ON position.

b. PROBABLE CAUSES. (1) Defective lamp bulb.

(2) Defective fuse 11–3.

(3) Defective lamp socket and connections.

(4) Defective panel lamp switch 19–1 and connections.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

(1) *Testing lamp bulbs.* Replace the panel lamp with a tested new bulb. If the new bulb does not glow, reinsert the original bulb into its socket.

(2) *Testing fuse 11–3.* (*a*) Shut down the rectifier unit and throw the circuit breaker to the OFF position.

(*b*) Remove the key from key switch 18. Unlock and open the rear door of the rectifier unit.

(*c*) Remove fuse 11–3 from the fuse panel.

(*d*) Check the fuse element in the fuse cartridge. Replace the fuse element if defective.

(3) *Testing lamp socket and connections.* (*a*) Throw the circuit breaker to the OFF position and remove the front section of the right side panel.

(*b*) Check all terminals and connections on the panel lamp sockets. Repair or replace any loose or broken connections.

(*c*) Check for continuity across the lamp socket terminals with the lamp bulb in the socket. If no continuity is obtained, repair or replace the lamp socket under test.

NOTE. Test each lamp socket individually. Remove the bulb from the panel lamp socket not under test.

(4) *Testing panel lamp switch 19–1 and connections.* (*a*) Check the panel lamp switch terminals. Repair or replace any loose or broken connections.

(*b*) With panel lamp switch 19–1 thrown to the ON position, check for continuity across the lamp switch terminals.

NOTE. The rear panel lamp switch and heater switch 19-3 must be in the OFF position for this test.

(*c*) If continuity is not obtained, repair or replace front panel lamp switch 19–1.

70. Rectifier, High Voltage On Indicator Lamp, Red 15

a. ABNORMAL CONDITION. HIGH VOLTAGE ON indicator lamp does not glow.

b. PROBABLE CAUSES. (1) Defective lamp bulb.

(2) Defective fuse 12.

(3) Defective socket and connections.

(4) Defective series resistor, indicator lamp 15.

(5) Defective key switch 18.

(6) Defective push-button station 22.

(7) Defective relay coil, main contactor 36.

(8) Defective interlock circuit.

(9) Defective panel interlock switches 23 (1–8).

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

NOTE. If the HIGH VOLTAGE OFF indicator lamp 16 stops glowing when the HIGH VOLTAGE ON switch is depressed, proceed with tests (1) through (4). If the indicator lamp glows, proceed with tests (5) through (9).

(1) *Testing bulb of indicator lamp 15.* Replace the lamp bulb with a tested new bulb. If the new bulb does not glow, reinsert the original bulb into its socket. If the new bulb glows brilliantly, remove it and test the series resistor.

dicated, replace the filament transformer.

(*c*) Disconnect and tag the leads from the primary terminals of the filament transformer. Check for continuity across the primary terminals. If no continuity is indicated, replace the filament transformer.

NOTE. Check the primary and the secondary of the filament transformer for a shorted condition between the windings or terminals, and the transformer core.

(7) *Testing variable autotransformer 27.* (*a*) Disconnect the cables from the primary of the main-plate transformer.

(*b*) Remove the bulb from the HIGH VOLTAGE ON indicator lamp socket 15.

(*c*) Check for continuity across the two inner terminals of the variable autotransformer 27. If continuity is not indicated, refer to TM 11–1410, Maintenance Manual.

(8) *Testing transformer 25.* (*a*) Check for continuity across the plate terminals of the rectifier tubes. Normal resistance is approximately 3,000 ohms. If there is no continuity reading, notify person in charge for repair or replacement of main plate transformer 25.

(*b*) Disconnect the leads from the primary terminals of the plate transformer. Check for continuity across the primary terminals of the transformer. If no continuity is indicated, notify person in charge.

74. Rectifier, D-C Output Current Meter 31

a. ABNORMAL CONDITION. Output current meter does not indicate when station is being placed on the air.

b. PROBABLE CAUSES. (1) Defective high-voltage cable between the rectifier and the transmitter unit.

(2) Defective meter and connections, rectifier unit.

(3) Defective resistor 9, rectifier unit.

(4) Defective center tap and connections, filament transformer 16, transmitter unit.

(5) Defective output current meter 23 and connections in transmitter unit.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

(1) *Testing high-voltage cable, rectifier unit.* (*a*) Remove the a-c power to the rectifier unit.

(*b*) Check the high-voltage and ground terminals of the rectifier unit. Repair or replace any loose or broken connections.

(*c*) Connect the positive lead of the high-voltage cable to the rectifier ground terminal.

(*d*) Check for a shorted indication between the plates of the transmitting tubes and ground.

(*e*) If no shorted indication is obtained, the high-voltage cable is open-circuited.

(*f*) Repair or replace the high-voltage cable.

NOTE. Remove the positive lead of the high-voltage cable from the ground terminal of the rectifier unit immediately after this test is completed before proceeding with any further tests.

(*g*) Check the high-voltage terminal in the transmitter unit. Repair or replace any loose or broken connections.

(2) *Testing current meter and connections.* (*a*) Remove the right front panel of the rectifier unit.

(*b*) Check the terminals of the current meter. Repair or replace any loose or broken connections.

(*c*) Remove and tag the leads from the terminals of the current meter.

(*d*) Using the high range of the analyzer, check for continuity across the meter terminals. Observe polarity.

(*e*) If no continuity is indicated, replace the current meter.

(3) *Testing resistor 9, rectifier unit.* (*a*) Remove the right or left rear panel.

(*b*) Remove resistor 9, and check the resistor for continuity. Normal resistance 15 ohms.

(*c*) If no continuity is indicated, replace the resistor.

(4) *Testing center tap and connections, filament transformer 16, transmitter unit.*

Caution: Be sure to shut down keyer and transmitter.

(*a*) Remove the lower right panel of the transmitter unit.

(*b*) Check the center-tap terminal of the filament transformer. Repair or replace any loose or broken connections.

(*c*) Check for continuity between the center-tap terminal of the filament transformer and ground.

(*d*) If continuity is indicated, disregard test (5) below. If no continuity is indicated, proceed with test (5).

(5) *Testing current meter 23 and connections, transmitter unit.* (*a*) Check the terminals of the current meter. Repair or replace any loose or broken connections.

(*b*) Check the meter series resistor 4–2 for continuity. If no continuity is indicated, replace the resistor.

(*c*) Using the high range of the analyzer, check for continuity across the meter terminals. Polarity should be observed.

(*d*) If no continuity is indicated, replace the current meter.

NOTE. Check the ground lead of the current meter. An open-circuited condition may exist between the ground terminal of the meter and ground.

75. Rectifier, Filament Voltmeter 32

a. ABNORMAL CONDITION. Filament voltmeter 32 reads zero.

b. PROBABLE CAUSES. (1) Lack of a-c power to voltmeter 32.

(2) Defective fuse 11–1.

(3) Defective filament rheostat 8 and connections.

(4) Defective filament voltmeter 32.

(5) Defective bypass capacitors 1–3 and 1–4.

(6) Defective filament transformer 26.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

(1) *Testing for a-c power to voltmeter 32.* Note whether the HIGH VOLTAGE ON indicator lamp 15 is glowing. If the indicator lamp is not glowing, follow the procedure outlined in paragraph 70d(1).

(2) *Testing fuse 11–1.* See paragraph 69d(2).

(3) *Testing filament rheostat 8 and connections.* (*a*) Remove the front panel from the right side of the rectifier.

(*b*) Check the rheostat terminals. Repair or replace any loose or broken connections.

(*c*) Remove and tag all leads from the rheostat terminals. Check for continuity across the rheostat terminals. If no continuity is indicated, replace the rheostat.

(4) *Testing filament voltmeter 32.* (*a*) Two persons are required for this test. Connect an a-c test voltmeter across terminals H2 and H5 or filament transformer 26.

Caution: Do not handle test leads or meter after connection to the circuit.

(*b*) Throw the circuit breaker to the ON position.

(*c*) Depress and hold the panel interlock switches.

(*d*) Depress the START button on the pushbutton station switch 22.

(*e*) Turn the FILAMENT VOLTAGE CONTROL slightly clockwise. Note reading on the a-c test voltmeter. If a reading is obtained, check all leads at the meter terminals for loose or broken connections. If the leads and connections are normal, replace filament voltmeter 32.

(5) *Testing bypass capacitors 1–3 and 1–4.* (*a*) Remove the bypass capacitors from the voltmeter terminals.

(*b*) Check the capacitors for a shorted condition. Replace capacitors if found shorted.

(6) *Testing filament transformer 26.* See paragraph 73d(6).

76. Rectifier, Line Voltmeter 33

a. ABNORMAL CONDITION. Line voltmeter 33 shows no reading.

b. PROBABLE CAUSES. (1) Lack of a-c power to voltmeter 33.

(2) Defective voltmeter 33 or connections.

(3) Defective circuit breaker 38.

(4) Defective cable between distribution panel and rectifier.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

(1) *Testing a-c power to voltmeter 33.* Throw the panel lamp switch to the ON position. If the panel lamps glow, test the meter and connections. If the panel lamps do not glow, test the circuit breaker.

(2) *Testing voltmeter 33 and connections.* (*a*) Throw the circuit breaker to the OFF position. Remove the front panel from the right side of the rectifier.

(*b*) Check all leads at the meter terminals. Repair or replace any loose or broken connections.

(*c*) Connect an a-c test voltmeter across the terminals of the voltmeter 33.

Caution: Do not handle the test prods or meter after connection to the circuit.

(*d*) Throw the circuit breaker to the ON position. If the a-c test voltmeter shows an indication, replace the rectifier line voltmeter 33.

NOTE. The lead from the bottom terminal of circuit breaker 38 feeds the line voltmeter and the LINE VOLTAGE ON indicator lamp 17. Check this lead for a loose or broken connection.

(3) *Testing circuit breaker 38.* (*a*) Throw the circuit breaker to the OFF position and remove the front panel from the right side of the rectifier.

(*b*) Check for an a-c voltage indication between the top terminals of the circuit breaker and ground.

Caution: Connect the ground test lead first. Do not handle the metal tip of the test leads when applying them to the top terminals of the circuit breaker. A-c voltage is always present at these terminals.

(*c*) If a voltage indication is obtained, check for a voltage indication between the bottom terminals of the circuit breaker and ground, with the circuit breaker in the ON position. If no voltage indication is obtained, replace the circuit breaker.

(4) *Testing cable to a-c supply generator.* Check the cable for loose or broken connections between the rectifier unit and the distribution panel. Repair or replace cable, if found defective.

77. Rectifier, Line Current Ammeter 35

a. Abnormal Condition. Rectifier line current meter does not register.

b. Probable Causes. (1) Defective current transformer 28.

(2) Defective line current, ammeter bypass capacitor 1–6.

(3) Defective ammeter 35.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located.

(1) *Testing current transformer 28.* (*a*) Shut down the rectifier and throw the circuit breaker to the OFF position.

(*b*) Remove the front panel from the right side of the rectifier.

(*c*) Remove the two leads from the ammeter terminals, and check for continuity across the leads. If no continuity is indicated, check the leads for loose or broken connections. If the leads are normal, replace the current transformer.

(2) *Testing bypass capacitor 1–6.* Remove the bypass capacitor from the ammeter terminals, and check the capacitor for a shorted condition. Replace the capacitor if shorted.

(3) *Testing ammeter 35.* Remove and tag the leads from the ammeter terminals. Check for continuity across the ammeter terminals, using the high range of the analyzer. If no continuity is indicated, replace the ammeter.

Section III. TRANSMITTING SYSTEM

78. General Information

a. Faults in the transmitting system will usually be indicated by improper operation of the transmitter or keying unit. However, the first indication of transmitting system trouble often may be found in the appearance of the image on the oscilloscope.

b. If no r-f output is obtained when the rectifier, keying unit, and transmitter all appear to be normal, it is likely that the pulsing voltage is not being supplied to the transmitter. The indications of this condition are no d-c plate current in the transmitter, the lack of a main pulse image on the screen of the oscilloscope, and no spark across the spark gap. First see whether the base line appears on the oscilloscope screen. If not, the oscillator tube or circuit in the oscilloscope is probably faulty. If the base line appears normal, see whether the cord is plugged into the KEYER jack on the right side of the oscilloscope. Check with a headset to see if the 621-cycle tone appears at the KEYER jack. If the tone is not present at this point, trouble is indicated in the synchronizing line amplifier tube or its circuit in the oscilloscope. If the tone does appear at the KEYER jack, the trouble is probably in the pulse-generating tubes or circuit of the keying unit. Malfunctioning of this circuit can best be located by means of signal tracing.

c. If the investigation up to this point indicates that there is no trouble in the pulsing circuit, the only remaining possibility is tube or circuit trouble in the transmitter itself. Check the transmitter r-f circuit carefully and test the tubes by substituting new ones.

d. If the rectifier high voltage can be turned on but the overload relay trips it off when the voltage is raised to normal, the trouble is probably due to a fault or misadjustment of the transmitting system. Improper bias or keying high-voltage settings of the keying unit may result in the establishment of continuous-wave (c-w) oscillation in the transmitter, especially if the keying unit itself is not operating properly. An arc-over in the transmitter or the antenna system due to improper adjustments or inadequate insulation may also cause this trouble. Arc-overs will usually produce

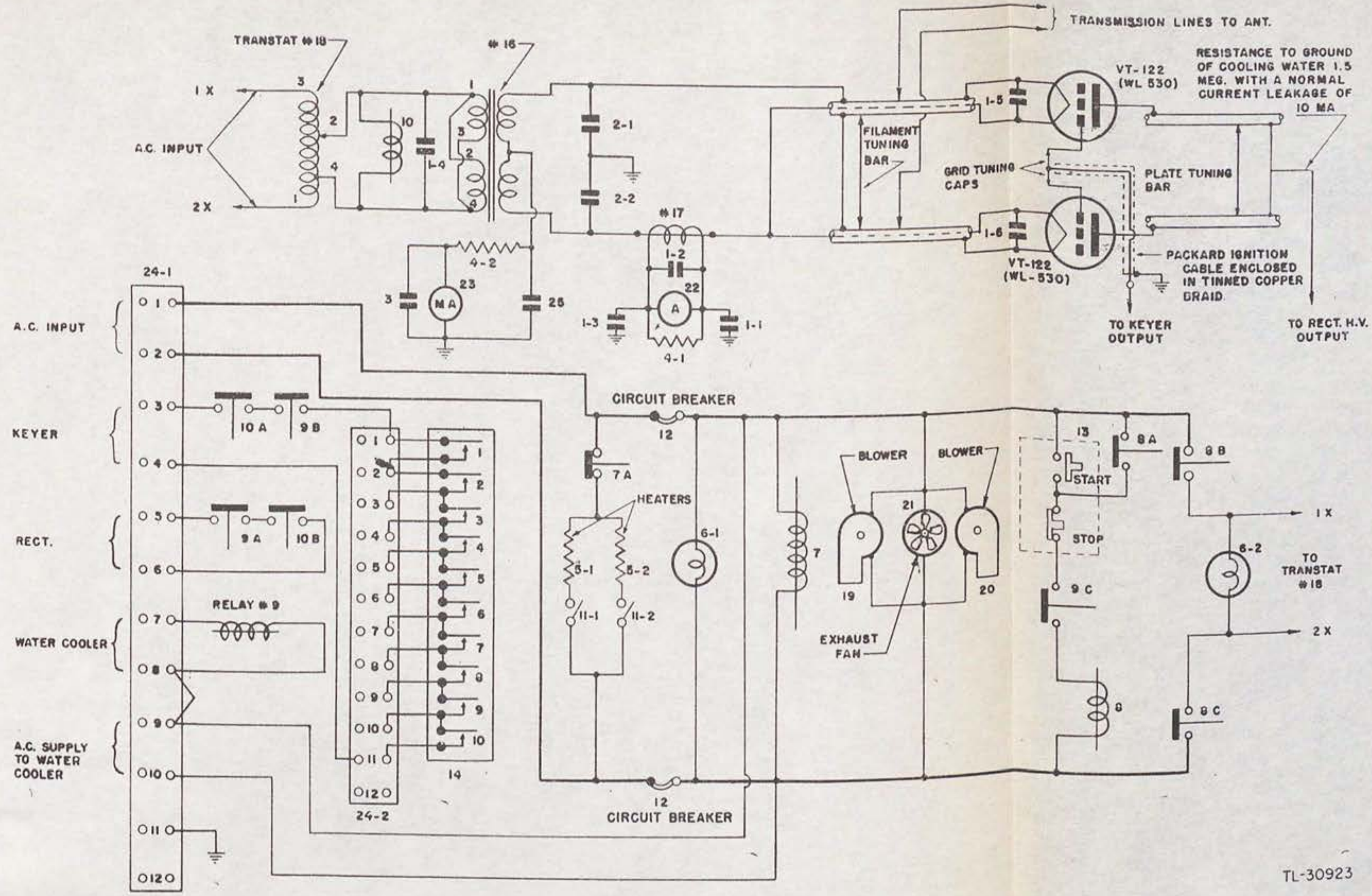


Figure 41. Transmitter BC-785-A, schematic.

APPARATUS LEGEND FOR TRANSMITTER BC-785-A

Part No.	Quantity required	Name of part and description	Part No.	Quantity required	Name of part and description
1	6	Capacitor, 0.00025 µf, 2,500 volts.	14	10	Switch, interlock, solder lug terminals.
2	2	Capacitor, 0.01 µf, 5,000 volts.	15	1	Switch, s.p.s.t. (on earlier xmtr models only).
3	1	Capacitor, 0.00035 µf, 500 volts.	16	1	Transformer, 220-110 volts, 60 cycles.
4	2	Resistor, 10 ohms, 100 watts.	17	1	Transformer (current), 200-5 ratio.
5	2	Heater, 150 watts, cartridge type screw base.	18	1	Transtat (regulator).
6	2	Pilot light, 6 watts, 125 volts, candelabra base.	19	1	Blower circulator, 115 volts, 60 cycles.
7	1	Relay, 110 volts, 60 cycles.	20	1	Blower intake, 115 volts, 60 cycles.
8	1	Relay, 110 volts, 60 cycles.	21	1	Exhaust fan, 115 volts, 60 cycles.
9	1	Relay, 110 volts, 60 cycles.	22	1	Ammeter, 0-200 amp.
10	1	Relay, 55 to 125 volts, 60 cycles.	23	1	Milliammeter, 0-400 ma.
11	2	Switch, s.p.s.t.	24	2	Terminal block (12 terminals).
12	1	Circuit breaker.	25	1	Capacitor, 0.00025 µf, 8,000 volts.
13	1	Switch, push-button, flush type.			

an audible 621-cycle note which can readily be heard and located by ear. A faulty tube or circuit trouble in the transmitter, cabling, or keying unit may cause the transmitter to draw excessive plate current. Excessive electrical leakage through the water column or in any other part of the plate-supply circuit may also be responsible for this condition.

e. If the current output of the high-voltage rectifier is too low when the transmitter is in operation, it is an indication that the transmitter is not functioning properly. This condition will normally accompany any trouble which causes a reduction in the r-f output of the transmitter and should be treated in the same manner.

f. If the transmitter or the antenna system is subject to r-f flashover or arcing, it is an indication of improper tuning adjustments. The arcs will usually cause the rectifier to be shut down and will also produce an audible 621-cycle note. The actual point of arc-over may be within the transmitter or external to it on the transmission line or the antenna, and may often be found by examining the circuit for indications of pitting or burning. When the point of arc-over is found, determine whether the trouble is due to proximity of the circuit to shields or other conductors, or to poor insulation, or to excessive standing waves in the circuit. If the fault is due to the latter cause, a readjustment of the transmitter and antenna system is in order, and other indications of that fact, such as reduced echoes, should be present.

g. Another trouble which might occur is overheating of the cooling system. Check to see that the fan is running and that the cooling system is filled. If they are, the trouble is probably due to severe restriction of the water flow because of improper shut-off valve settings or some obstruction in the water lines.

(1) If the transmitting system shuts down automatically because of operation of the *high pressuretrol relay,* check the water pressure and flow, the valve settings, and the high pressuretrol relay itself, in the order named, until the cause of the trouble is found.

(2) If the transmitting system shuts down automatically because of operation of the *low pressuretrol relay,* check the water level, pressure, and flow, the valve settings, and the *low pressuretrol relay* itself, in the order named, until the cause of the trouble is found.

h. The remainder of this section deals specifically with a detailed analysis of troubles in the transmitter, watercooling unit, keying unit, and antenna system.

79. Transmitter, A-C POWER ON Indicator Lamp 6–1

a. Abnormal Condition. A-C POWER ON indicator lamp does not glow.

b. Probable Causes. (1) Defective lamp bulb.

(2) Defective lamp socket and connections.

(3) Defective circuit breaker.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located:

Note. Throw the transmitter circuit breaker to the ON position. Notice whether the transmitter blowers are in operation. If the blowers operate, proceed with tests (1) and (2) below. If the blowers do not operate, proceed with test (3) below.

(1) *Testing lamp bulb.* Replace the panel lamp with a tested new bulb. If the new bulb does not glow with the circuit breaker in the ON position, reinsert the original bulb into its socket.

(2) *Testing lamp socket and connections.* (*a*) Remove the upper-left side panel. Check the terminals of the lamp socket. Repair or replace any loose or broken connections.

(*b*) Throw the circuit breaker to the ON position. Check for a-c voltage indication across the lamp socket terminals. If a voltage indication is obtained, repair or replace the lamp socket.

(3) *Testing circuit breaker.* (*a*) Remove the bottom right panel. Check for a-c voltage across terminals 1 and 2 of the transmitter terminal block 24–1. If no voltage indication is obtained, check the transmitter line fuse for an open-circuited condition.

(*b*) Check the terminals of terminal block 24–1. Repair or replace any loose or broken connections.

(*c*) Check the circuit breaker terminals. Repair or replace any loose or broken connections.

(*d*) Throw the circuit breaker to the ON position. Check for a-c voltage across the upper terminals of the circuit breaker. If no voltage indication is obtained, check for voltage indication across the lower terminals of the circuit breaker. If voltage indication is obtained, repair or replace the circuit breaker.

(*e*) If no voltage indication is obtained, remove the line fuse to the transmitter unit, and check the a-c cables between the circuit breaker and terminals 1 and 2 of terminal block 24–1. Repair or replace any loose or broken connections.

80. Transmitter, FILAMENT ON Indicator Lamp 6–2

a. ABNORMAL CONDITION. FILAMENT ON indicator lamp does not glow.

b. PROBABLE CAUSES. (1) Defective lamp bulb.

(2) Defective lamp socket and connections.

(3) Defective relay 9.

(4) Defective FILAMENT ON switch 13.

(5) Defective relay 8.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located:

NOTE. Depress the START button of the FILAMENT ON switch. Slightly rotate the filament control clockwise. Note whether the transmitter filament-current meter indicates. If the meter indicates, proceed with tests (1) and (2) below. If the meter does not indicate, and the A-C POWER ON indicator lamp is glowing, proceed with tests (3), (4), and (5) below.

(1) *Testing lamp bulb*. See paragraph 79*d*(1).

(2) *Testing lamp socket and connections*. (*a*) Remove the right upper panel. Check the lamp socket terminals. Repair or replace any loose or broken connections.

(*b*) Remove the lamp bulb from the socket.

(*c*) Check for continuity across the lamp socket terminals. If continuity is indicated repair or replace the lamp socket.

(3) *Testing relay 9*. (*a*) Remove the lower right panel. With the water cooler in operation, check for a-c voltage indication across terminals 7 and 8 of transmitter terminal block 24–1. If no voltage indication is obtained, check the cable between terminal 7 of the transmitter terminal block and terminal 3 of water cooler terminal block 8. Repair or replace any loose or broken connections.

NOTE. Check the terminals of the low pressuretrol switch of the water cooler unit for loose or broken connections.

(*b*) Throw the transmitter circuit breaker to the OFF position.

(*c*) Disconnect the cable between the transmitter and the water cooler units, from terminal 7 of transmitter terminal block 24–1. Check for continuity across terminals 7 and 8 of terminal block 24–1. If no continuity is indicated, check for loose or broken connections at the relay coil terminals of relay 9.

(*d*) Disconnect the leads from one of the relay coil terminals. Check for continuity across the relay coil terminals. If no continuity is indicated, repair or replace relay 9.

(4) *Testing FILAMENT ON switch 13*. (*a*) Remove the rear cover from the switch assembly. Check the switch terminals. Repair or replace any loose or broken connections.

(*b*) Check for continuity across the left upper and lower terminals. If no continuity is indicated, repair or replace the switch.

(*c*) If continuity is indicated, check for continuity across the right upper and lower terminals. If continuity is not indicated, check the jumper lead on the switch terminals. If the jumper lead is normal, repair or replace the switch.

(5) *Testing relay 8*. (*a*) Check the relay terminals. Repair or replace any loose or broken connections.

(*b*) Disconnect the leads from one of the relay coil terminals. Check for continuity across the relay coil terminals. If no continuity is indicated, repair or replace relay 8.

81. Transmitter, Blowers 19 and 20 and Exhaust Fan 21

a. ABNORMAL CONDITION. Transmitter blowers and exhaust fan do not operate.

NOTE. Air streamers, seen through the glass window and attached to the blowers, indicate normal operation of the blowers and exhaust fan. If all blowers do not operate, immediately shut down the transmitter unit. If only one blower fails to operate and the water temperature indicator on the water cooler does not show a temperature above normal (see TM 11–1310) continue operation and notify person in charge of the abnormal condition.

b. PROBABLE CAUSES. (1) Lack of a-c power to the blowers and exhaust-fan units.

(2) Defective terminal connections.

(3) Defective blower and exhaust-fan motors.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

NOTE. If all blowers are inoperative see paragraph 79*d*(3), testing the circuit breaker.

(1) *Testing for a-c at blower motor terminals*. (*a*) Remove the upper right panel.

(*b*) Throw the circuit breaker to the ON position.

(*c*) Check for a-c voltage across the a-c input terminals of the blower unit under test. If no voltage indication is obtained, check the a-c input leads between the terminals of the blower-motor unit and the circuit breaker. Repair or replace any loose or broken connections.

(2) *Testing blower-motor terminal connections*. (*a*) Throw circuit breaker to the OFF position.

(*b*) Check all connections at the blower-motor a-c input terminals.

(*c*) Check all connections and leads between the blower-motor a-c input terminals and the blower-motor units. Repair or replace any loose or broken connections.

(3) *Testing blower motors and exhaust-fan unit.* (*a*) Remove the motor leads from the blower-motor a-c input terminals.

(*b*) Check for continuity across the motor leads of the blower-unit under test. If no continuity is indicated, repair or replace the blower motor unit.

82. Transmitter, Filament Current Meter 22, Zero Reading

a. ABNORMAL CONDITION. Transmitter filament-current meter shows zero reading.

b. PROBABLE CAUSES. (1) Defective meter and connections.

(2) Defective meter bypass capacitors 1 (1–3).

(3) Defective meter resistor 4–1.

(4) Defective current transformer 17.

(5) Defective filament-transformer bypass capacitors 2 (1–2), 1–4.

(6) Defective filament transformer 16.

(7) Defective transtat 18.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located:

NOTE. With the transmitter circuit breaker thrown to the ON position, depress the START button of the FILAMENT switch. Rotate the filament control slowly clockwise to about one-third of its normal position when the transmitter is operating normally. Note whether the transmitting tubes are glowing. If the tubes do not glow, use tests (5) through (7) below. If the tubes are glowing, use tests (1) through (4) below.

(1) *Testing meter and connections.* (*a*) Remove the upper right panel. Check all leads on the ammeter terminals. Repair or replace any loose or broken connections.

(*b*) Remove and tag the leads from the ammeter terminals; check for continuity across the meter terminals. If no continuity is indicated, replace the ammeter.

(2) *Testing meter bypass capacitors 1 (1–3).* (*a*) Remove the meter bypass capacitors from the meter terminals.

(*b*) Check the capacitors for a shorted condition. Replace any capacitor that shows a shorted condition.

(3) *Testing meter resistor 4–1.* (*a*) Remove the meter resistor from the meter terminals.

(*b*) Check the resistor for an open or shorted condition. Normal resistance of resistor is approximately 10 ohms. Replace resistor if found defective.

(4) *Testing current transformer 17.* (*a*) Remove the lower right panel.

(*b*) Remove one of the current transformer leads from its mounting strip.

(*c*) Check for continuity across the winding of the current transformer. If no continuity is indicated, repair or replace the current transformer.

(5) *Testing filament-transformer bypass capacitors.* (*a*) Remove the ground bus from the terminals of capacitors 2–1 and 2–2. Check across the capacitor terminals. Replace any capacitor showing a shorted condition.

(*b*) Disconnect one lead of capacitor 1–4, and check across the capacitor terminals for a shorted indication; replace capacitor if found shorted.

(6) *Testing filament transformer 16.* (*a*) Remove one of the connections from one of the secondary terminals of the filament transformer. (Do not remove the lead from the center-tap terminal.)

(*b*) Check for continuity across the secondary and center-tap terminals of the filament transformer. If no continuity is indicated, repair or replace the transformer.

(*c*) Remove the leads from the primary terminals of the filament transformer. Tag the leads. Remove the connecting bus from terminals 1, 2, 3, and 4.

(*d*) Check for continuity across terminals 1 and 3; if no continuity is indicated, replace the filament transformer. Check for continuity across terminals 2 and 4; if no continuity is indicated, replace the transformer.

(7) *Testing transtat 18.* (*a*) Remove the upper left panel.

(*b*) Remove the cover of the transtat unit.

(*c*) Remove and tag the leads from terminals 1 and 3 of the transtat. Check for continuity across the terminals (1 and 3). If no continuity is indicated, repair or replace the transtat.

(*d*) Remove and tag the leads from terminals 2 and 4 of the transtat unit.

(*e*) Connect an a-c test voltmeter across transtat terminals 2 and 4.

(*f*) Throw the transmitter circuit breaker to the ON position and start the water cooler unit.

(*g*) Depress the transmitter FILAMENT switch.

(*h*) Slowly rotate the filament control clockwise. Note the a-c test voltmeter for a voltage output indication from the transtat. If no voltage indication is obtained, repair or replace the transtat.

83. Transmitter, Filament Current Meter 22, High Reading

a. ABNORMAL CONDITION. Transmitter filament-current meter indicates high current when the filament voltage control is rotated slightly.

b. PROBABLE CAUSES. (1) Filament spark gaps spaced too close.

(2) Shorted filament bypass capacitors 1–5 and 1–6.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located:

(1) *Testing filament spark gaps.* (*a*) Remove the right or left upper panel.

(*b*) Examine the spark gaps on the filament terminals of the transmitting tubes. Normal spacing is approximately 1/4 to 1/2 inch.

(2) *Testing filament bypass capacitors 1–5 and 1–6.* (*a*) Remove the mica bypass capacitors.

(*b*) Check each individually for continuity across the capacitor terminals. If continuity is indicated, replace the capacitor under test.

84. Transmitter, Current Meter 23

a. ABNORMAL CONDITION. Current meter does not indicate when station is being placed on the air.

b. PROBABLE CAUSES. (1) Defective high-voltage cable between the rectifier and the transmitter unit.

(2) Defective meter 31 and connections, rectifier unit.

(3) Defective resistor 9, rectifier unit.

(4) Defective center tap and connections, filament transformer, transmitter unit.

(5) Defective current meter 23 and connections, transmitter unit.

c. REMEDY. Follow procedures outlined in paragraph 74.

85. Transmitter Unit Does Not Oscillate, Preliminary Tests

a. Check the base line on the oscilloscope unit. If the base line is abnormal, check the oscilloscope unit.

b. Set the keyer synchronization switch to the INTERNAL SYNC. position. Note whether the transmitter unit oscillates. If the transmitter unit oscillates, the trouble has been traced to the oscilloscope unit. If the base line on the oscilloscope unit is normal, check the sync. line cord between the oscilloscope and the keyer unit; check also the sync. line amplifier stage within the oscilloscope unit.

c. If the transmitter unit does not oscillate when the keyer is set to the INTERNAL SYNC. position, the keyer or transmitter units are at fault.

d. Check the pulse output of the keyer unit with the test oscilloscope. If a normal pulse indication is obtained, the transmitter unit is at fault.

e. If no pulse output indication is obtained, the keyer unit is at fault and should be tested. Use the signal tracing procedure.

f. Check the grid bias cable between the keyer and transmitter unit, before testing the transmitter unit.

86. Water Cooler, High Pressuretrol Pilot Lamp 1 (fig. 42)

a. ABNORMAL CONDITION. High pressuretrol pilot light does not glow when the transmitter circuit breaker is thrown to the ON position.

b. PROBABLE CAUSES. (1) Defective lamp bulb.

(2) Defective lamp socket and connections.

(3) Lack of a-c power or defective connections at terminal blocks 8 and 10.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

NOTE. With the transmitter circuit breaker in the ON position, note whether the water cooler indicator lamps 5–1 and 5–2 are glowing. If the lamps are glowing, use tests (1) and (2) below. If the lamps are not glowing, use test (3) below.

(1) *Testing lamp bulb.* Replace the bulb with a tested new bulb. If the new bulb does not glow, reinsert the original bulb into its socket.

(2) *Testing lamp socket and connections.* (*a*) Throw the transmitter circuit breaker to the OFF position.

(*b*) Check the terminals of the lamp socket; repair or replace any loose or broken connections.

(*c*) Remove the indicator lamp bulbs 5–1 and 5–2 from their sockets.

(*d*) Disconnect the a-c input lead from the transmitter to the water cooler unit, from terminal 1 of the water-cooler terminal block 8.

(*e*) Check for continuity across terminals 1 and 5 of the water-cooler terminal block 10. If no continuity is indicated, repair or replace the lamp socket assembly of pilot lamp 1.

NOTE. Before repairing or replacing the lamp socket, check the terminals of the high pressuretrol switch 7 for loose or broken connections (fig. 43).

(3) *Testing a-c input to water-cooler unit.* (*a*) Check the terminals of terminal blocks 8 and

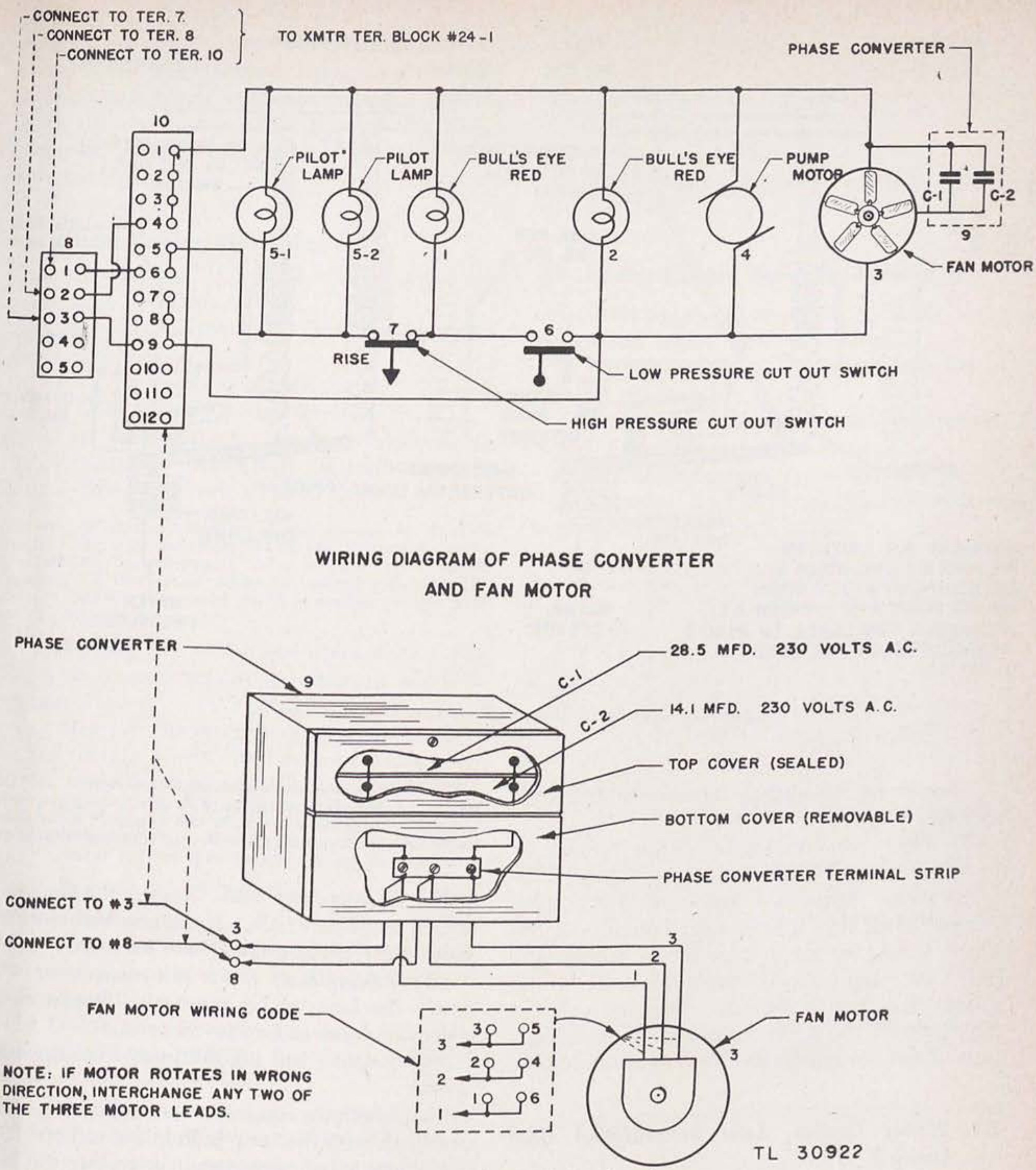


Figure 42. Water cooler RU-4-A, schematic.

APPARATUS LEGEND FOR WATER COOLER RU-4-B

Part No.	Quantity required	Name of part and description	Part No.	Quantity required	Name of part and description
1	1	Pilot light, 6 watts, 125 volts, candelabra base.	6	1	Low-pressure cut-out switch.
2	1	Pilot light, 6 watts, 125 volts, candelabra base.	7	1	High-pressure cut-out switch.
3	1	Fan motor, 115 volts, 60 cycles, single phase.	8	1	Terminal block (5 terminals).
4	1	Pump and motor, 1/4 hp, 115 volts, 60 cycles, single phase.	9	1	Converter.
5	2	Lamp, 6 watts, 125 volts, candelabra base.	10	1	Terminal block (12 terminals).

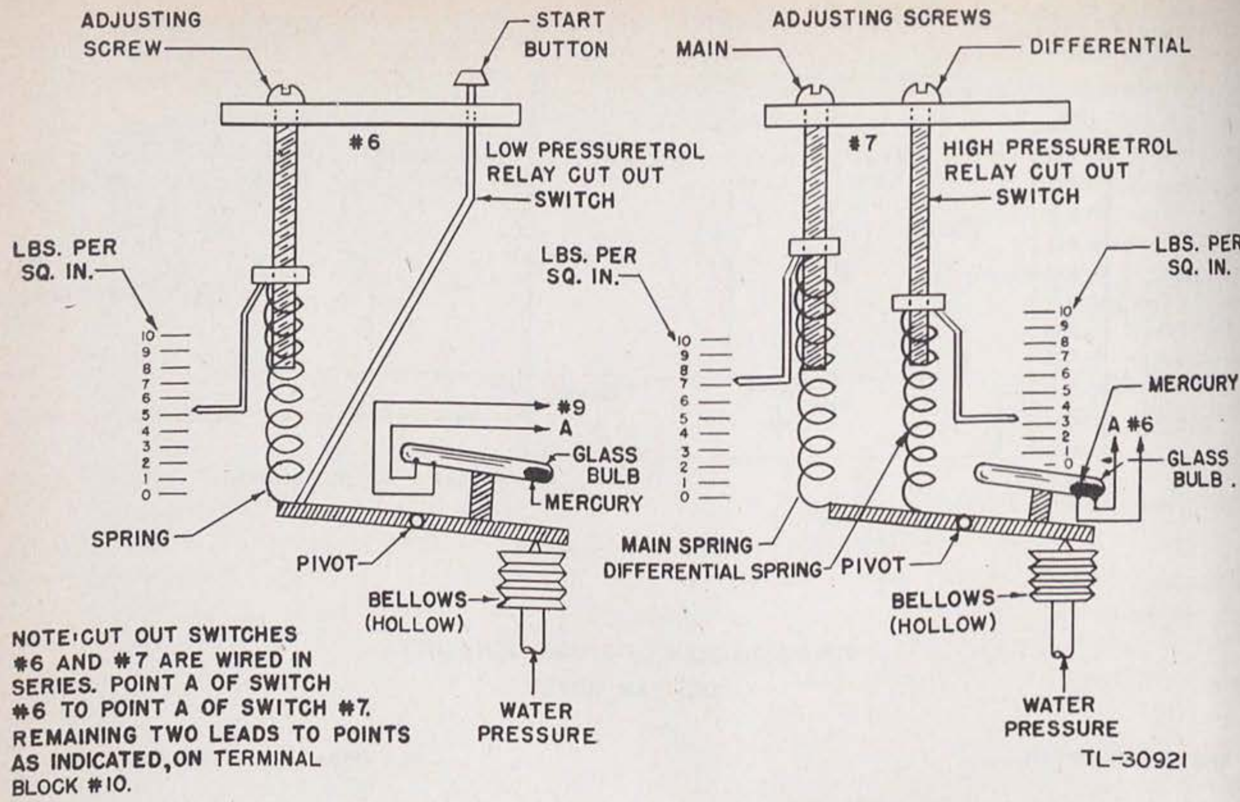


Figure 43. Functional diagram of pressuretrol cut-out switches.

10. Repair or replace any loose or broken connections.

(*b*) Throw the transmitter circuit breaker to the ON position. Check for an a-c voltage indication across terminals 1 and 5 of water-cooler terminal block 10. If no voltage indication is obtained, check for a-c voltage across terminals 1 and 2 of water-cooler terminal block 8. If no voltage indication is obtained, check the a-c input cable between the water cooler and the transmitter unit. Repair or replace any loose or broken cables.

87. Water Cooler, Low Pressuretrol Pilot Lamp 2

a. Abnormal Condition. Water-cooler low pressuretrol pilot light does not glow when low pressuretrol switch START button has been depressed.

b. Probable Causes. (1) Defective lamp bulb.

(2) Defective lamp socket and connections.

(3) Defective low pressuretrol switch.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located.

Note. With the transmitter circuit breaker in the ON position, depress the start button of the low pressuretrol switch and note whether the water-cooler unit operates. If the water-cooler unit operates, proceed with tests (1) and (2) below. If it does not operate, proceed with test (3) below.

(1) *Testing lamp bulb.* Replace the lamp bulb with a tested new bulb. If the new bulb does not glow, reinsert the original into its socket.

(2) *Testing lamp socket and connections.* (*a*) Check the lamp socket terminals. Repair or replace any loose or broken connections.

(*b*) Remove and tag the leads from the lamp socket.

(*c*) Check for continuity across the lamp socket terminals with the lamp bulb in the socket. If no continuity is indicated, repair or replace the lamp socket.

(3) *Testing low pressuretrol switch 6.* (*a*) Remove the cover from the low pressuretrol switch.

(*b*) Check the leads of the mercury switch. Repair or replace any loose or broken connections.

(*c*) Check the main pressure spring for abnormal condition.

(*d*) If the above-mentioned conditions are normal, short out the low pressuretrol switch. With the transmitter circuit breaker in the ON position, note whether the water-cooler unit operates. If the unit operates, replace the low pressuretrol switch. If the unit does not operate, check the connecting cables between the switch terminals, and the terminals of the water-cooler terminal block.

88. Water Cooler, Fan Motor 3

a. Abnormal Condition. Water-cooler fan motor does not operate.

b. Probable Causes. (1) Defective fan motor and connections.

(2) Defective phase converter.

(3) Defective low pressuretrol switch.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located.

Note. With the transmitter circuit breaker in the ON position, depress the start button of the low pressuretrol switch. Note whether the water-pump motor or pilot light 2 are in operation. If they are in operation, proceed with tests (1) and (2) below. If they are not in operation, proceed with test (3) below.

(1) *Testing fan motor and connections.* (*a*) Throw the transmitter circuit breaker to the OFF position.

(*b*) Remove the protecting dust cover from the fan motor. Check the fan-motor leads. Repair or replace any loose or broken connections.

(*c*) Remove the fan-motor a-c input leads from terminals 3 and 8 of water-cooler terminal block 10.

(*d*) Remove the bottom cover from the phase-converter unit.

(*e*) Check for continuity across the two left terminals. If no continuity is indicated, replace the fan motor.

(*f*) Check for continuity across the two right terminals. If no continuity is indicated, replace the fan motor.

Note. The fan motor should never be replaced until the phase converter has been tested and found normal.

(2) *Testing phase converter* (fig. 42). (*a*) Remove the rear panel from the water-cooler unit.

(*b*) Remove the lower cover from the phase-converter unit. Check the terminals. Repair or replace any loose or broken connections.

(*c*) Remove the fan-motor lead from the right terminal of the phase-converter terminal strip.

(*d*) Check for a shorted indication across the two outer terminals. If a shorted indication is obtained, check the two capacitors in the upper compartment of the phase-converter case individually for a shorted condition.

Note. If the capacitors are found normal and the fan motor does not operate, the capacitors may be open-circuited. Test the capacitors for open-circuited condition by substituting two new capacitors across the two outer terminals of the phase-converter terminal strip. If the fan motor operates, replace the defective capacitor.

(3) *Testing low pressuretrol switch.* See paragraph 87*d*(3).

89. Water Cooler, Pump and Motor 4

a. Abnormal Condition. Water - cooler pump and motor do not operate.

b. Probable Causes. (1) Defective low pressuretrol switch.

(2) Defective pump motor and connections.

(3) Defective water pump.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located.

Note. If the fan motor operates and the water pump remains inoperative, proceed with tests (2) and (3) below. If the fan motor does not operate, proceed with test (1) below.

(1) *Testing low pressuretrol switch.* See paragraph 87*d*(3).

(2) *Testing water-pump motor and connections.* (*a*) Remove the water-pump motor a-c input leads from terminals 4 and 7 of water-cooler terminal Block 10.

(*b*) Check for continuity across the a-c input leads of the water-pump motor. If continuity is indicated, replace the water-pump motor starting capacitor located on the top of the water-pump motor. If no continuity is indicated, replace the water-pump motor.

(3) *Testing water pump.*

Note. The water pump should be tested only when the flapper valve on the water-cooler unit is in a downward position, indicating a lack of water pressure. Check the water level indicator. Check the water valves; they may be partly closed.

(*a*) Connect a hose to the upper petcock of the water pump.

(*b*) Insert the free end of the hose into a pail or other receptacle, and start the water-cooler unit by shorting out the low pressuretrol switch.

(*c*) Open the drain petcock on the water pump and note whether the water flows into the receptacle under pressure. If the water does not flow under pressure, repair or replace the water pump.

90. Water Cooler, Panel Lamps 5–1, 5–2

a. Abnormal Condition. Indicator Lamps 5 do not glow.

b. PROBABLE CAUSES. (1) Lack of a-c power from the transmitter to the water cooler.

(2) Defective lamp bulbs.

(3) Defective sockets and connections.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located:

NOTE. If one lamp only does not glow, proceed with steps (2) and (3) below.

(1) *Testing a-c power from transmitter to water cooler.* (*a*) Throw the transmitter circuit breaker to the ON position.

(*b*) Check for a-c voltage indication across terminals 1 and 2 of the water-cooler terminal block 8. If no voltage indication is obtained, check the a-c cable between the water cooler and the transmitter unit.

(*c*) If a voltage indication is obtained, check for a voltage indication across terminals 1 and 5 of water-cooler terminal block 10. If no voltage indication is obtained, check all connections between terminal blocks 8 and 10.

(2) *Testing lamp bulbs.* Replace the lamp bulb with a tested new bulb. If the lamp bulb does not glow, reinsert the original bulb into its socket.

(3) *Testing lamp socket and connections.* (*a*) Check the terminals of the lamp socket. Repair or replace any loose or broken connections.

(*b*) Throw the transmitter circuit breaker to the OFF position.

(*c*) Remove the two leads from terminals 1 and 2 of terminal block 8 connecting to terminal block 10.

(*d*) Remove the lamp bulbs from lamp sockets 1, 5–1, and 5–2.

(*e*) Check for continuity across the lamp socket terminals of the lamp socket under test, with the lamp bulb in the socket. If no continuity is indicated, repair or replace the lamp socket under test.

91. Water Cooler, Flapper Valve

a. ABNORMAL CONDITION. (1) Water valves closed, or partly closed.

(2) No water pressure due to a defective water pump.

b. REMEDY. Follow procedure outlined in paragraph 89.

NOTE. Check the water valves by turning counterclockwise as far as possible. Check the water level indicator. If the flapper valve is in the vertical position and the fan motor is heard operating, the flapper valve may be stuck or corroded. Repair or replace the flapper valve.

92. Keyer, Blower 41 (fig. 44)

a. ABNORMAL CONDITION. Blower motor does not operate.

b. PROBABLE CAUSES. (1) Lack of a-c power to the blower motor.

(2) Defective toggle switch 52.

(3) Defective blower motor.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located:

(1) *Testing for a-c power to blower motor.* (*a*) Depress the START button on the MAIN POWER switch. Throw the circuit breaker to the ON position. Note whether the MAIN POWER ON indicator lamp, green 43–1, is glowing. If the lamp does not glow, check the circuit breaker.

(*b*) If the indicator lamp glows, throw the blower-motor toggle switch to the ON position. Note whether the blower-motor indicator lamp, blue 43–5, is glowing. If the lamp does not glow, check the blower-motor toggle switch. If the lamp glows, check the blower motor.

(2) *Testing toggle switch 52.* (*a*) Depress the STOP button on the MAIN POWER switch.

(*b*) Remove the right side panel. Check the toggle switch terminals. Repair or replace any loose or broken connections.

(*c*) Throw the toggle switch to the ON position. Check for continuity across the upper left and lower left terminals of the toggle switch. If no continuity is indicated, repair or replace the blower-motor toggle switch.

(3) *Testing blower motor.* (*a*) Depress the STOP button on the MAIN POWER switch. Check the blower-motor terminals. Repair or replace any loose or broken connections.

(*b*) Remove the a-c input leads from the blower-motor terminals. Check for continuity across the blower-motor input leads. If no continuity is indicated, repair or replace the keyer blower motor.

93. Keyer Main Power On Indicator Lamp, Green 43–1

a. ABNORMAL CONDITION. MAIN POWER ON indicator lamp does not glow.

b. PROBABLE CAUSES. (1) Defective lamp bulb.

(2) Defective socket and connections.

(3) Defective circuit breaker and connections.

(4) Defective relay 46.

(5) Defective switch 51–1.

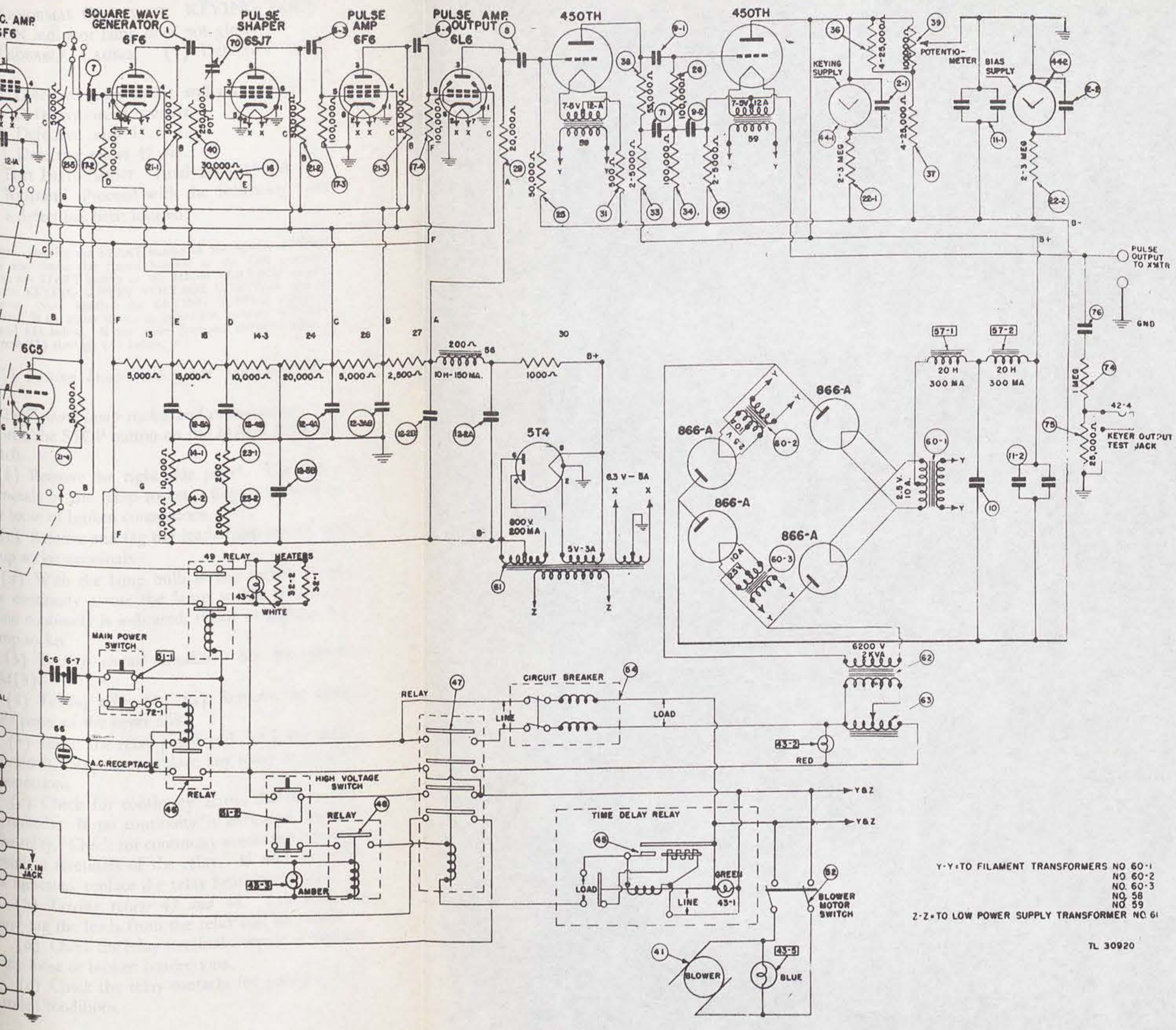


Figure 44. Keyer BC-758-A, schematic.

APPARATUS LEGEND FOR KEYER UNIT BC-758-A

Part No.	Quantity required	Name of part and description
1	1	Capacitor, 0.0002 µf, 600 volts, mica.
2	20	Capacitor, 0.00035 µf, 600 volts, mica.
3	10	Capacitor, 0.001 µf, 600 volts, mica.
4	1	Capacitor, 0.01 µf, 600 volts, mica.
5	1	Capacitor, 3-.03 µf, 600 volts, mica.
6	8	Capacitor, 0.1 µf, 600 volts, paper.
7	1	Capacitor, 0.1 µf, 1,600 volts, oil.
8	1	Capacitor, 0.01 µf, 8,000 volts, mica.
9	2	Capacitor, 1.0 µf, 3,000 volts, Dykanol "a."
10	1	Capacitor, 1.0 µf, 10,000 volts, inerteen.
11	2	Capacitor, 2-1 µf, 6,000 volts, inerteen.
12	5	Capacitor, a-8 µf, b-8 µf, 600 volts.
13	1	Resistor, 5,000 ohms, ½ watt.
14	4	Resistor, 10,000 ohms, ½ watt.
15	1	Resistor, 15,000 ohms, ½ watt.
16	1	Resistor, 30,000 ohms, ½ watt.
17	6	Resistor, 100,000 ohms, ½ watt.
18	1	Resistor, 200,000 ohms, ½ watt.
19	2	Resistor, 2,000 ohms, 1 watt.
20	1	Resistor, 20,000 ohms, 1 watt.
21	5	Resistor, 50,000 ohms, 1 watt.
22	2	Resistor, 2-3 megohm units.
23	2	Resistor, 200 ohms, 2 watts.
24	1	Resistor, 20,000 ohms, 2 watts.
25	1	Resistor, 50,000 ohms, 2 watts.
26	1	Resistor, 100,000 ohms, 2 watts.
27	1	Resistor, 2,500 ohms, 10 watts.
28	1	Resistor, 5,000 ohms, 10 watts.
29	1	Resistor, 20,000 ohms, 20 watts.
30	1	Resistor, 1,000 ohms, 20 watts.
31	1	Resistor, 50 ohms, 50 watts.
32	2	Resistor, heater, 110 volts, 50 watts, screw base.
33	1	Resistor, 10,000 ohms, 100 watts.
34	1	Resistor, 100,000 ohms, 60 watts.
35	2	Resistor, 2-5,000 ohms, 60 watts
36	4	Resistor, 4-25,000 ohms, 60 watts.
37	4	Resistor, 4-25,000 ohms, 60 watts.
38	3	Resistor, 27,500 ohms (2-10,000 ohms, 100 watts) (1-7,500 ohms, 100 watts).

APPARATUS LEGEND FOR KEYER UNIT BC-758-A (Contd.)

Part No.	Quantity required	Name of part and description
39	1	Potentiometer, 100,000 ohms.
40	1	Potentiometer, 250,000 ohms.
41	1	Blower.
42	4	Jack, 2 contact, normally open.
43	5	Pilot light, 125 volts, 6 watts, candelabra base
44	2	Meter, 0-6,000 volts.
45	1	Relay, time delay (30 seconds).
46	1	Relay (contactor), 2-pole make.
47	1	Relay (contactor), 4-pole make.
48	1	Relay (contactor), 1-pole make.
49	1	Relay (contactor), 2-pole break.
50	1	Switch, 6 pole, 3 position, 2 wafer, nonshorting.
51	2	Switch, start-stop.
52	1	Switch, toggle, d.p.s.t., 2 amp, 250 volts.
53	1	Switch, 10 contact (selector).
54	1	Circuit breaker, 5 amp, 20 amp.
55	1	Oscillator coil (special), 335 ohms.
56	1	Choke, 10 h, 150 ma.
57	2	Choke, 20 h, 300 ma.
58	1	Transformer (filament), 7.5 volts, 12 amp, center tap.
59	1	Transformer (filament), low capacity, special.
60	3	Transformer (filament), 2.5 volts, 10 amp, center tap.
61	1	Transformer (power), primary 115 volts; secondary 800 volts at 200 ma, 5 volts at 3 amp, 6.3 volts at 5 amp.
62	1	Transformer (plate), primary 105/110/115 volts; secondary 6,200 volts at 2 kva.
63	1	Transformer (auto), variable, 2 kva.
64	1	Transformer (audio), primary 7,000 ohms, secondary 500 ohms.
65	1	Terminal block (12 terminals).
66	1	Socket, single round type (female).
70	1	Capacitor, 100 µµf, variable.
71	1	Capacitor, 1 µf, 5,000 volts, Dykanol.
72	6	Switch (interlock), solder lug terminals.
73	1	Resistor, 250,000 ohms, 1 watt.
74	1	Resistor, 1 megohm, 25 watts.
75	1	Resistor, 25,000 ohms, 2 watts.
76	1	Capacitor, 0.05 µf, 7,500 volts, oil filled.

wer motor does

ck of a-c power

2.

zer I-153-A.
e following tests

o blower motor.
on on the MAIN
circuit breaker to
ether the MAIN
, green 43-1, is
ot glow, check the

glows, throw the
o the ON position.
tor indicator lamp,
the lamp does not
r toggle switch. If
lower motor.

52. (*a*) Depress
IN POWER switch.
le panel. Check the
epair or replace any

itch to the ON posi-
across the upper left
the toggle switch. If
repair or replace the
.

tor. (*a*) Depress the
AIN POWER switch.
erminals. Repair or re-
connections.
input leads from the
Check for continuity
input leads. If no con-
air or replace the keyer

er On Indicator Lamp,

TION. MAIN POWER
not glow.
(1) Defective lamp

nd connections.
breaker and connections.
.

1-1.

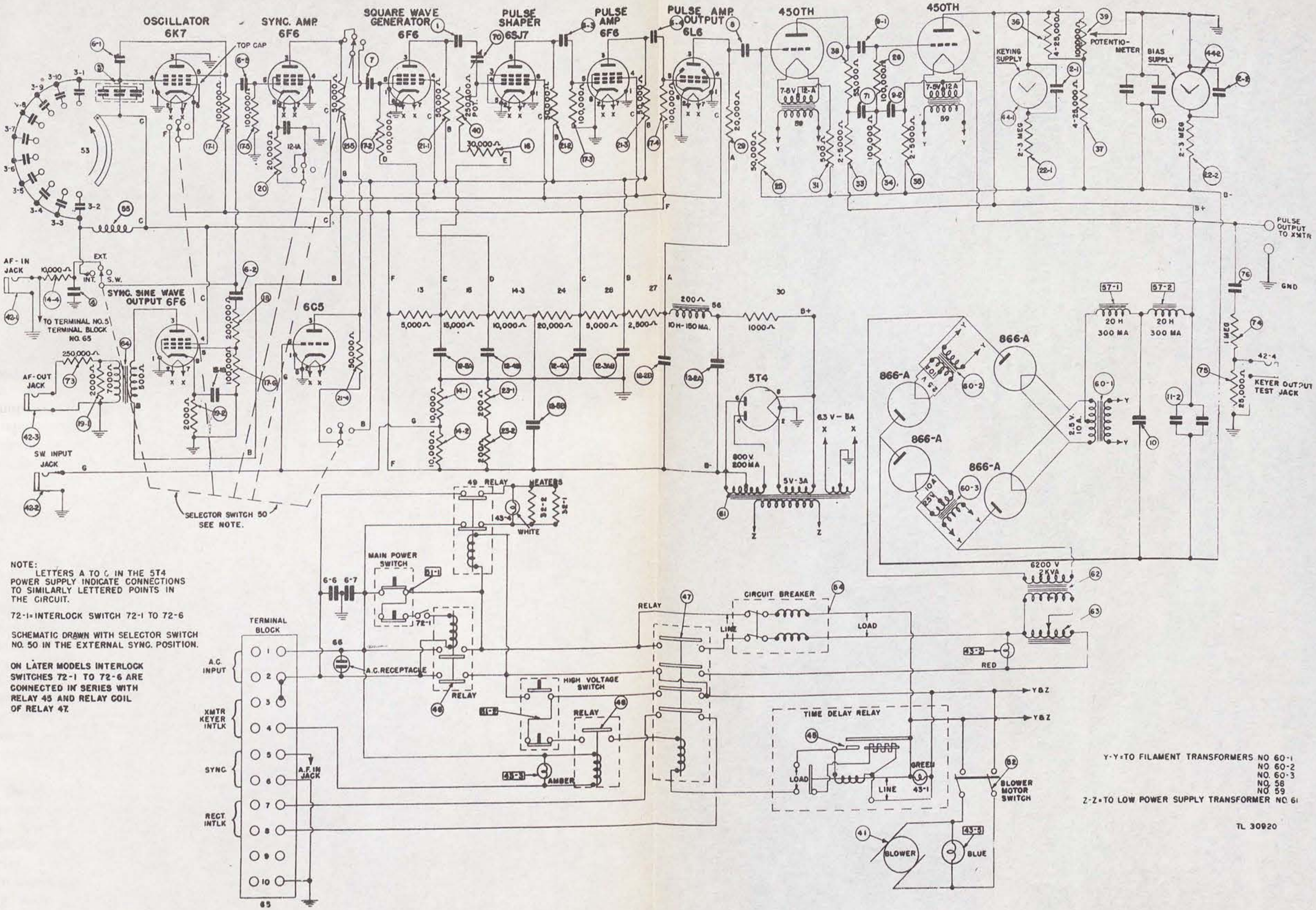


Figure 44. Keyer BC-738-A, schematic.

APPARATUS LEGEND FC

Part No.	Quantity required	Na
1	1	Capacitor, 0.000
2	20	Capacitor, 0.000
3	10	Capacitor, 0.001
4	1	Capacitor, 0.01
5	1	Capacitor, 3-.0
6	8	Capacitor, 0.1 μ
7	1	Capacitor, 0.1 μ
8	1	Capacitor, 0.01
9	2	Capacitor, 1.0 μ
10	1	Capacitor, 1.0 μ
11	2	Capacitor, 2-1 μ
12	5	Capacitor, a-8 μ
13	1	Resistor, 5,000
14	4	Resistor, 10,000
15	1	Resistor, 15,000
16	1	Resistor, 30,000
17	6	Resistor, 100,00
18	1	Resistor, 200,00
19	2	Resistor, 2,000
20	1	Resistor, 20,000
21	5	Resistor, 50,000
22	2	Resistor, 2-3 m
23	2	Resistor, 200 oh
24	1	Resistor, 20,000
25	1	Resistor, 50,000
26	1	Resistor, 100,00
27	1	Resistor, 2,500
28	1	Resistor, 5,000
29	1	Resistor, 20,000
30	1	Resistor, 1,000
31	1	Resistor, 50 oh
32	2	Resistor, heater
33	1	Resistor, 10,000
34	1	Resistor, 100,00
35	2	Resistor, 2-5,00
36	4	Resistor, 4-25,0
37	4	Resistor, 4-25,0
38	3	Resistor, 27,500 (1-7,500 ohm

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following test until a defect has been located.

(1) *Testing lamp bulb.* (*a*) Remove the lamp bulb and replace with a tested new bulb. If the new lamp bulb does not glow, reinsert the original bulb into its socket.

(*b*) Depress the START button on the MAIN POWER switch and throw the circuit breaker to the ON position. Throw the blower-motor toggle switch to the ON position and note whether the blower-motor indicator lamp (blue) glows. If the lamp glows, test the indicator lamp socket of lamp 43–1. If the lamp does not glow, test the circuit breaker and Relay 46.

(2) *Testing lamp socket and connections.* (*a*) Depress the STOP button on the MAIN POWER switch.

(*b*) Remove the right or left side panel. Check the terminals of the lamp socket. Repair or replace any loose or broken connections.

(*c*) Depress the START button on the MAIN POWER switch. Throw the circuit breaker to the ON position. Check for a voltage indication across the lamp socket terminals. If no voltage is obtained, repair or replace the lamp socket.

(3) *Testing circuit breaker.* (*a*) Depress the STOP button on the MAIN POWER switch. Check the circuit breaker terminals. Repair or replace any loose or broken connections.

(*b*) The MAIN POWER switch must be in the OFF position. Throw the circuit breaker to the ON position. Check for continuity across the lower right and top terminals of the circuit breaker. If no continuity is indicated, check for continuity across the lower right and top right terminals. If no continuity is indicated, repair or replace the circuit breaker.

(4) *Testing relay 46.* (*a*) Depress the START button on the MAIN POWER switch. Note whether the heater on indicator lamp, white 43–4 stops glowing. If the lamp stops glowing, check the connections between relay 46 and the circuit breaker. If the lamp continues to glow, check relay 46.

(*b*) Invert the relay panel.

(*c*) Remove and tag the leads from the relay coil terminals. Check for continuity across the relay coil terminals. If no continuity is indicated, replace the relay. Check the relay terminals for loose or broken connections.

(5) *Testing main power switch 51–1.* See paragraph 96*d*(1).

94. Keyer, Keying Voltage On Indicator Lamp, Red, 43–2

a. Abnormal Condition. KEYING VOLTAGE ON indicator lamp does not glow.

b. Probable Causes. (1) Defective lamp bulb.

(2) Defective lamp socket and connections.

(3) Defective circuit breaker.

(4) Defective relay 45.

(5) Defective relays 47, 48.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located:

Note. Depress the START button of the MAIN POWER switch and throw the circuit breaker to the ON position. Depress the START button on the HIGH VOLTAGE switch. Turn the KEYING SUPPLY VOLTAGE CONTROL slightly clockwise. Note whether the KEYING SUPPLY voltmeter indicates. If the meter shows an indication, proceed with tests (1) and (2) below. If the meter does not indicate, proceed with tests (3) through (5) below.

(1) *Testing lamp bulb.* See paragraph 93*d* (1).

(2) *Testing lamp socket and connections.* (*a*) Depress the STOP button on the MAIN POWER switch.

(*b*) Remove the right side panel. Check the terminals of the lamp socket. Repair or replace any loose or broken connections.

(*c*) Remove and tag the leads from one of the lamp socket terminals.

(*d*) With the lamp bulb in the socket, check for continuity across the lamp socket terminals. If no continuity is indicated, repair or replace the lamp socket.

(3) *Testing circuit breaker.* See paragraph 93*d*(3).

(4) *Testing relay 45.* (*a*) Remove the right side panel of the keyer unit.

(*b*) Invert the relay panel and check the relay terminals. Repair or replace any loose or broken connections.

(*c*) Check for continuity across the relay coil terminals. If no continuity is indicated, replace the relay. Check for continuity across the heating-element terminals of the relay. If no continuity is indicated, replace the relay heating element.

(5) *Testing relays 47 and 48.* (*a*) Remove and tag the leads from the relay coil terminals.

(*b*) Check the relay terminals, repair or replace any loose or broken connections.

(*c*) Check the relay contacts for pitted or corroded conditions.

(*d*) Check for continuity across the relay coil terminals. If no continuity is indicated, replace the relay coil or the relay.

95. Keyer, TRANSMITTER READY Indicator Lamp, Amber 43–3

a. Abnormal Condition. TRANSMITTER READY indicator lamp does not glow.

b. Probable Causes. (1) Defective lamp bulb.

(2) Defective lamp socket and connections.

(3) Defective interlock circuit and switches in the transmitter.

(4) Defective relay 10 in transmitter.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located:

Note. Notice whether the keyer HIGH VOLTAGE ON indicator lamp (red) glows. If the lamp glows, proceed with the tests (1) and (2) below. If the lamp does not glow, proceed with tests (3) and (4) below.

(1) *Testing lamp bulb.* See paragraph 93*d*(1).

(2) *Testing lamp socket and connections.* (*a*) Depress the STOP button on the MAIN POWER switch.

(*b*) Lower the filament current of the transmitting tubes to 50 amperes.

(*c*) Remove the right panel of the keyer unit. Check the lamp socket terminals. Repair or replace any loose or broken connections. Check for continuity across the lamp socket terminals with the bulb in the socket. If no continuity is indicated, repair or replace the lamp socket.

(3) *Testing interlock circuit and switches.* (*a*) Shut down the transmitter unit.

(*b*) Remove the fuse supplying the keyer unit with a-c power from the distribution panel or power panel.

(*c*) Remove the transmitter-keyer interlock leads from terminals 3 and 4 on the keyer terminal block 65. Connect the two free ends of the leads together.

(*d*) Remove the bottom right panel of the transmitter unit. Check for continuity across terminals 3 and 4 of the transmitter terminal block 24–1. If no continuity is indicated, check the transmitter-keyer interlock cables for an open-circuited condition. Repair or replace cables if they are found defective.

(*e*) Check for continuity across terminals 1 and 4 or the keyer terminal block 65. If no continuity is indicated, check the leads between the terminals and the lamp socket for loose or broken connections.

(*f*) Connect a jumper across terminals 1 and 2 and across terminals 2 and 3 of transmitter terminal block 24–2. Check for continuity across terminals 1 and 11. If no continuity is indicated, check each of the interlock switches, 1 through 10, for an open-circuited condition.

(4) *Testing relay 10 in transmitter unit.* (*a*) Remove the glass cover from the relay unit.

(*b*) Disconnect the leads from one terminal of the relay coil. Check for continuity across the relay coil terminals. If no continuity is indicated, repair or replace the relay. Check the relay contacts for a pitted or corroded condition.

96. Keyer, HEATER ON Indicator Lamp, White, 43–4

a. Abnormal Condition. HEATER ON indicator lamp does not stop glowing when the START button of the MAIN POWER switch is depressed.

b. Probable Causes. (1) Defective MAIN POWER switch 51–1.

(2) Defective interlock switches 72 (1–6).

(3) Defective relay 46.

(4) Defective relay 49.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located.

Note. Depress the START button of the MAIN POWER switch. Note whether the relay 46 was heard closing. Throw the circuit breaker to the ON position. Note whether the MAIN POWER ON indicator lamp, green, is glowing. If the relay was heard closing and the indicator lamp is glowing, omit steps (1), (2), and (3) below and check relay 49, step (4) below.

(1) *Testing MAIN POWER switch.* (*a*) Remove the a-c power to the keyer unit at the distribution panel.

(*b*) Remove the left panel from the keyer unit.

(*c*) Remove the rear cover from the MAIN POWER switch and check the switch terminals. Repair or replace any loose or broken connections.

(*d*) Check for continuity across the left top and bottom terminals of the switch. If no continuity is indicated, repair or replace the wire jumper in the switch. Check for continuity across the right top and bottom terminals with the START button of the switch depressed. If no continuity is indicated, repair or replace the switch.

(2) *Testing interlock switches.* (*a*) Check the terminals of the interlock switches. Repair or replace any loose or broken connections.

(*b*) Check for continuity across the terminals of the interlock switches with the interlock switch button depressed. Test each switch individually. If no continuity is indicated, repair or replace the switch under test.

(3) *Testing relay 46.* (*a*) Remove the right side panel and invert the relay panel.

(*b*) Remove one of the leads from the relay coil terminals and check for continuity across the relay coil terminals. If no continuity is indicated, repair or replace the relay. Check the relay terminals and contacts. Repair or replace any loose or broken connections.

97. Keyer, BLOWER Indicator Lamp, Blue 43–5

a. ABNORMAL CONDITION. BLOWER indicator lamp does not glow when the BLOWER toggle switch is thrown to the ON position.

b. PROBABLE CAUSES. (1) Defective lamp bulb.

(2) Defective lamp socket and connections.

(3) Defective toggle switch 52.

(4) Defective circuit breaker.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

NOTE. Depress the START button on the MAIN POWER switch and throw the circuit breaker to the ON position. Throw the BLOWER toggle switch to the ON position. Note whether the blower is operating. If the blower is operating, proceed with the tests (1) and (2) below. If the blower is not operating, proceed with tests (3) and (4) below.

(1) *Testing lamp bulb.* Remove the lamp bulb and replace with a tested new bulb. If the new bulb does not glow, reinsert the original bulb into its socket.

(2) *Testing lamp socket and connections.* (*a*) Remove the right side panel of the keyer unit.

(*b*) Check the lamp socket terminals. Repair or replace any loose or broken connections.

(*c*) Remove and tag the leads from one of the socket terminals.

(*d*) With the lamp bulb in the socket and the toggle switch in the OFF position, check for continuity across the lamp socket terminals. If no continuity is indicated, repair or replace the lamp socket.

(3) *Testing toggle switch.* See paragraph 92*d* (2).

(4) *Testing circuit breaker.* See paragraph 93*d*(3).

98. Keyer, Keying Supply Voltmeter 44–1, Reading Too Low

a. ABNORMAL CONDITION. Keying supply voltmeter indicates a voltage lower than 5,000 volts when the KEYING SUPPLY VOLTAGE CONTROL is set to the division designated by the Equipment Performance Log.

b. PROBABLE CAUSES. (1) Defective rectifier tubes 866.

(2) Defective filament transformers 60 (2–3).

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Follow the procedure outlined in paragraphs 104 and 105.

99. Keyer, Keying Supply Voltmeter 44–1, No Reading

a. ABNORMAL CONDITION. Keying supply voltmeter reads zero.

b. PROBABLE CAUSES. (1) Defective meter and connections.

(2) Defective meter multipliers 22–1.

(3) Defective rectifier tubes 866–A.

(4) Defective filter capacitors 10 and 11 (1–2).

(5) Defective chokes 57 (1–2).

(6) Defective filament transformers 60 (1–3).

(7) Defective plate transformer 62.

(8) Defective autotransformer 63.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. For tests (3) through (8) follow procedure outlined in paragraphs 104 and 105.

NOTE. Place the keyer unit in operation. Turn the keying voltage control slightly clockwise. Note whether the BIAS VOLTAGE meter indicates normally; if the BIAS VOLTAGE meter indicates normally, proceed with tests (1) and (2) below. If the above-mentioned conditions are abnormal, proceed with tests (3) through (8) below.

(1) *Testing meter and connections.* (*a*) Remove the right panel from the keyer unit.

(*b*) Check the connections at the meter terminals. Repair or replace any loose or broken connections.

(*c*) Remove and tag the leads from one of the meter terminals.

(*d*) With the analyzer set to the 600,000-ohm range, check for continuity across the meter terminals. If no continuity indication is obtained, repair or replace the meter.

(*e*) Check the meter bypass capacitor, 2–1 for a shorted indication. Replace if shorted.

(2) *Testing meter multipliers.* Remove the meter multipliers from their terminals. Check for continuity across the meter-multiplier terminals. If no continuity indication is obtained, replace the meter multipliers. Check the meter-multiplier terminals. Repair or replace any defective connections.

100. Keyer, Bias Voltmeter 44–2

a. ABNORMAL CONDITION. Bias voltmeter reads zero.

b. PROBABLE CAUSES. (1) Defective meter and connections.

(2) Defective meter multipliers 22–2.

c. TEST INSTRUMENT. Analyzer I–153–A.

NOTE. To test the meter and meter multipliers see paragraph 99*d*(1) and (2). If tests (1) and (2) are normal, see paragraph 102.

101. Keyer, Testing High-Voltage Power Supply (fig. 45)

a. CHOKES. Apply test prods between the output side of Choke 57–2 and the center tap of filament transformer 60–1. Check for a continuity indication. If an infinite resistance indication is obtained, check chokes 57–1 and 57–2 for an open circuit.

b. RESISTORS 33 AND 38. (1) Apply test prods between the plate of the first 450TH and the plate of the second 450TH.

(2) Normal resistance is 37,000 ohms.

(3) If an infinite resistance indication is obtained, check Resistors 33 and 38 for an open circuit.

(4) If the resistance indication obtained is below normal, check resistors 33 and 38 for a shorted condition.

c. RESISTORS 31 AND 35. (1) Apply test prods between the center taps of filament transformers 58 and 59.

(2) Normal resistance is 10,500 ohms.

(3) If an infinite resistance indication is obtained, check resistors 35 and 31 for an open circuit.

(4) If the resistance indication obtained is below normal, check resistors 35 and 31 for a shorted condition.

d. RESISTORS 22–1 AND 22–2. (1) Remove one of the meter-multiplier units 22–1 and 22–2 from each meter circuit.

(2) Apply test prods between the high side of capacitor 11–1 and ground.

NOTE. Potentiometer 39 must be turned to maximum clockwise position for this test.

(3) Normal resistance is 150,000 ohms.

(4) If an infinite resistance indication is ob-

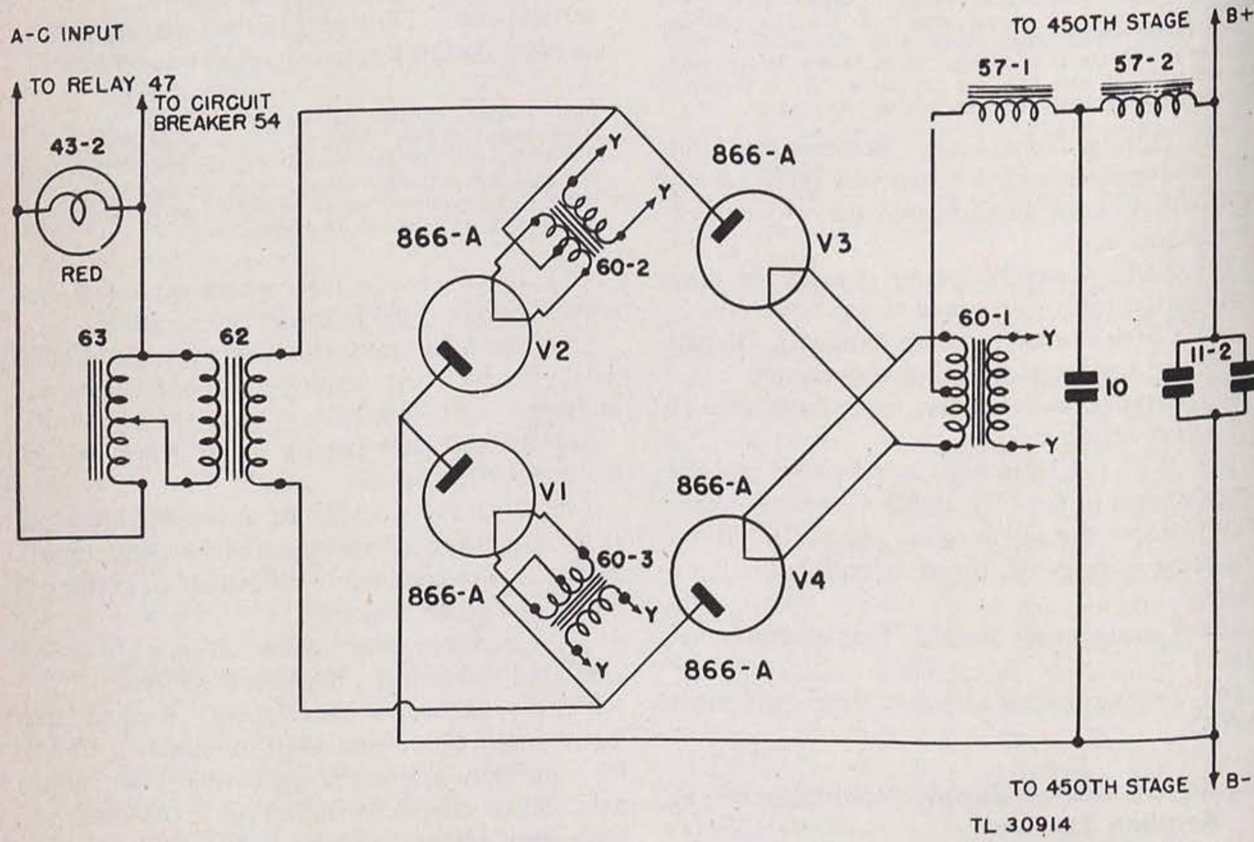


Figure 45. Keyer BC–758–A, schematic of high-voltage power supply.

tained, check resistor unit 37 for an open circuit in one of the resistors.

(5) If a resistance indication of 200,000 ohms is obtained, check Potentiometer 39 and the resistor units 36 for an open circuit.

(6) If the resistance indication obtained is below normal, check potentiometer 39 and resistor units 36 and 37 for a shorted condition.

(7) If a shorted indication is obtained, check capacitors 11–1, 11–2, and 10 for a shorted condition.

e. CAPACITOR 76. (1) Disconnect the capacitor from the circuit.

(2) Apply test prods across the terminals of the capacitor and check for a shorted indication. Observe polarity of the ohmmeter test prods. If a shorted indication is obtained, capacitor 76 has a short circuit and must be replaced.

f. RESISTOR 74. (1) Apply test prods across terminals of resistor 74.

(2) Normal resistance is 1 megohm.

(3) An infinite resistance reading indicates that resistor 74 has an open circuit and must be replaced.

g. RESISTOR 75. (1) Apply test prods between resistors 74 and 75 to ground.

(2) Normal resistance is 25,000 ohms.

(3) An infinite resistance reading indicates that resistor 75 has an open circuit and must be replaced. If a shorted indication is obtained, check the keyer test output jack for a shorted condition.

h. CAPACITORS 2–1 AND 2–2.

NOTE. The capacitors should be removed from the meters and tested individually whenever they are suspected of having a short circuit. This may be indicated by failure of the meter to register.

Apply test prods across the terminal of the capacitors under test and check for a shorted condition. If a shorted indication is obtained, capacitor must be replaced.

i. PRIMARIES OF FILAMENT TRANSFORMERS 58 AND 59. (1) Disconnect one of the primary leads of the transformers and apply test prods across the primary terminals of the transformer. Check for a continuity indication. If an infinite resistance indication is obtained, the primary winding of the transformer has an open circuit. If no repair can be made, replace the transformer.

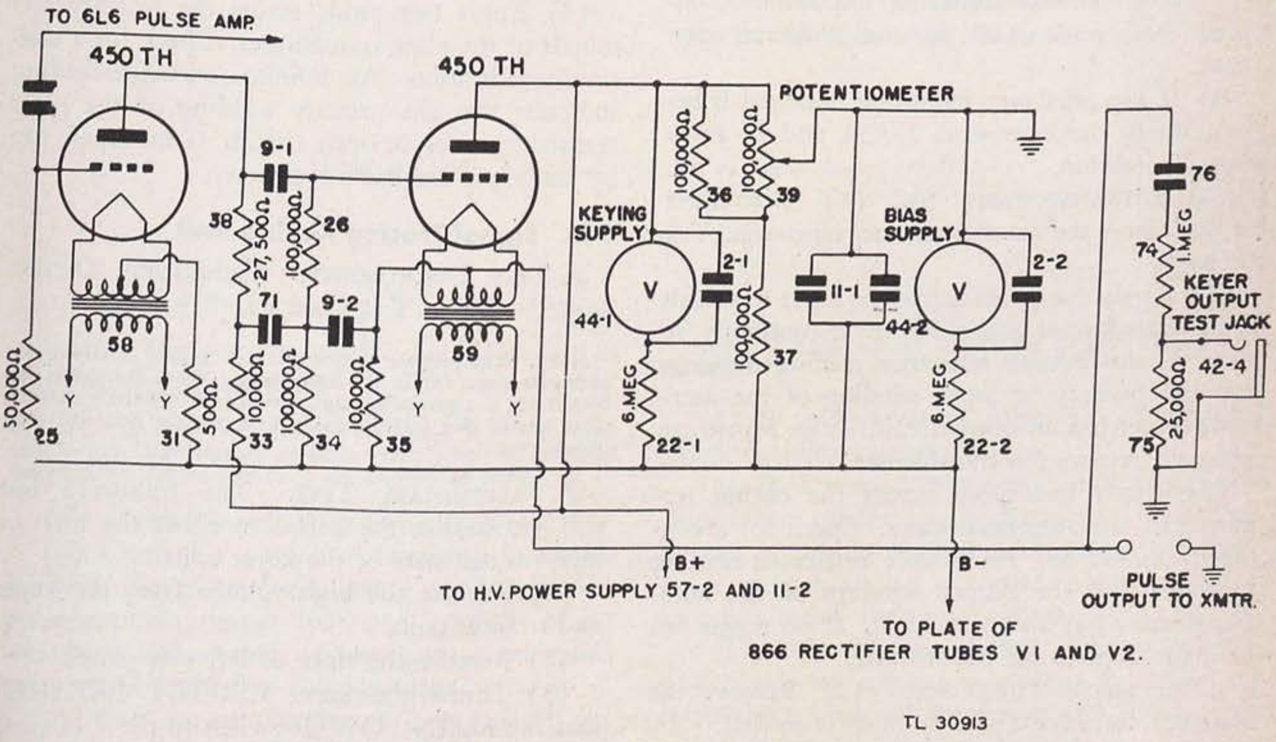


Figure 46. Keyer BC–758–A, schematic of 450th stages.

(2) Remove the 450TH tubes from their sockets. Apply test prods across the secondaries of transformers 58 and 59 in turn. Check for continuity. If an infinite resistance indication is obtained, the secondary winding of the transformer under test is open. If no repair can be made, replace the transformer.

NOTE. While checking the output of the autotransformer for continuity, rotate the autotransformer control arm (keying voltage supply) from zero to maximum. Failure to obtain a variable indication on the ohmmeter is an indication that the rotating arm of the autotransformer is defective.

102. Keyer, Testing 450th Final Amplifier Stages (fig. 46)

a. CAPACITORS 9–1, 9–2, AND 71.

NOTE. Before a resistance test of the final amplifier stage is made, the resistance of the capacitors must be tested.

(1) Using a shorting tool, discharge the capacitors.

(2) Disconnect from the circuit one side of the capacitor under test.

(3) Apply test prods across the terminals of the capacitor and check for a shorted indication. If a shorted indication is obtained, the capacitor has a short circuit and must be replaced.

b. RESISTOR NETWORK. (1) Apply test prods between the grid of the first 450TH and the grid of the second 450TH.

(2) Normal resistance is 250,000 ohms.

(3) If an infinite resistance indication is obtained, check resistors 25, 34, and 26 for an open circuit.

(4) If the resistance indication obtained is below normal, check resistors 25, 34, and 26 for a shorted condition.

c. AUTOTRANSFORMER 63. (1) Disconnect the leads from the autotransformer terminals. Tag the leads.

(2) Apply test prods across the input terminals of the transformer and check for a continuity indication. An infinite resistance reading indicates that the primary or input winding of the autotransformer has an open circuit. If no repair can be made, replace the transformer.

(3) Apply test prods across the output terminals of the autotransformer. Check for a continuity indication. An infinite resistance reading indicates that the output winding of the autotransformer has an open circuit. If no repair can be made, replace the transformer.

d. RECTIFIER TUBES 866. (1) Remove the four 866 Rectifier Tubes from their sockets.

(2) Apply test prods across the filament terminals of each tube and check for continuity. Check each tube individually. If an infinite resistance indication is obtained, the filament element of the tube under test has an open circuit and the tube must be replaced.

e. FILAMENT TRANSFORMERS 60–1, 60–2, AND 60–3. (1) With the 866 Rectifier Tubes removed from their sockets, apply test prods to the filament terminals of the tube sockets and check for continuity. Check each tube socket individually. If an infinite resistance indication is obtained at the socket filament terminals, check for an open circuit in the filament transformer corresponding to the tube socket.

(2) Disconnect one side of the primary winding of filament transformers 60–1, 60–2, and 60–3. Check for a continuity indication. If no continuity indication is obtained, the primary winding of the filament transformer under test has an open circuit. If no repair can be made, replace the transformer.

f. PLATE TRANSFORMER 62. (1) Apply test prods across the secondary terminals of the transformer. Check for continuity only.

(2) An infinite resistance reading indicates that the secondary winding of the plate transformer has an open circuit. If no repair can be made, replace the transformer.

(3) Disconnect one of the a-c input leads from the primary terminals of plate transformer 62.

(4) Apply test prods across the primary terminals of the plate transformer. Check for a continuity indication. An infinite resistance reading indicates that the primary winding of the plate transformer has an open circuit. If no repair can be made, replace the transformer.

103. Signal Tracing Keying Unit

a. TEST INSTRUMENT. Cathode-ray Oscilloscope I–134–A; Test Cord CD–719.

NOTE. The purpose of this test is to isolate defects to one particular stage within the keyer unit. When the defect has been traced to a particular stage, a voltage or resistance measurement test of that stage is made to locate the defective component part.

b. PRELIMINARY TEST. The following test will sectionalize the defect to either the low- or high-voltage state of the keyer unit:

(1) Remove the high voltage from the keyer and rectifier units.

(2) Remove the right or left side panel.

(3) Throw the keyer CIRCUIT BREAKER and the MAIN POWER switch to the ON position.

(4) Turn the selector switch to the internal

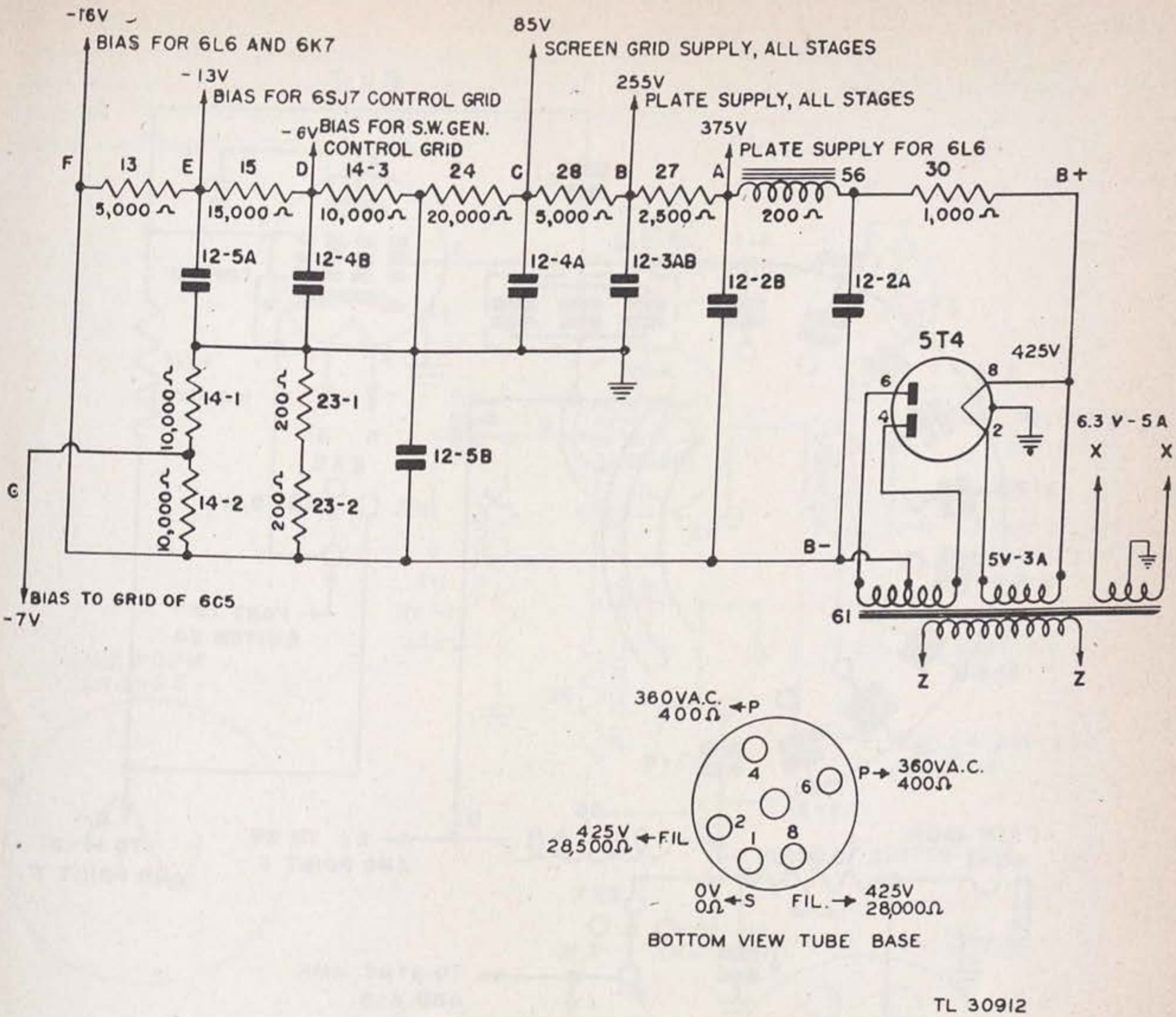


Figure 47. Keyer BC-578-A, schematic of voltage power supply.

position. The selector switch should be left in this position for all tests.

NOTE. On some models of the keyer unit, it will be necessary to short the interlock switches where panels are removed before power can be applied to the low-voltage stages.

(5) Check low-voltage power supply (fig. 47).

(6) Check for a normal waveform indication between the plate (tube prong 3) of the 6L6 pulse-amplifier output tube and ground. If no waveform indication is obtained, the trouble has been traced to the low-voltage stages.

(7) If a normal waveform indication is obtained, check for a waveform indication between the grid of the first 450TH tube and ground.

NOTE. No high voltage is necessary for this test and should be kept off.

(8) If no waveform indication is obtained, check coupling capacitor 8.

(9) If a normal waveform indication is obtained, the trouble has been traced to the high-voltage amplifier stage provided that no waveform indication was obtained when the keyer unit was tested for pulse output.

c. TESTING THE OSCILLATOR STAGE (fig. 48). (1) Check for normal waveform indication between the screen grid (tube prong 4) and ground.

(2) If no waveform indication is obtained, test the oscillator tube and stage.

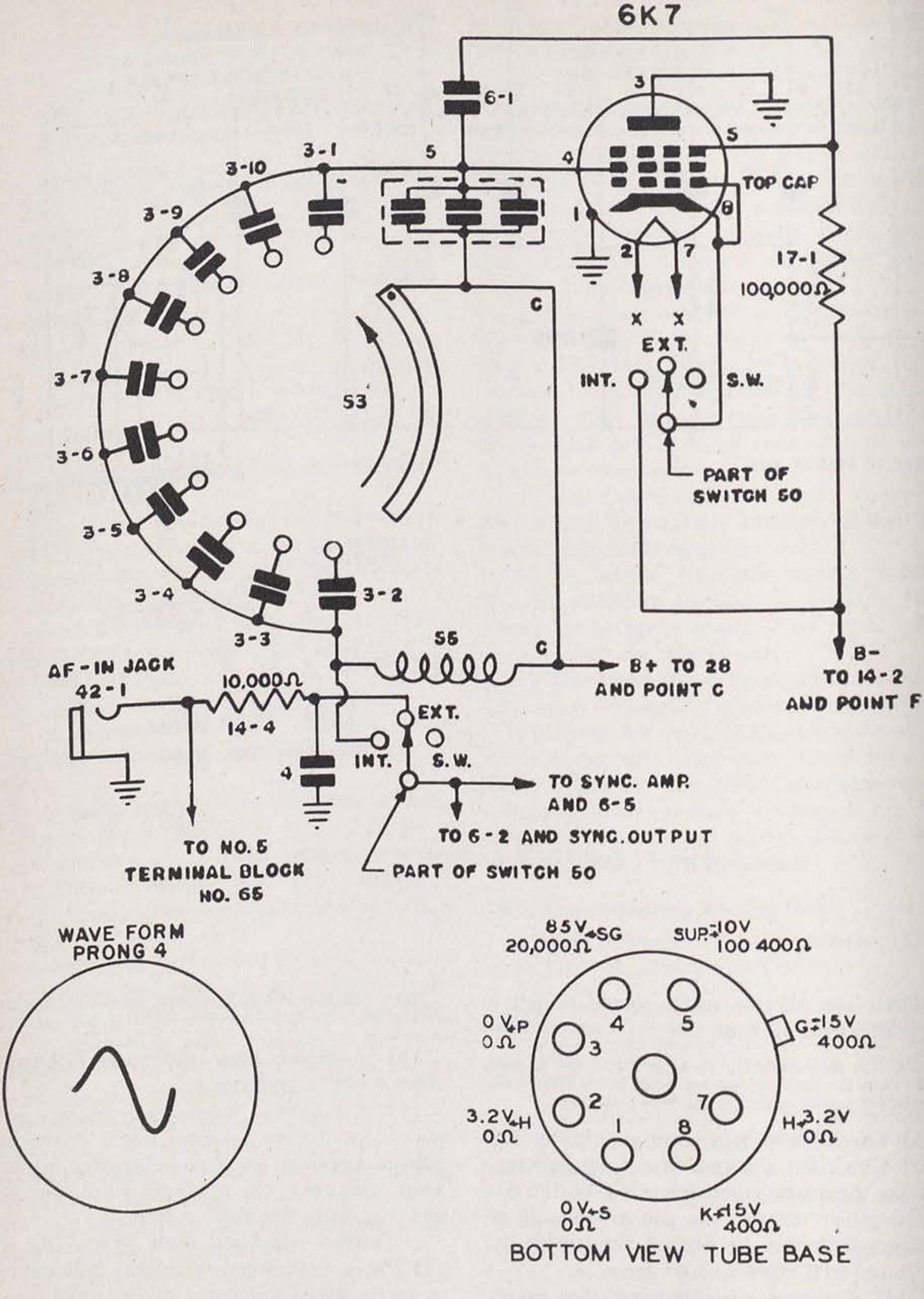


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Figure 48. Keyer BC-758-A, oscillator stage.

d. Testing the Sync. Amplifier Stage (fig. 49). (1) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling capacitor 6–5, and stage.

(2) Check for a normal waveform indication between the plate (tube prong 3) and ground. If no waveform indication is obtained, test the tube and stage.

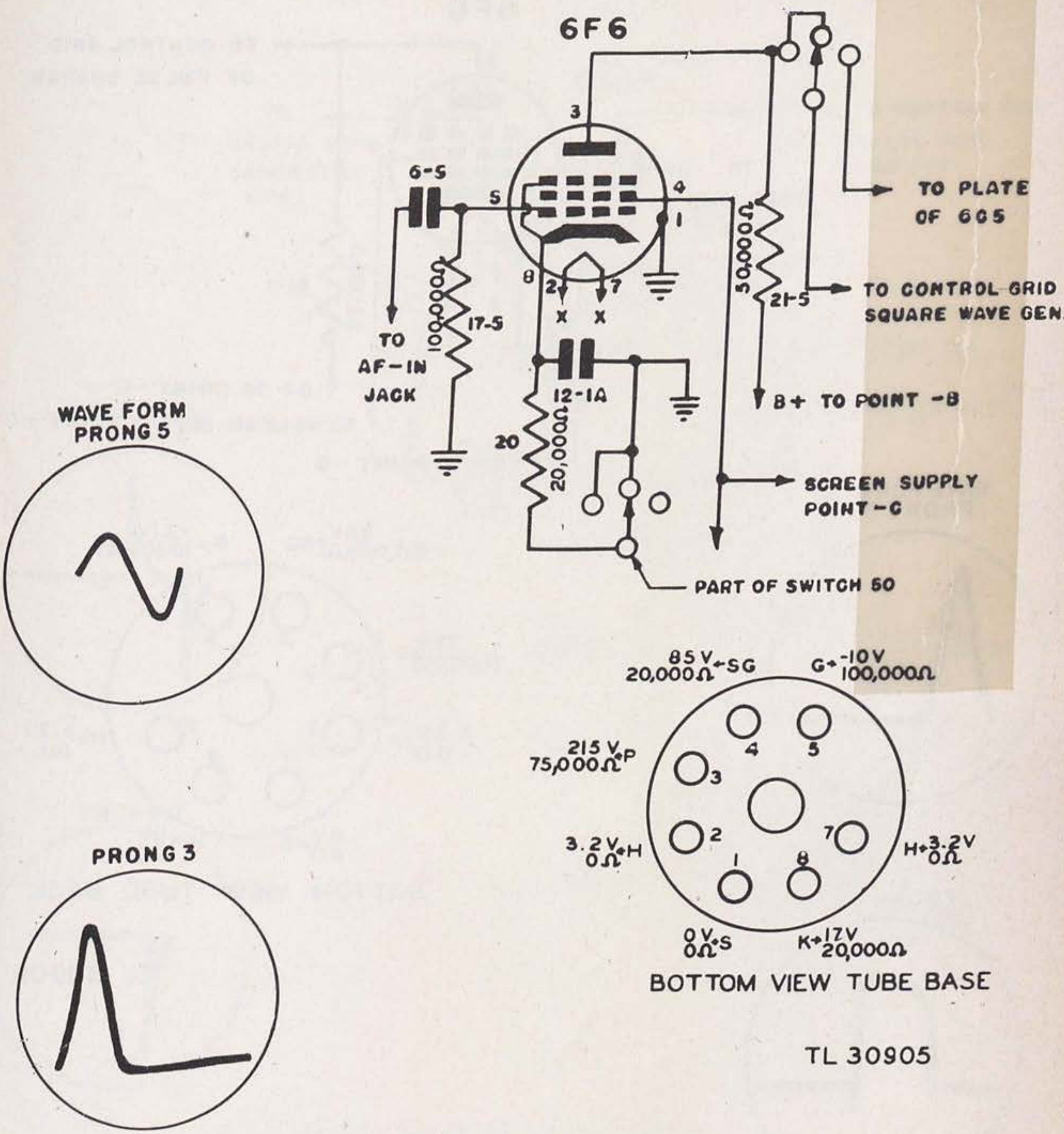


Figure 49. Keyer BC–758–A, sync. amplifier stage.

e. TESTING THE SQUARE-WAVE GENERATOR STAGE (fig. 50). (1) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling capacitor 7 and stage.

(2) Check for normal waveform indication between the plate (tube prong 3) and ground. If no waveform indication is obtained, test the tube and stage.

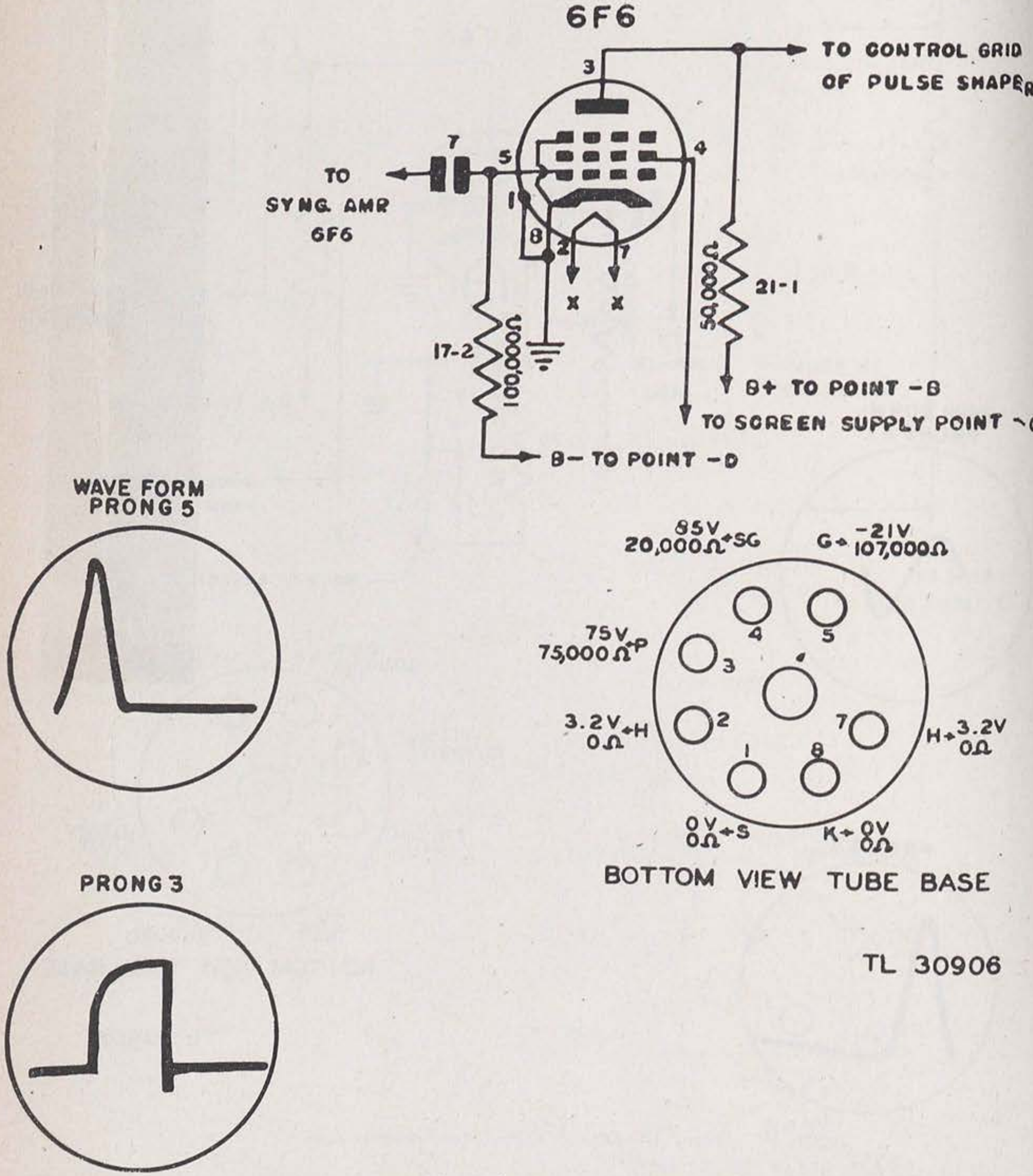


Figure 50. Keyer BC–758–A, square-wave generator stage.

f. Testing the Pulse Shaper Stage (fig. 51). (1) Check for normal waveform indication between the control grid (tube prong 4) and ground. If no waveform indication is obtained, check coupling capacitor 1, variable capacitor 70, and the stage.

(2) Check for normal waveform indication between the plate (tube prong 8) and ground. If no waveform indication is obtained, test the tube and stage.

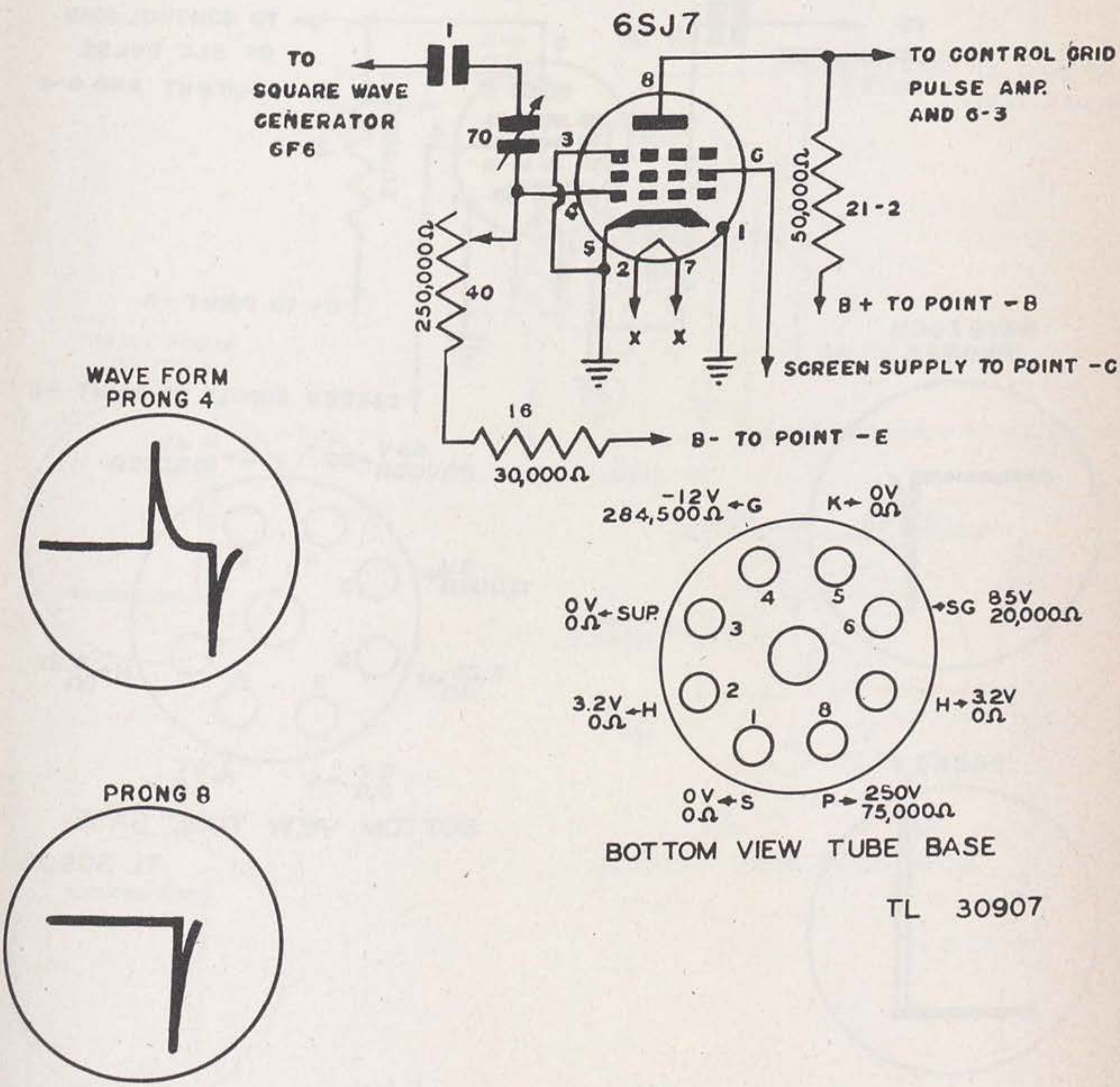


Figure 51. Keyer BC-758-A, pulse shaper stage.

g. TESTING PULSE AMPLIFIER STAGE 6F6 (fig. 52). (1) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling capacitor 6–3 and stage.

(2) Check for normal waveform indication between the plate (tube prong 3) and ground. If no waveform is obtained, test the tube and stage.

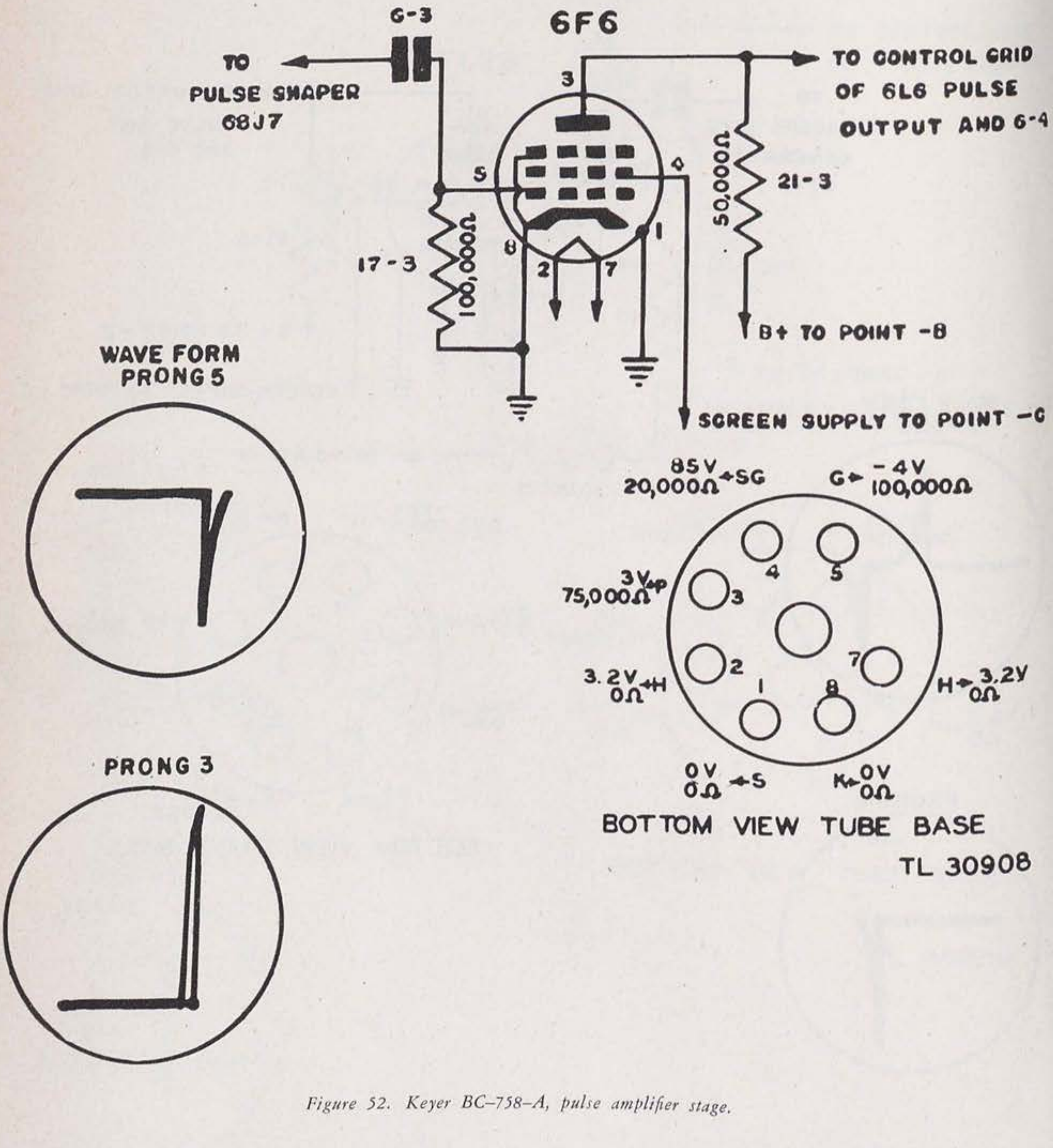


Figure 52. Keyer BC–758–A, pulse amplifier stage.

b. Testing 6L6 Pulse Amplifier Output Stage (fig. 53). (1) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling capacitor 6–4 and stage.

(2) Check for normal waveform indication between the plate (tube prong 3) and ground. If no waveform indication is obtained, test the tube and stage.

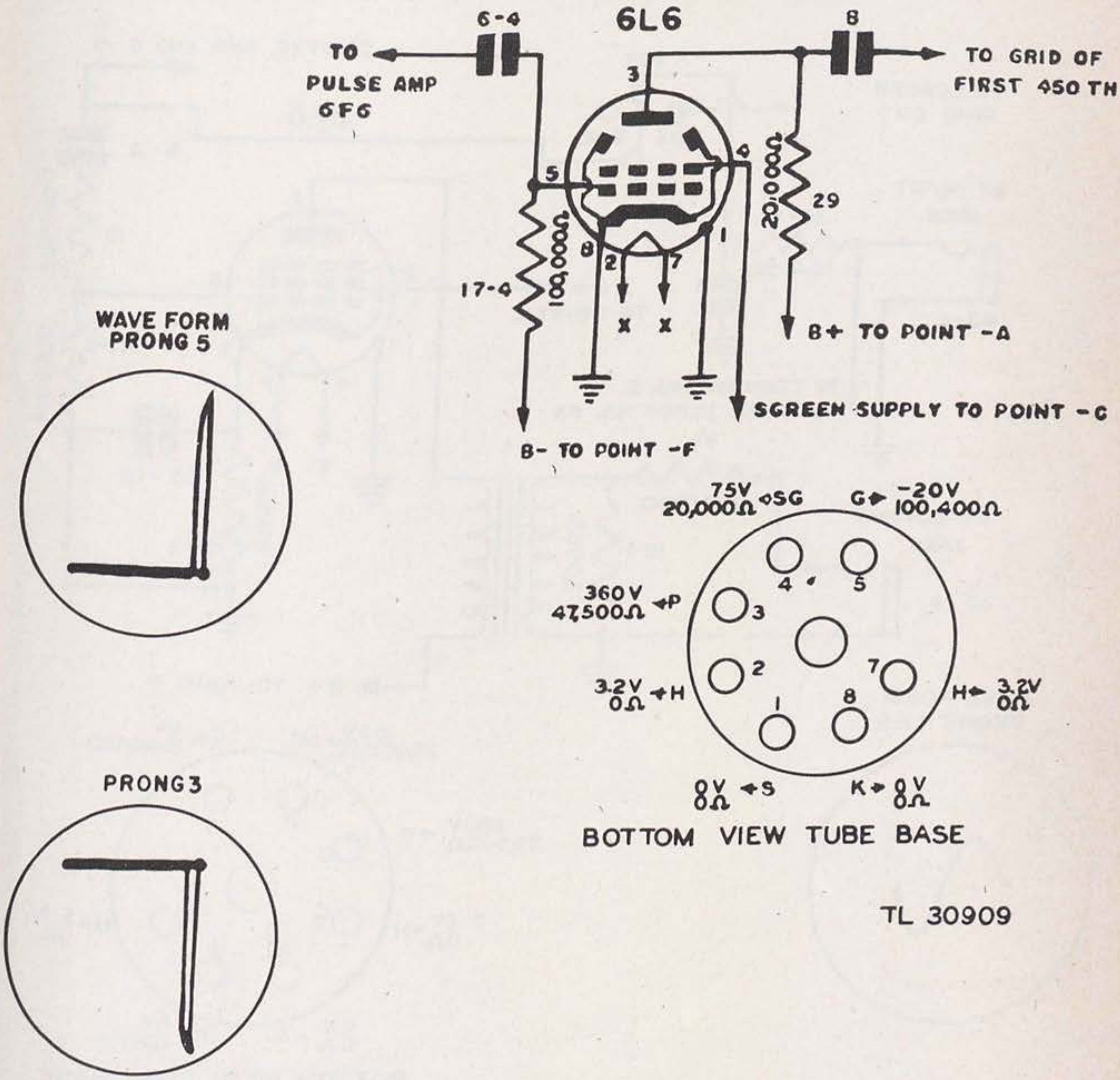


Figure 53. Keyer BC–758–A, pulse amplifier output stage.

i. TESTING 6L6 SYNC. SINE-WAVE OUTPUT STAGE (fig. 54).

NOTE. This stage should be tested especially when no waveform indication was obtained when testing the oscillator stage. Do not omit this stage when signal tracing even though it may seem that this stage has no direct relation to the preceding stages.

(1) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling capacitor 6–2 and stage.

(2) Check for normal waveform indication between the plate (tube prong 3) and ground. If no waveform indication is obtained, test the tube and stage.

(3) Check for normal waveform indication at the a-f output jack. If no waveform indication is obtained, check the jack circuit.

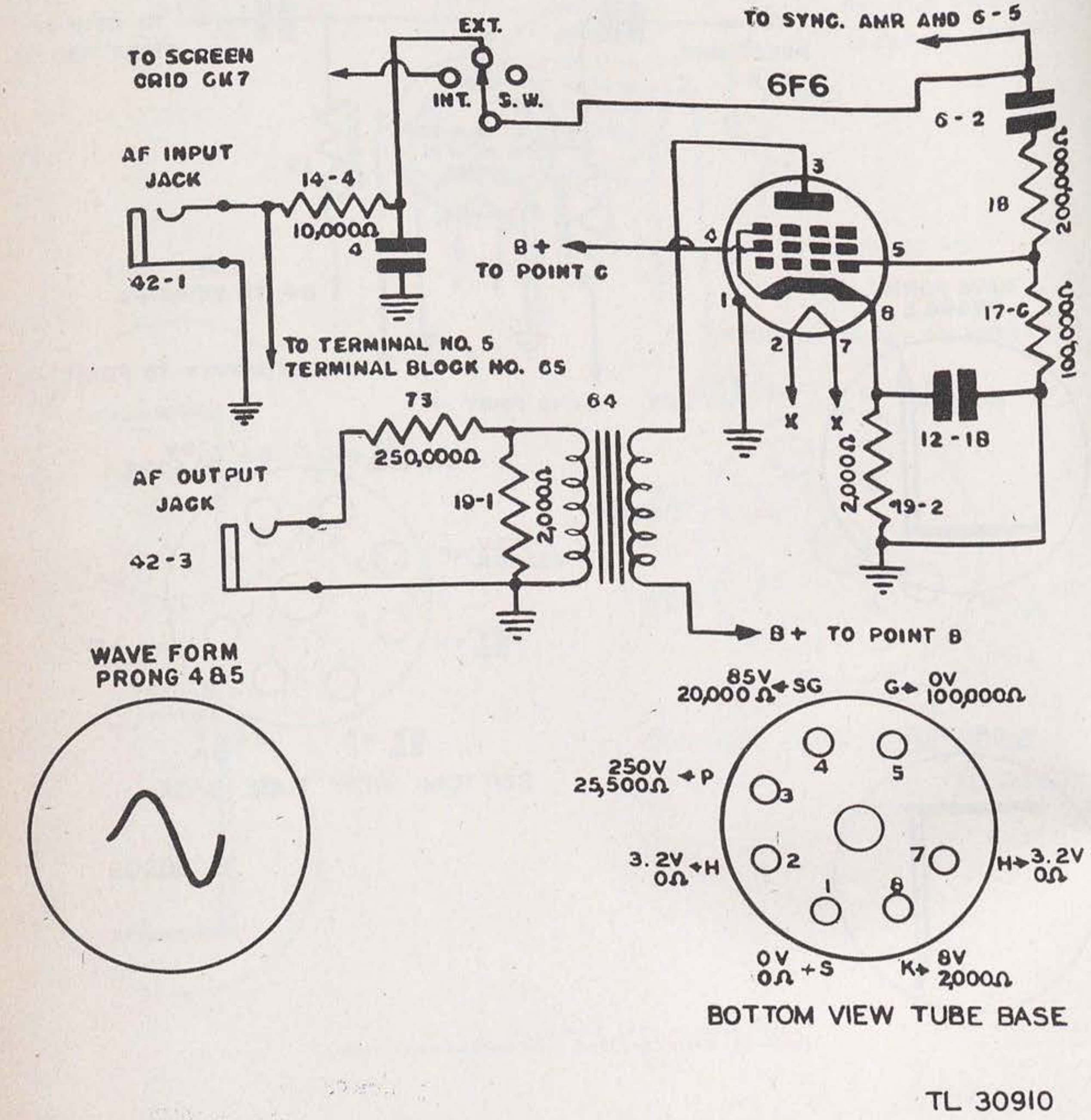
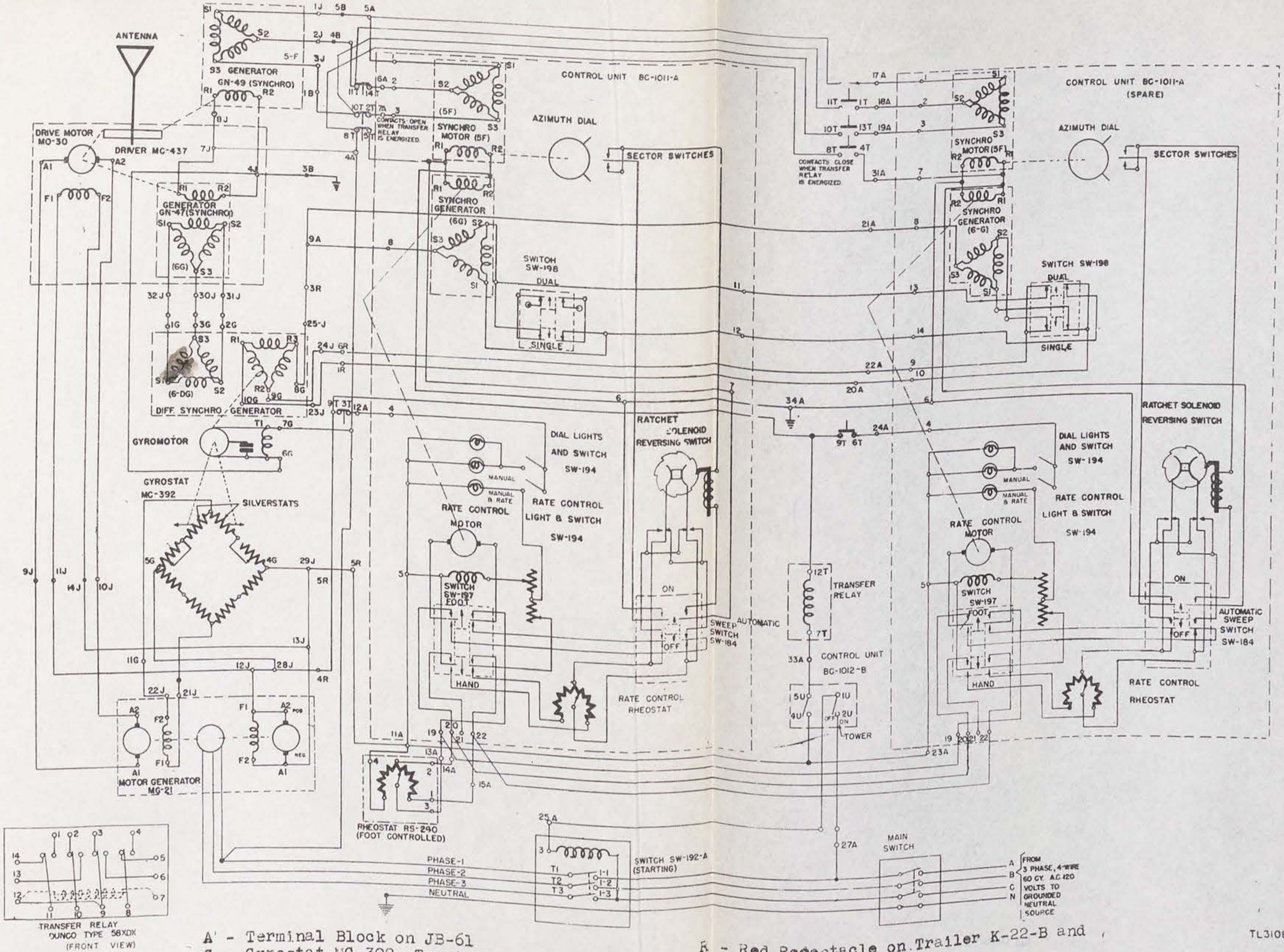
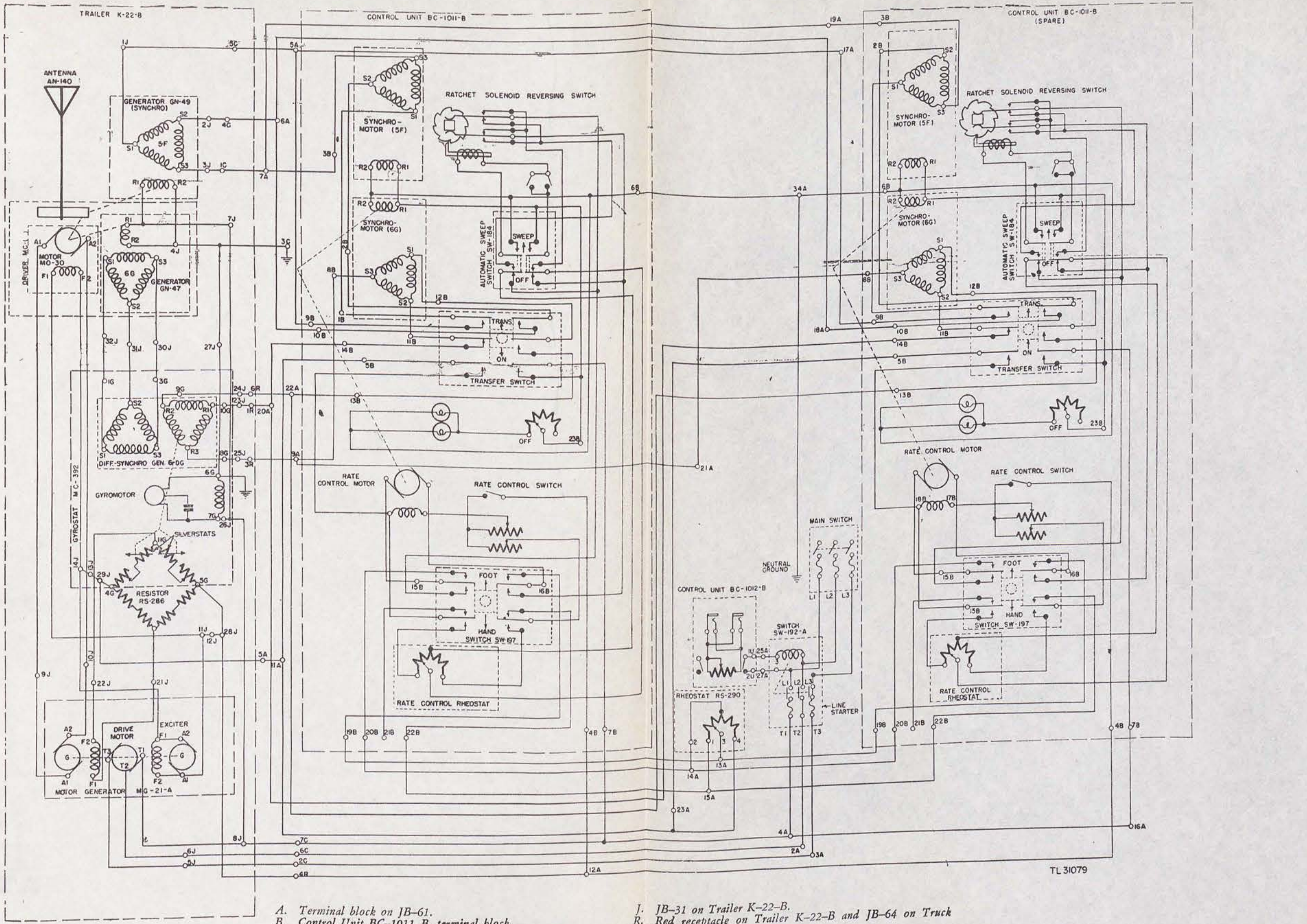


Figure 54. Keyer BC–758–A, sync. sine-wave output stage.



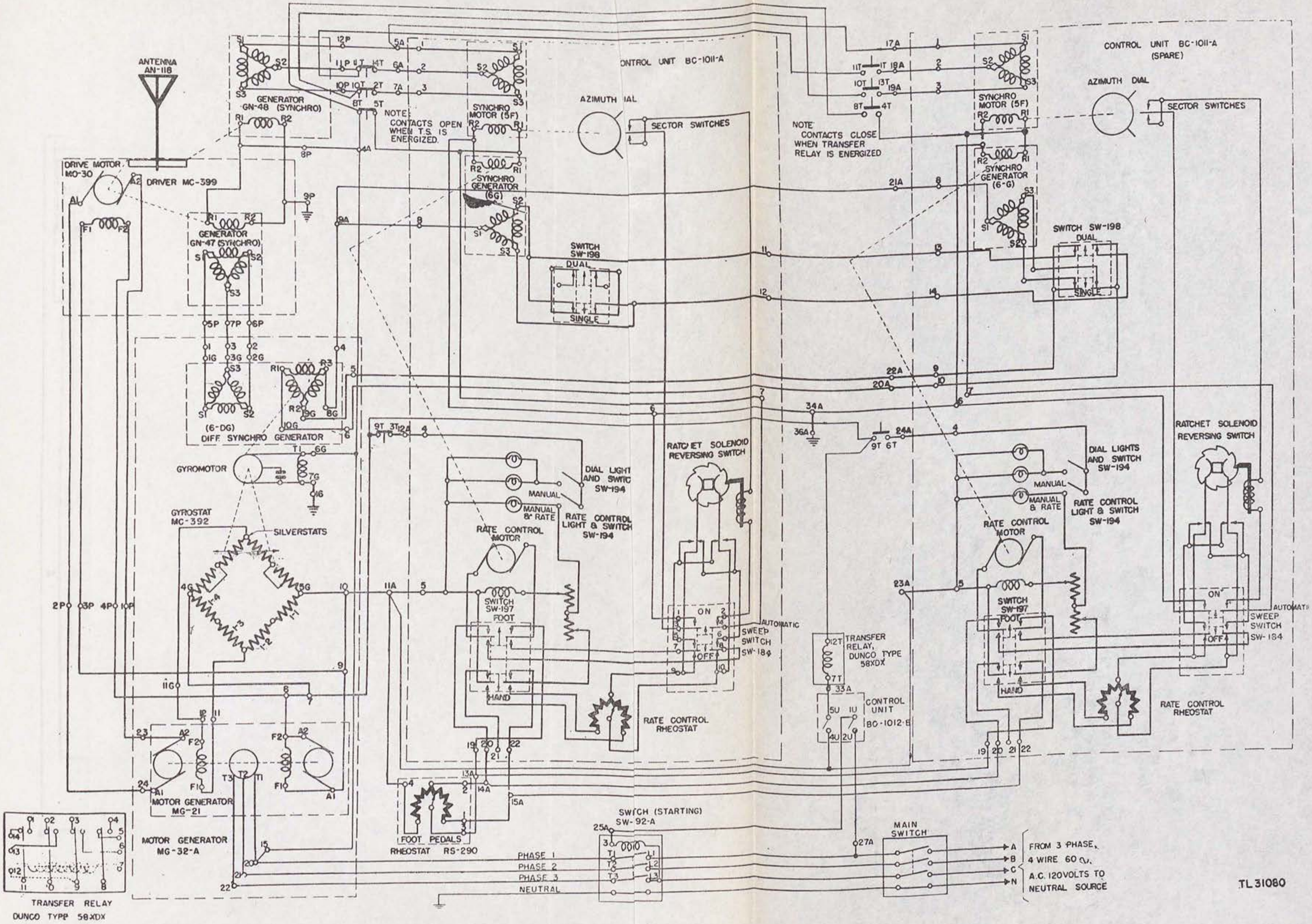
A' - Terminal Block on JB-61
G - Gyrostat MC-392, Terminal Block
J - Terminal Block on JB-31 (on Trailer K-22-B)
R - Red Receptacle on Trailer K-22-B and JB-64 on Truck K-30
U - Control Unit BC-1012-B, Terminal Block

Figure 55. Antenna Position Control MC-298-A, schematic (with Control Unit BC-1011-A).



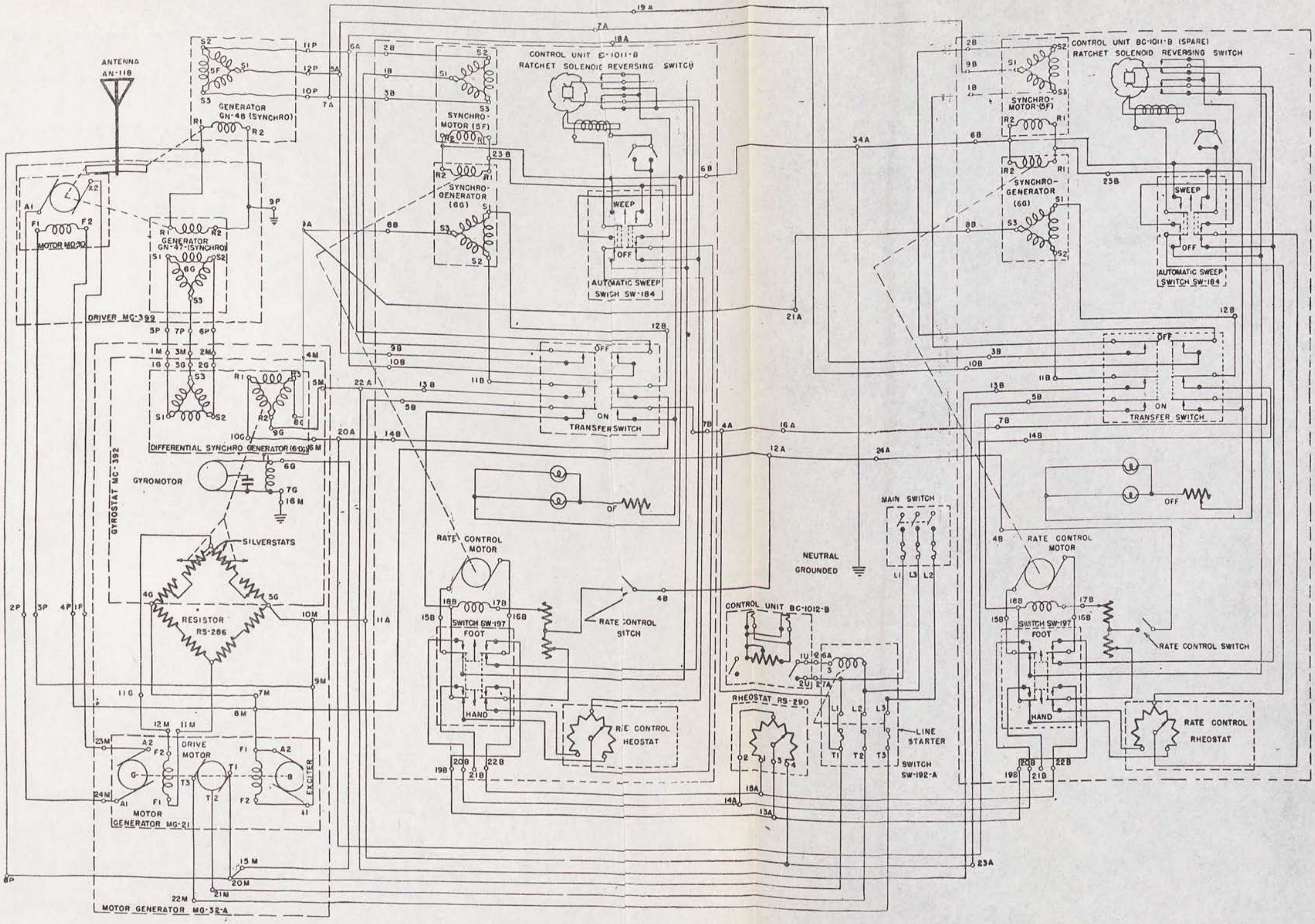
A. *Terminal block on JB-61.*
B. ***Control Unit BC-1011-B, terminal block.***
C. *Green receptacle on trailer K-22-B and JB-64 on Truck K-30.*
G. *Gyrostat MC-392, terminal block.*
J. *JB-31 on Trailer K-22-B.*
R. *Red receptacle on Trailer K-22-B and JB-64 on Truck K-30.*
U. *Control Unit BC-1012-B, terminal block.*

Figure 56. Antenna Position Control MC-298-A, schematic (with Control Unit BC-1011-B)



A. *Terminal block on JB–61.*
G. *Gyrostat MC–392, terminal block.*
P. *Power Panel BD–111–A, terminal block.*
T. *Terminal on transfer relay.*
U. *Control Unit BC–1012–B, terminal block.*

Figure 57. Antenna Position Control MC–298–B, schematic (with Control Unit BC–1011–A).



A. Terminal block on JB-61.
B. Control Unit BC-1011-B, terminal block.
G. Gyrostat MC-392, terminal block.
M. JB-77 on Motor Generator MG-32-A.
P. Power Panel BD-111-A, terminal block.
U. Control Unit BC-1012-B, terminal block.

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Figure 58. Antenna Position Control M-298-B, schematic (with Control Unit BC-1011-B).

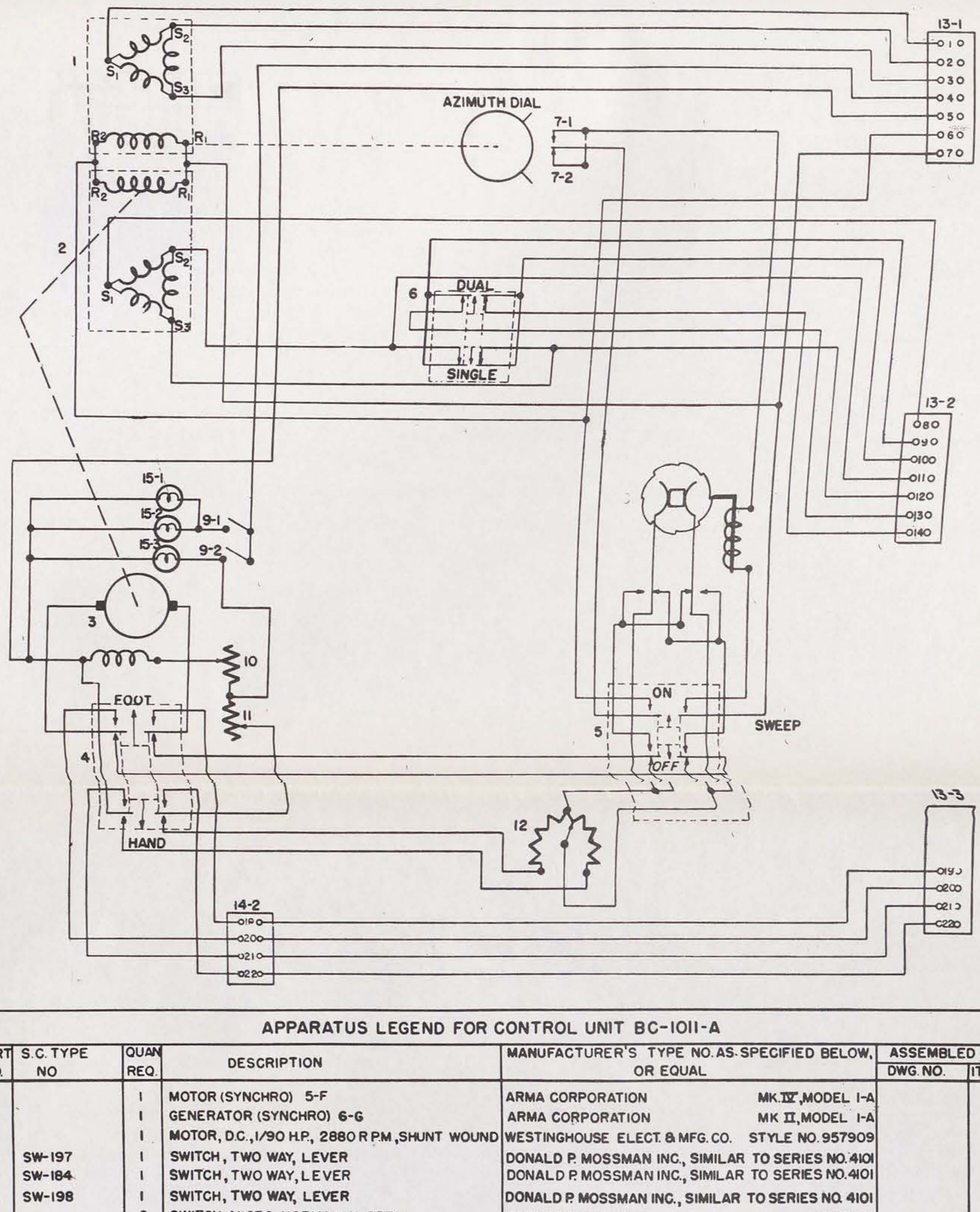
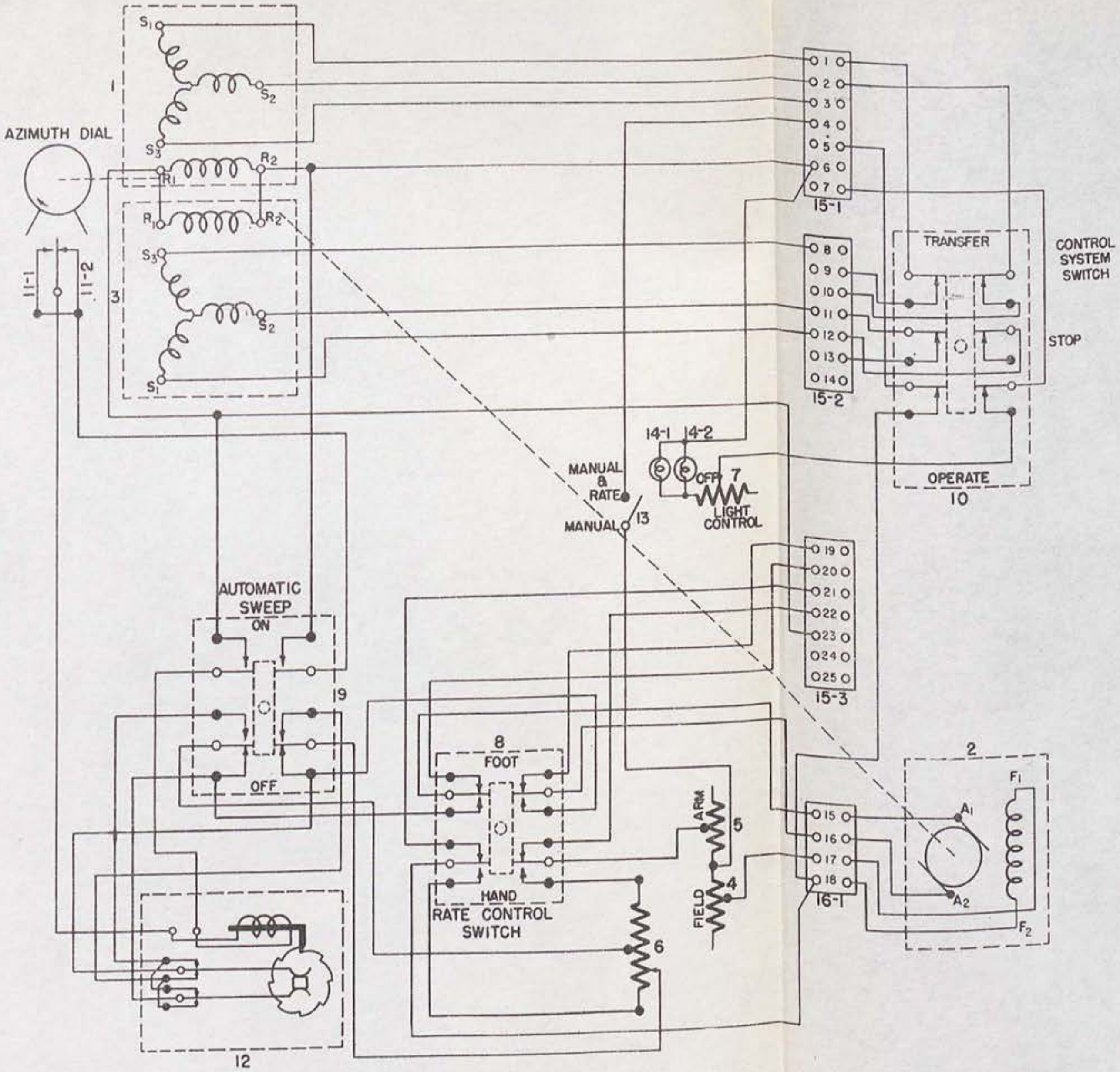


Figure 59. Control Unit BC-1011-A, schematic.

APPARATUS LEGEND FOR CONTROL UNIT BC-1011-A						
PART NO.	S.C. TYPE NO	QUAN REQ.	DESCRIPTION	MANUFACTURER'S TYPE NO. AS SPECIFIED BELOW, OR EQUAL	ASSEMBLED ON DWG. NO.	ITEM
1		1	MOTOR (SYNCHRO) 5-F	ARMA CORPORATION MK.IV, MODEL 1-A		
2		1	GENERATOR (SYNCHRO) 6-G	ARMA CORPORATION MK II, MODEL 1-A		
3		1	MOTOR, D.C., 1/90 H.P., 2880 R.P.M., SHUNT WOUND	WESTINGHOUSE ELECT. & MFG. CO. STYLE NO. 957909		
4	SW-197	1	SWITCH, TWO WAY, LEVER	DONALD P. MOSSMAN INC., SIMILAR TO SERIES NO. 4101		
5	SW-184	1	SWITCH, TWO WAY, LEVER	DONALD P. MOSSMAN INC., SIMILAR TO SERIES NO. 4101		
6	SW-198	1	SWITCH, TWO WAY, LEVER	DONALD P. MOSSMAN INC., SIMILAR TO SERIES NO. 4101		
7		2	SWITCH, MICRO, NORMALLY OPEN	MICRO SWITCH CORP. NO. YZR17		
8		1	SWITCH, RATCHET SOLENOID, REVERSING	GENERAL CONTROL CO. TYPE RS-5		
9	SW-194	2	SWITCH, TOGGLE, 3 AMP. 250 VOLT	BRYANT ELECTRIC CO. CAT. NO. 5141-A		
10		1	RESISTOR 1000 OHMS, 50 WATTS	OHMITE MFG. CO. CAT. NO. 0572		
11		1	RESISTOR 100 OHMS 100 WATTS	OHMITE MFG. CO. CAT. NO. 0960		
12		1	RHEOSTAT 2000 OHMS, 600 V., 1.06 AMP.	OHMITE MFG. CO. MODEL P, SPEC. NO. 9584		
13		3	TERMINAL STRIP, 7 TERMINAL	HOWARD B. JONES CAT. NO. 7-21		
14		1	TERMINAL STRIP, 4 TERMINAL	HOWARD B. JONES CAT. NO. 4-21		
15		3	LIGHT, DIAL, MAZDA, 6 W., 120 V.,	WESTINGHOUSE ELECT. & MFG. CO. STYLE NO. S-6		
				TL-31904		



APPARATUS LEGEND

REF. NO.	S.C. TYPE NO.	DESCRIPTION	*MANUFACTURER	MFR'S. TYPE NO.	QUAN.
		MOTORS			
1		SYNCHRO-MOTOR 5-F	ARMA CORP.	MK IV MODEL I-A	1
2		DC, 1/90 H.P., 2800 R.P.M. SHUNT WOUND	WESTINGHOUSE ELEC.& MFG. CO.	957909	1
		GENERATOR			
3		SYNCHRO-GENERATOR 6-G	ARMA CORP.	MK II MODEL I-A	1
		RESISTORS			
4		1000 OHMS, 50 WATTS	OHMITE MFG. CO.	0572	1
5		100 OHMS, 100 WATTS	OHMITE MFG. CO.	0960	1
6		RHEOSTAT, 200 OHMS, 600 V., 1.06 AMP.	OHMITE MFG. CO.	MODEL P #9584	1
7		RHEO., 2500 OHMS, WITH OFF POSITION	OHMITE MFG. CO.	MODEL H #3520	1
		SWITCHES			
8	SW-197	4-POLE, DOUBLE-THROW, LEVER	D.P. MOSSMAN INC.	4101	1
9	SW-184	D.P.D.T., D.P.S.T., LEVER	D.P. MOSSMAN INC.	4101	1
10		6-POLE, SINGLE-THROW, LEVER	D.P. MOSSMAN INC.	4101	2
11		MICROSWITCH, NORMALLY OPEN	MICROSWITCH CORP.	Y2R17	1
12		RATCHET SOLENOID, D.P.D.T.	GENERAL CONTROL CO.	RS-5	1
13	SW-194	TOGGLE, 3 AMP., 250 V., S.P.S.T.	BRYANT ELECTRIC CO.	5141-A	1
		LAMP			
14		DIAL, 6 W., 120 V.	WESTINGHOUSE ELEC.& MFG. CO.	S-6	2
		TERMINAL STRIPS			
15		7-TERMINAL	H.B. JONES	7-21	3
16		4-TERMINAL	H.B. JONES	4-21	1

* MANUFACTURER INDICATED OR EQUAL AND INTERCHANGEABLE WITH ITEM SPECIFIED.

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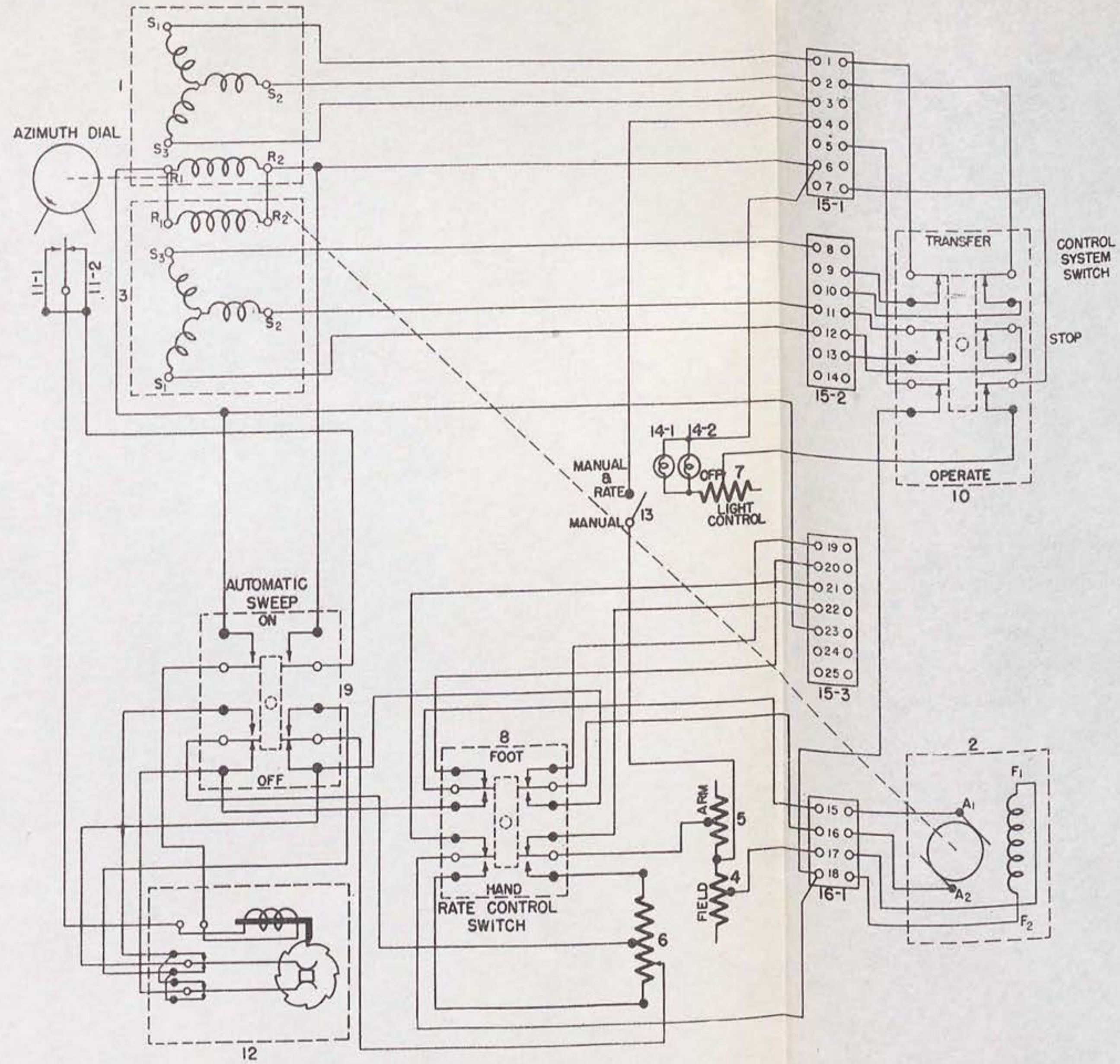
Figure 60. Control Unit BC-1011-B, schematic.



APPARATUS LEGEND

REF NO.	S.C. TYPE NO.	DESCRIPTION	*MANUFACTURER	MFR'S. TYPE NO.	QUAN.
		MOTORS			
1		SYNCHRO-MOTOR 5-F	ARMA CORP.	MK IV MODEL I-A	1
2		DC, 1/90 H.P., 2800 R.P.M. SHUNT WOUND	WESTINGHOUSE ELEC.& MFG. CO.	957909	1
		GENERATOR			
3		SYNCHRO-GENERATOR 6-G	ARMA CORP.	MK II MODEL I-A	1
		RESISTORS			
4		1000 OHMS, 50 WATTS	OHMITE MFG. CO.	0572	1
5		100 OHMS, 100 WATTS	OHMITE MFG. CO.	0960	1
6		RHEOSTAT, 200 OHMS, 600 V, 1.06 AMP.	OHMITE MFG. CO.	MODEL P#9584	1
7		RHEO, 2500 OHMS, WITH OFF POSITION	OHMITE MFG. CO.	MODEL H#3520	1
		SWITCHES			
8	SW-197	4-POLE, DOUBLE-THROW, LEVER	D.P. MOSSMAN INC.	4101	1
9	SW-184	D.P.D.T., D.P.S.T., LEVER	D.P. MOSSMAN INC.	4101	1
10		6-POLE, SINGLE-THROW, LEVER	D.P. MOSSMAN INC.	4101	1
11		MICROSWITCH, NORMALLY OPEN	MICROSWITCH CORP.	Y2R17	2
12		RATCHET SOLENOID, D.P.D.T.	GENERAL CONTROL CO.	RS-5	1
13	SW-194	TOGGLE, 3 AMP., 250 V., S.P.S.T.	BRYANT ELECTRIC CO.	5141-A	1
		LAMP			
14		DIAL, 6 W., 120 V.	WESTINGHOUSE ELEC.& MFG. CO.	S-6	2
		TERMINAL STRIPS			
15		7-TERMINAL	H.B. JONES	7-21	3
16		4-TERMINAL	H.B. JONES	4-21	1

* MANUFACTURER INDICATED OR EQUAL AND INTERCHANGEABLE WITH ITEM SPECIFIED.

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Figure 60. Control Unit BC-1011-B, schematic.

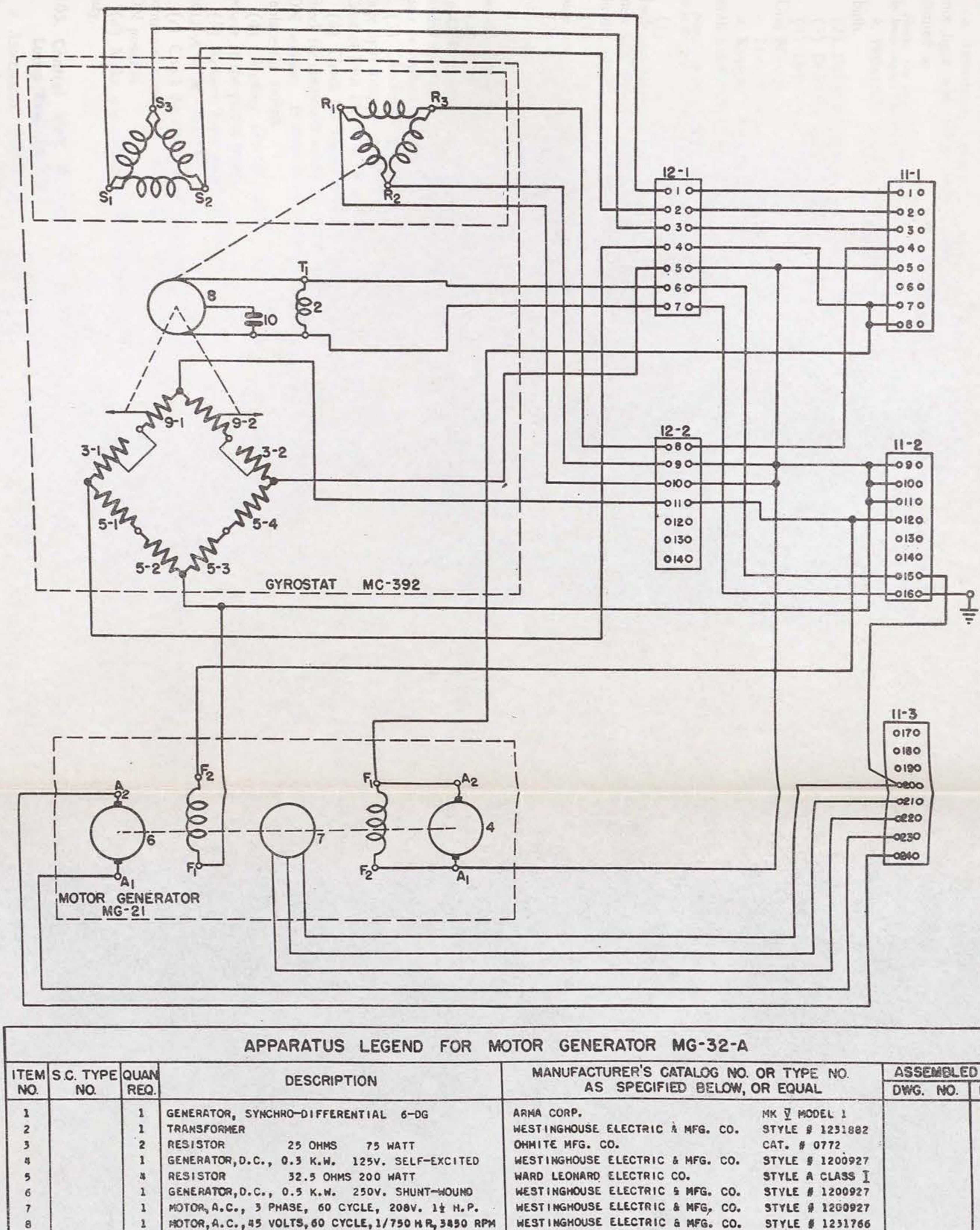

Figure 61. Motor Generator MG-42-A, schematic.

APPARATUS LEGEND FOR MOTOR GENERATOR MG-32-A

ITEM NO.	S.C. TYPE NO.	QUAN REQ.	DESCRIPTION	MANUFACTURER'S CATALOG NO. OR TYPE NO. AS SPECIFIED BELOW, OR EQUAL		ASSEMBLED ON DWG. NO.	ASSEMBLED ON ITEM
1		1	GENERATOR, SYNCHRO-DIFFERENTIAL 6-DG	ARMA CORP.	MK V MODEL 1		
2		1	TRANSFORMER	WESTINGHOUSE ELECTRIC & MFG. CO.	STYLE # 1231882		
3		2	RESISTOR 25 OHMS 75 WATT	OHMITE MFG. CO.	CAT. # 0772		
4		1	GENERATOR, D.C., 0.3 K.W. 125V. SELF-EXCITED	WESTINGHOUSE ELECTRIC & MFG. CO.	STYLE # 1200927		
5		4	RESISTOR 32.5 OHMS 200 WATT	WARD LEONARD ELECTRIC CO.	STYLE A CLASS I		
6		1	GENERATOR, D.C., 0.5 K.W. 250V. SHUNT-WOUND	WESTINGHOUSE ELECTRIC & MFG. CO.	STYLE # 1200927		
7		1	MOTOR, A.C., 3 PHASE, 60 CYCLE, 208V. 1½ H.P.	WESTINGHOUSE ELECTRIC & MFG. CO.	STYLE # 1200927		
8		1	MOTOR, A.C., 45 VOLTS, 60 CYCLE, 1/750 H.P., 3450 RPM	WESTINGHOUSE ELECTRIC & MFG. CO.	STYLE # 1231766		
9		2	SILVERSTAT RESISTOR 6 TO 590 OHMS	WARD LEONARD ELECTRIC CO., WEMCO	STYLE # 1231459		
10		1	CAPACITOR, 5 MFD, 165V. 60 CYCLES	CORNELL DUBILIER CO.	CAT. # KLA2050		
11		3	TERMINAL STRIP, 8 TERMINAL	WESTINGHOUSE ELECTRIC & MFG. CO.	STYLE # 542246		
12		2	TERMINAL STRIP, 7 TERMINAL	WESTINGHOUSE ELECTRIC & MFG. CO.	STYLE # 1231696		

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104. Control Unit BC–1011–A or BC–1011–B Panel Lamps

a. ABNORMAL CONDITION. Panel lamps do not light with DIAL LIGHT toggle switch is turned on.

NOTE. On Control Unit BC–1011–B, lamps are controlled by knob labeled LIGHT CONTROL.

b. PROBABLE CAUSES. (1) Defective lamp bulb.

(2) Defective socket or connections.

(3) Defective toggle switch.

(4) Defective ON–OFF switch on Control Unit BC–1012–A or BC–1012–B.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located:

NOTE. If one lamp lights and the other does not, the trouble is in the bulb, socket, or wiring of the lamp affected.

(1) *Testing light bulb.* Remove the lamp bulb and replace with a tested new bulb. If the new bulb does not light, replace the original bulb in the socket.

(2) *Testing lamp socket.* (*a*) Remove the side panel of Control Unit BC–1011–A.

(*b*) Check the socket terminals. Repair or replace any broken connections.

(*c*) Remove and tag the leads from one of the socket terminals.

(*d*) With bulb in the socket and toggle switch in OFF position, check for continuity across the socket terminals. If no continuity is indicated, repair or replace the socket.

(3) *Checking toggle switch.* (*a*) Remove voltage by turning off power to the unit at switch on Control Unit BC–1012–A or BC–1012–B.

(*b*) Check the toggle switch connections and check for continuity across the switch with it in the ON position. If there is no continuity, repair or replace the switch.

(4) *Checking On–Off switch.* (*a*) Remove power at the power panel.

(*b*) Remove front panel of Control Unit BC–1012–A or BC–1012–B.

(*c*) Check the switch connections and check for continuity across the switch with the switch in the ON position.

(*d*) Make any repairs or replacement necessary.

105. Control Unit BC–1011–A, Indicator Lamp (Red) (fig. 59)

a. ABNORMAL CONDITION. Indicator lamp does not glow when MANUAL AND RATE–MANUAL switch is in the MANUAL AND RATE position.

b. PROBABLE CAUSES. (1) Defective light bulb.

(2) Defective socket.

(3) Defective switch SW–194.

(4) Defective ON-OFF switch.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

(1) *Testing light bulb.* Remove the lamp bulb and replace it with a new tested bulb. If the new bulb does not light replace the original one in the socket.

(2) *Testing socket.* (*a*) Remove side panel of Control Unit BC–1011–A.

(*b*) Check the socket terminals. Repair any loose or broken connections.

(*c*) Check the socket for continuity with the voltage off and the bulb in the socket.

(*d*) If no continuity is indicated, repair or replace the socket.

(3) *Checking toggle switch.* See paragraph 104*d*(3).

(4) *Testing ON-OFF switch.* See paragraph 104*d*(4).

106. Motor Generator MG–21 (fig. 61)

NOTE. The component parts of Motor Generator MG–32–A are Gyrostat MG–392, Motor Generator MG–21, and Resistors RS–289. When mounted on Trailer K–22–B, these components are treated individually. When used in the fixed installation, they are treated as one unit Motor Generator MG–32–A.

a. ABNORMAL CONDITION. Motor generator set does not start when the ON-OFF switch on Control Unit BC–1012–A or BC–1012–B is turned to ON position.

b. PROBABLE CAUSES. (1) Defective wiring to Motor Generator MG–21.

(2) Defective ON-OFF switch on Control Unit BC–1012–A or BC–1012–B.

(3) Defective a-c induction motor.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

(1) *Checking wiring of motor generator MG–21.* (*a*) Check for presence of alternating current at the terminals of the induction motor.

(*b*) If alternating current is not present at the motor terminals, check for loose connections or broken wiring in the circuit.

(2) *Checking ON-OFF switch.* See paragraph 104*d*(4).

(3) *Checking induction motor.* (*a*) If induction motor will not start and the proper alternat-

ing current is available at the motor terminals, the motor generator set should be replaced with the spare unit. Ordinarily, the repair of an induction motor should not be attempted by the radar technician.

(*b*) Before disassembly of the set, permission must be obtained from the officer in charge.

NOTE. Voltage used by the induction motor is 3-phase, 208-volt.

107. Control Unit BC–1011–A or BC–1011–B, Indicator Dials

a. ABNORMAL CONDITION. Indicator dials do not rotate when motor generator set is started.

b. PROBABLE CAUSES. (1) Defective wiring in Selsyn system.

(2) Defective Selsyn motor or Selsyn generator.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located:

(1) *Checking wiring in Selsyn system.* (*a*) Check a-c voltage at terminals in junction boxes and terminal strips until a defect is localized.

(*b*) If defective wiring is discovered, make any necessary repairs.

(2) *Checking Selsyns.* (*a*) Make a voltage check at the terminals of the Selsyn.

(*b*) Remove and tag leads to Selsyn terminals.

(*c*) Check continuity between Selsyn terminals. Remove and replace Selsyn if an internal open circuit is indicated.

NOTE. Do not take apart or attempt any internal repair on a Selsyn unit unless permission of the officer in charge has been obtained.

108. Antenna System

a. ABNORMAL CONDITION. Antenna does not rotate when rate control rheostat is energized.

b. PROBABLE CAUSES. (1) Defective rate control rheostat.

(2) Defective rate control motor.

(3) Defective d-c exciter.

(4) Defective Selsyn control system.

(5) Defective Silverstat in Gyrostat MC–392.

(6) Defective d-c generator.

(7) Defective antenna drive motor.

(8) Defective antenna drive mechanism.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

(1) *Checking rate control rheostat* (fig. 59).

NOTE. Try both hand and foot controls. If the antenna rotates, when either control is used, the trouble has been localized to the other rheostat circuit.

(*a*) Check wiring between the rate control rheostat and the rate control motor, including switches in the circuit.

(*b*) Make sure that the contactor arm is making a good contact on the rheostat.

(*c*) Make a resistance measurement of the rheostat.

(*d*) Make any necessary repair or replacement.

(2) *Testing rate control motor* (fig. 59). (*a*) Measure d-c voltage present across the field of the rate control motor. It should be approximately 50 volts.

(*b*) If the voltage is wrong, check variable series resistors 10 and 11. Adjust the resistance, if necessary.

(*c*) Check condition of motor brushes and bearings. Replace or clean brushes if necessary. If bearings are worn, replace the motor.

(*d*) If no voltage is present, check the d-c exciter in Motor Generator MG–21. See test (3).

(*e*) If rate control motor is operating properly, check the transmission gears to synchro-generator 6G.

(3) *Testing d-c exciter* (fig. 61).

NOTE. The d-c exciter provides excitation for the Wheatstone bridge field of the rate control motor and the field of Antenna Drive Motor MO–30.

(*a*) Check the output voltage of the exciter. This should be 118–132 volts.

(*b*) If the correct voltage is present, check the wiring and connections of all output circuits.

(*c*) Check the condition of brushes. Clean or replace, as the condition requires. Brushes should be replaced if they are worn to half their original length.

(*d*) If voltage is not present, replace the exciter unit.

(4) *Testing Selsyn control system.* See paragraph 107*d*(2).

(5) *Testing silverstat in Gyrostat MC–392* (fig. 62). (*a*) Check the two legs of the Wheatstone bridge for continuity. Replace any defective resistor or repair any broken connections.

(*b*) Check alignment of Silverstat. The two fibre push pins should just touch the first Silverstat leaves on each side but not cause the closing of any contacts when the rate control rheostats are in the center position.

(*c*) See that all contacts are clean.

(*d*) If necessary, adjust the gyromotor centering springs to proper tension.

(6) *Checking d-c generator.* (*a*) Check condition of brushes.

(*b*) Check voltage across d-c generator field. It should be 29–37 volts direct current.

(c) If no voltage is present make a continuity test of the field of the generator.

(d) Measure d-c current on armature. It should be 1.4 to 1.6 amperes. If there is no current, make a continuity test.

(e) Replace the generator if either the field or armature is found defective.

(7) *Testing antenna drive motor MO–30.* (a) Check condition of motor brushes and bearings.

(b) Make d-c current measurements of both field and armature. Refer to table of test readings and operating data, e below. Field current should be 0.27 to 0.34 amperes. Armature current should be 1.4 to 1.6 amperes.

(c) If there is no current through the field winding, make a continuity check of the field and the wiring connections to the d-c exciter.

(d) If there is no current in the armature winding, check the armature and the connections to the d-c generator for continuity.

(e) Repair any open or broken connections. If there is an open circuit in the field or armature of the motor, replace the motor.

(8) *Testing antenna drive mechanism.* (a) Inspect the gears for proper meshing and lubrication.

(b) Repair or replace any defective part.

e. ABNORMAL CONDITION. Antenna moves erratically.

f. PROBABLE CAUSES. (1) Gyromotor is not running.

(2) Incorrect adjustment of Silverstat.

g. TEST INSTRUMENT. Analyzer I–153–A.

h. REMEDY. Proceed with the following tests until a defect has been located.

(1) *Testing gyromotor* (fig. 62). (a) Check transformer for continuity. Replace transformer if an open circuit is indicated.

(b) Check 5-μf capacitor for a short circuit, first removing one set of leads between the motor and the capacitor.

(c) If capacitor is defective, replace with a new one.

(2) *Testing adjustment of silverstat.* (a) See paragraph 108*d*(5).

(b) Try reversing the leads to the motor generator field (F1 and F2). The Silverstat correction may be in the wrong direction.

i. ABNORMAL CONDITION. Antenna rotates in wrong direction.

j. PROBABLE CAUSE. Reversal of leads to synchro-generator 6G.

k. REMEDY. Reverse two of the leads marked S on the armature of synchro-generator 6G.

NOTE. While checking the operation of the antenna position control system, examine carefully the mechanical operation of the system, noting any worn or broken gears or gear teeth, worn bearings, obstructions to operation of moving parts, and any lack of lubrication of gears and bearings. Replace any broken or worn part and lubricate when necessary with the proper oil or grease.

l. Test Readings and Operating Data Antenna Position Control MC–298.

1. Rate control motor speed (either direction)	2,880 rpm ± 5%
2. Antenna drive motor speed	1,800 rpm ± 5%
3. Gyromotor speed	3,300–3,500 rpm
4. Motor generator speed	1,725 rpm (min.)
5. Rate control motor field	50 v ± 1 v dc
6. D-c exciter output	118–132 v dc
7. D-c generator field	29–37 v dc
8. D-c generator output	250 v dc
9. A-c induction motor 3 phase, 208 v	1,120 watts (max.)
10. D-c exciter output	2.4–2.9 amp
11. D-c generator field	0.66–0.84 amp
12. Antenna drive motor field	0.27–0.34 amp
13. Antenna drive motor armature	1.42–1.60 amp
14. D-c input to control box	0.7–0.9 amp
15. D-c input to gyrostat	1.42–1.60 amp
16. A-c input to control box	2–2.4 amp
17. A-c input to gyrostat	0.130–0.155 amp
18. A-c input to 6G sychrotie	1.5–1.8 amp

Section IV. RECEIVING SYSTEM

109. General Information

a. Practically all of the more serious troubles encountered in the radio sets will show up, in one manner or another, as some irregularity in the image on the screen of the oscilloscope. Frequently, this will be the only outward sign that something is wrong. In the case of power system or transmitting system troubles, other indications of the nature and location of the trouble will usually accompany the appearance of an abnormal image on the screen, but troubles in the receiving system will not usually produce any other indication of their presence. Fortunately, however, the appearance of a distorted image frequently provides a good clue to the probable nature and location of its cause.

b. Due to the relatively small size of the components used in the receiving system, most of the actual trouble shooting work within the components normally will be done on the test bench. Actual trouble location and clearance done on the receiving system as a whole will usually be accomplished by the substitution of the proper spare components. For this reason, the spare components must be kept in good operating condition at all times. The regular and spare components should be interchanged at least once every 2 weeks, whether or not such interchange is necessitated by trouble conditions, in order that both units can be serviced and to prevent the deterioration of the equipment from long-standing idleness.

c. If the oscilloscope is off and cannot be turned on, as indicated by no pilot light on the range dial and no image on the screen, first check the a-c power plug connection on the rear panel of the unit. If the power is on, replace the oscilloscope with the spare unit; then locate and clear the trouble in the defective unit. If the fuse on the rear panel is blown, do not replace it without first investigating and correcting the cause of its failure.

d. If no image at all appears on the screen of the oscilloscope when the power is on, the oscilloscope itself is faulty. The nature and location of the fault within the unit cannot be predicted, but the most likely source of trouble is tube or capacitor failure.

e. If the image on the screen is a single spot, the trouble is most likely a tube or circuit fault in the 621-cycle oscillator of the oscilloscope. In this case the transmitter will not be operating due to the absence of the pulse.

f. If the image on the screen appears about normal except that it is too narrow or too wide, the trouble is in the horizontal sweep circuit or the oscillator circuit of the oscilloscope. It may be due to a faulty tube or a circuit trouble. If the image appears as a single vertical line on the screen it is an indication of tube or circuit trouble in the horizontal sweep circuit of the oscilloscope.

g. If the image appears normal, but is displaced horizontally to the right or left side of the screen and cannot be returned to its normal location by means of the horizontal positioning control, it is an indication of trouble in the cathode-ray tube or the horizontal positioning circuit.

h. If the image appears normal, but is displaced vertically upward or downward on the screen and cannot be returned to its normal location by means of the vertical positioning control, it is an indication of trouble in the cathode-ray tube or the vertical positioning circuit.

i. Another type of trouble which may be encountered is insufficient sensitivity resulting in the inability to observe the weaker echoes. The sensitivity of the receiving system should be ample to bring up the background noise pattern to full image height on the screen. If this cannot be done, there are several possible types and locations of trouble that may be responsible. First investigate the sensitivity control potentiometer and the associated cable between the oscilloscope and the receiver. Then check to see that the spark gap and the output connections of the receiver are operating correctly. If so, check the tuning adjustments of the r-f oscillator and the transmission line associated with the receiver. If these checks do not reveal the source of the trouble, replace the receiver with the spare unit. If the trouble is still present, replace the oscilloscope with the spare unit. As a final resort, it may be necessary to check the transmitter frequency and the line-up of the transmitter and antenna system to eliminate the trouble.

j. If the image on the screen shows only a very weak main pulse or simply a horizontal line, check first to see if the transmitting system is operating. If the transmitting system appears to be functioning properly, check the spark gap to see that it is not short-circuiting the receiver input. Then check the power, sensitivity, and output cabling connections to the receiver. If these are all intact, replace the receiver with the spare unit. If the trouble is still present, replace the oscilloscope with the spare unit. The unit in trouble should then be examined for a blown fuse, faulty tube, or circuit trouble as indicated by its characteristic symptoms on further tests and should be repaired as soon as possible in order to be ready for immediate use. Do not replace a blown fuse without first locating and removing the cause of its failure, since the trouble will then recur as soon as the unit is placed in operation.

k. When the image of more than one transmitted pulse appears on the screen, one of them standing still and the other drifting across the screen, the drifting image is caused by a second set operating in the same vicinity. The drift of the moving image is caused by the slight difference in frequency of the 621-cycle oscillator in the two sets.

l. Another trouble which may appear at times is a solid pattern, either regular or irregular in shape, superimposed upon the normal image in the oscilloscope. There are several possible causes

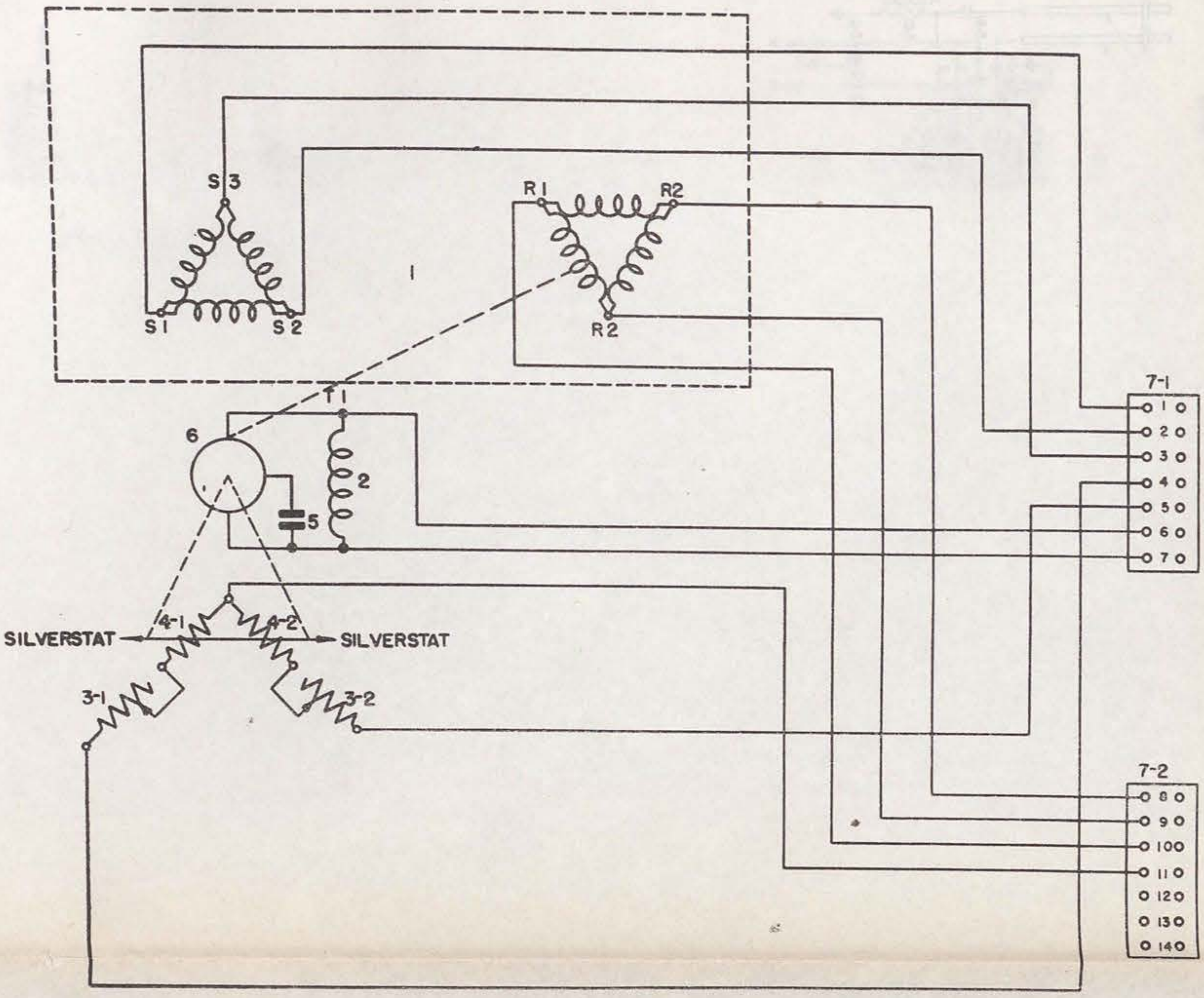

Figure 62. Gyrostat MC-392, schematic.

APPARATUS LEGEND FOR GYROSTAT MC-392

ITEM NO.	S.C. TYPE NO.	QUAN. REQ.	DESCRIPTION	MANUFACTURER'S CATALOG NO. OR TYPE NO. AS SPECIFIED BELOW, OR EQUAL	ASSEMBLED NO. DWG. NO.	ASSEMBLED NO. ITEM
1		1	GENERATOR, SYNCHRO-DIFFERENTIAL 6DG	ARMA CORP. MK V MODEL 1		
2		1	TRANSFORMER	WESTINGHOUSE ELECTRIC & MFG. CO. STYLE #1231802		
3		2	RESISTOR 25 OHMS 75 WATT	OHMITE MFG. CO. CAT. #0772		
4		2	SILVERSTAT RESISTOR 6 TO 590 OHMS	WARD LEONARD ELECTRIC CO., WEMCO STYLE #1231459		
5		1	CAPACITOR 5 MFD 165V. 60 CYCLES	CORNELL DUBILIER CO. CAT. #KLA2050		
6		1	MOTOR, A.C., 45V, 60 CYCLE 1/750 H.P., 3450 RPM	WESTINGHOUSE ELECTRIC & MFG. CO. STYLE #1231766		
7		2	TERMINAL STRIP, 7 TERMINAL	WESTINGHOUSE ELECTRIC & MFG. CO. STYLE #123696		

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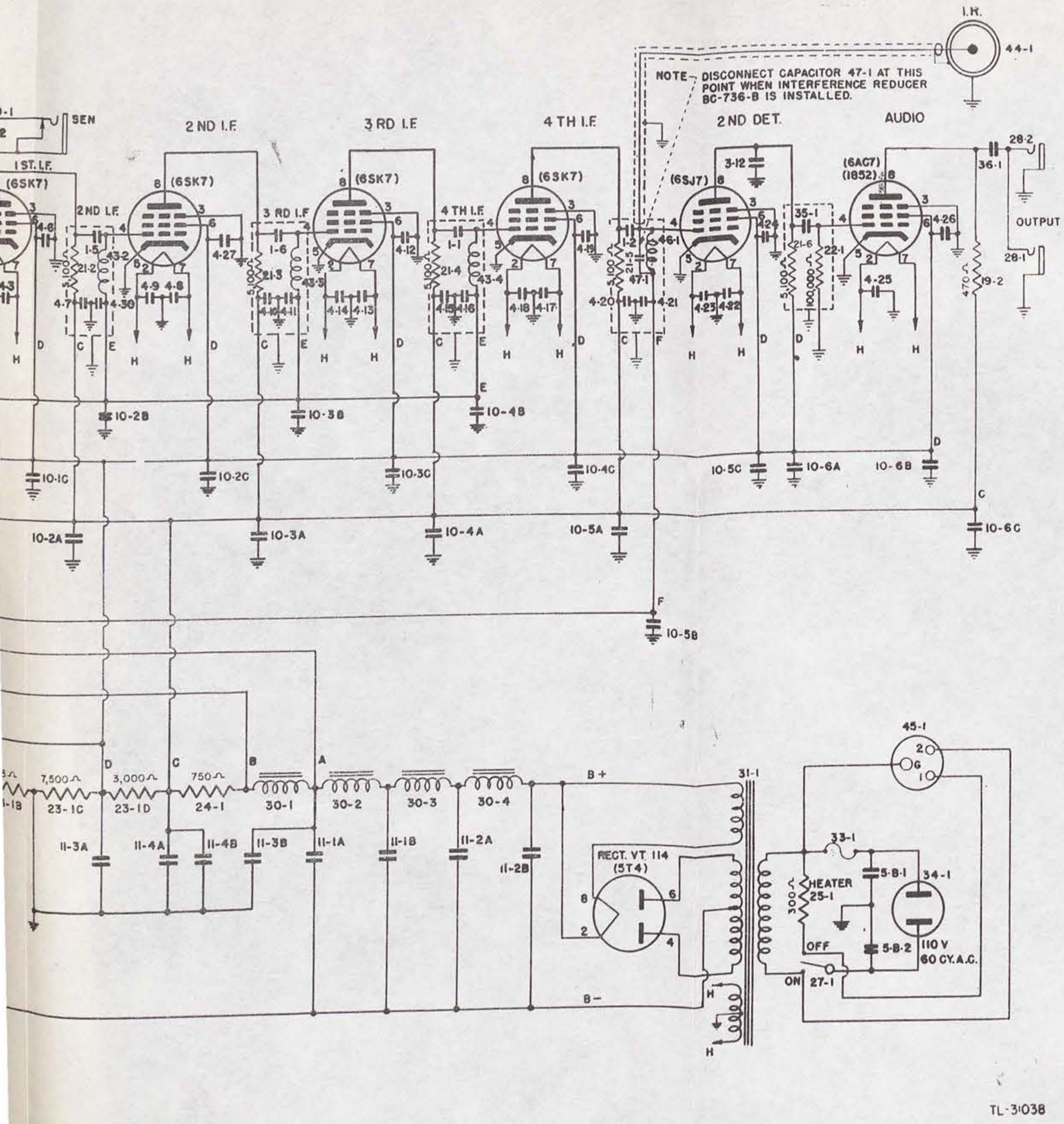


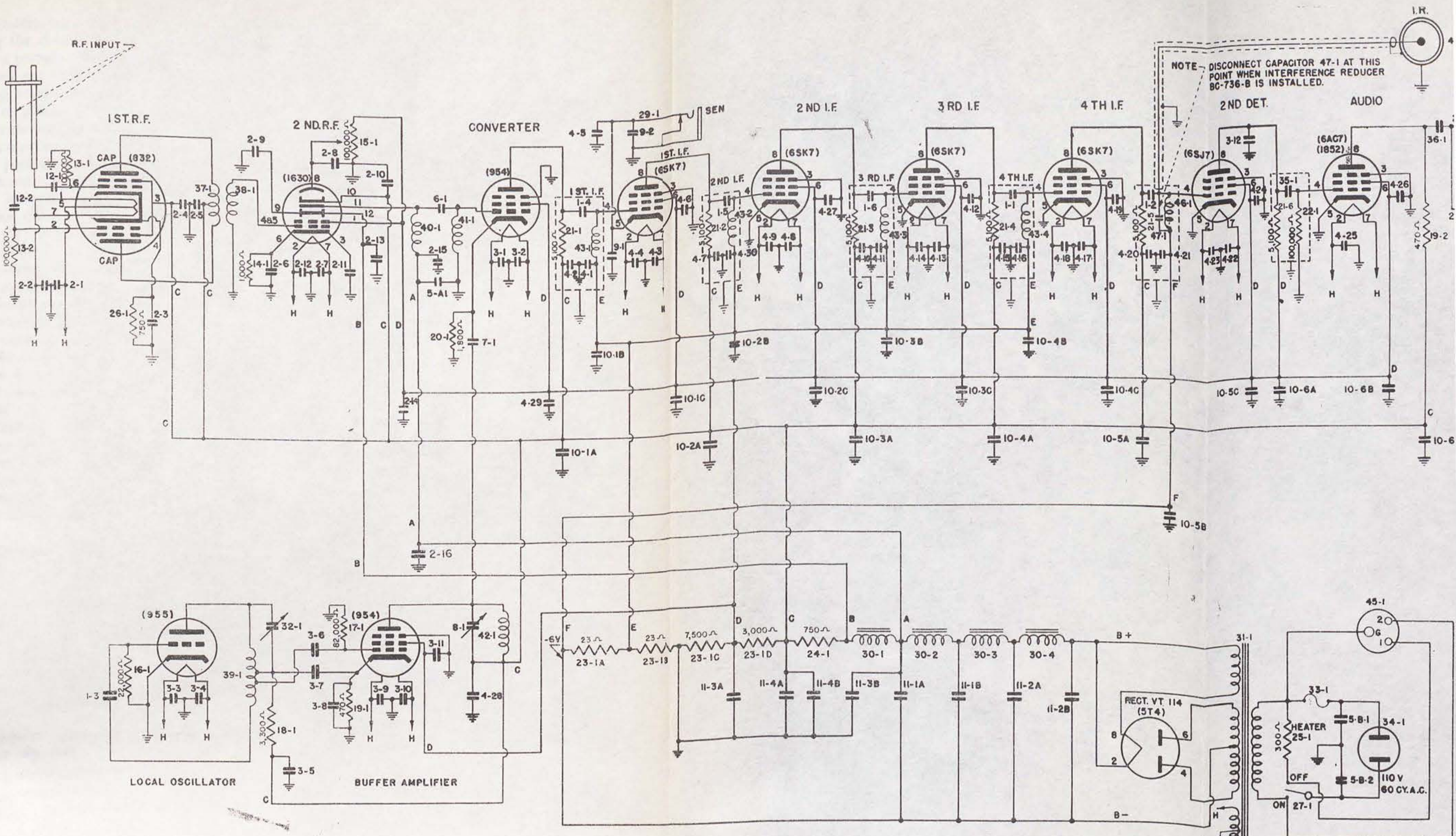
Figure 63. Receiver BC-404-C, schematic.

APPARATUS LEGEND
FOR RADIO RECEIVER BC-404-C

Part No.	Quantity required	Name of part and description
1	6	Capacitor, 47 μμf, 500 volts.
2	16	Capacitor, 500 μμf, 500 volts.
3	12	Capacitor, 100, μμf, 500 volts.
4	30	Capacitor, 0.009 μμf, 300 volts.
5A	1	Capacitor, 0.01 μf, 600 volts, oil filled.
5B	2	Capacitor, 0.01 μf, 400 volts.
6	1	Capacitor, 27 μμf, 500 volts.
7	1	Capacitor, 0.002 μf, 500 volts.
8	1	Capacitor, 3–30 μμf, variable.
9	2	Capacitor, 0.1, μf, 400 volts.
10	6	Capacitor, a–0.1 μf, 600 volts. b–0.1 μf, 600 volts. c–0.1 μf, 600 volts.
11	4	Capacitor, a–8, μf, 600 volts. b–8, μf, 600 volts.
12	2	Capacitor, 12–1 right hand, 25 μμf, 5,000 volts. 12–2 left hand (built in).
13	2	Resistor, 100,000 ohms, 1 watt.
14	1	Resistor, 1,000 ohms, ½ watt.
15	1	Potentiometer, 100,000 ohms.
16	1	Resistor, 22,000 ohms, ½ watt.
17	1	Resistor, 82,000 ohms, ½ watt.
18	1	Resistor, 3,300 ohms, ½ watt.
19	2	Resistor, 470 ohms, ½ watt.
20	1	Resistor, 1,800 ohms, ½ watt.
21	6	Resistor, 5,100 ohms, ½ watt.
22	1	Resistor, 100,000 ohms, ½ watt.
23	1	23–A, 23 ohms, 1 watt. 23–B, 23 ohms, 1 watt. 23–C, 7,500 ohms, 5 watts. 23–D, 3,000 ohms, 25 watts.
24	1	Resistor, 750 ohms, 20 watts.
25	1	Resistor, 300 ohms, 50 watts.
26	1	Resistor, 750 ohms, 2 watts.

APPARATUS LEGEND
FOR RADIO RECEIVER BC-404-C (contd)

Part No.	Quantity required	Name of part and description
27	1	Switch, s.p.d.t. (2-circuit switch).
28	2	Jack, 2-contact, normally open.
29	1	Jack, 2-contact, normally open with third contact to ground tip with plug out.
30	4	Choke, 8 h at 150 ma, 200 ohms.
31	1	Transformer, primary 110 volts; secondary, 350–0–350 volts at 145 ma, 5 volts at 3 amp, 6.3 volts at 4.5 amp ct.
32	1	Capacitor, 2.5, μf,–10 μμf, variable.
33	1	Fuse, 5 amp (with extractor post).
34	1	Receptacle, 2-pole male, 10 amp–250 volts, 15 amp –125 volts.
35	1	Capacitor, 0.1 μf, 400 volts.
36	1	Capacitor, 0.1 μf, 600 volts.
37	1	R-f primary coil, 7 turns No. 14 tinned copper wire, ½ inch ID.
38	1	R-f secondary coil, 3½ turns No. 18 insulated wire, 5/16 inch ID.
39	1	Oscillator coil, 8⅞ turns No. 14 tinned copper wire, 5/16 inch ID.
40	1	Second r-f coil, 11 turns No. 14 tinned copper wire, ½ inch ID.
41	1	Converter coil, 23 turns No. 18 tinned copper wire, 5/16 inch ID.
42	1	Buffer coil, 3¼ turns No. 14 tinned copper wire, ⅜ inch ID.
43	4	I-f coil, 12 turns No. 24 enameled copper wire, ⅝ inch ID.
44	1	Connector, female.
45	1	Connector, female.
46	1	I-f coil, 8 turns No. 24 enameled copper wire, ⅝ inch ID.
47	1	Capacitor, 15 μμf, 500 volts.



NOTE: LETTERS A TO F IN THE POWER SUPPLY INDICATE CONNECTIONS TO SIMILARLY LETTERED POINTS IN THE CIRCUIT.

Figure 63. Receiver BC-404-C, schematic.

or such troubles, some of which may be eliminated by noting the characteristics of the image. For example, a pattern which is regular in shape and which does not drift across the screen may be originating within the set and is probably due to feedback or pick-up of the radiated signal in the receiver or the oscilloscope. A faulty shield, filter, or by-pass capacitor may result in such a condition. Another possible cause of regular, peculiarly shaped patterns on the screen is oscillation in the receiver. Irregular patterns may be due to r-f interference either locally or remotely generated. Check to see that no frequency meter is operating in the vicinity.

m. Flickering of the image or jumping of the baseline may give the appearance of a double or multiple image on the screen. This type of trouble may originate in any one of several ways, but a possible cause is a loose connection or microphonic tube in the receiving system. Such troubles may occur in the receiver or the oscilloscope, or the cables connecting these units. It is also possible that a faulty connection in the antenna system or the transmitting system may cause this trouble by varying the frequency or the output of the system very rapidly. As was indicated in *l* above, the interference may be created intentionally and every effort must be made by the operator to continue operation of the radio set to the best of his ability.

n. Momentary blurring of the entire image on the screen may result from poor contact of the phasing-unit slip rings, or possibly from some trouble in the cathode-ray tube or its focusing-anode supply circuit. If the phasing unit is causing the trouble, the blurring will be noticed when the range dial is moved.

o. The remainder of this section deals specifically with a detailed analysis of troubles in the receiver and oscilloscope.

110. Receiver Component, Signal Substitution (fig. 63)

a. Test Instrument.

Signal generator I–22–B.
Cathode-ray Oscilloscope I–134–A.
Test Cords CD–627 and CD–666.

b. Preparatory Steps. (1) Check receiver power supply before proceeding with the following tests (fig. 64).

(2) Remove the receiver chassis from its case and place the receiver so that the end containing the power transformer rests on the work bench.

(3) Connect the test oscilloscope to the receiver output jack. The test scope must remain connected in this position during the complete signal-substitution procedure.

(4) Remove the 955 oscillator tube from the receiver unit.

(5) Turn the receiver and test instruments on.

(6) Connect the ground test lead from the signal generator to the receiver chassis.

(7) Insert a 0.001-μf capacitor in series with the test cord and the positive terminal of the signal generator.

(8) Set the signal generator to the intermediate frequency of the receiver.

Note. Allow the test instruments and the receiver to warm up for at least 15 minutes before applying test.

c. Procedure (fig. 65). (1) For signal substitution the receiver is divided into four sections. These sections must be checked in their proper sequence to save time in locating a defective stage or section.

(2) The i-f stages are tested individually only when the over-all test of the i-f stages (test point No. 2 on the application chart) shows an abnormal condition. The sections are as follows:

(*a*) Second detector and audio stages; test point No. 1.

(*b*) I-f stages; test point No. 2 with the signal generator tuned to the receiver i-f frequency and the 955 oscillator tube removed from the receiver.

(*c*) Mixer, oscillator, and buffer stages; test point No. 2 with the signal generator tuned to the receiver radio frequency and the 955 oscillator tube replaced in the receiver.

(*d*) First and second r-f stages; test point Nos. 3 and 4.

Note. Proceed with the following test procedures until a defective stage or section has been located. A stage or section is abnormal when, upon the application of the signal generator to the input of a stage or section, no signal (or distortion) appears on the screen of the test oscilloscope.

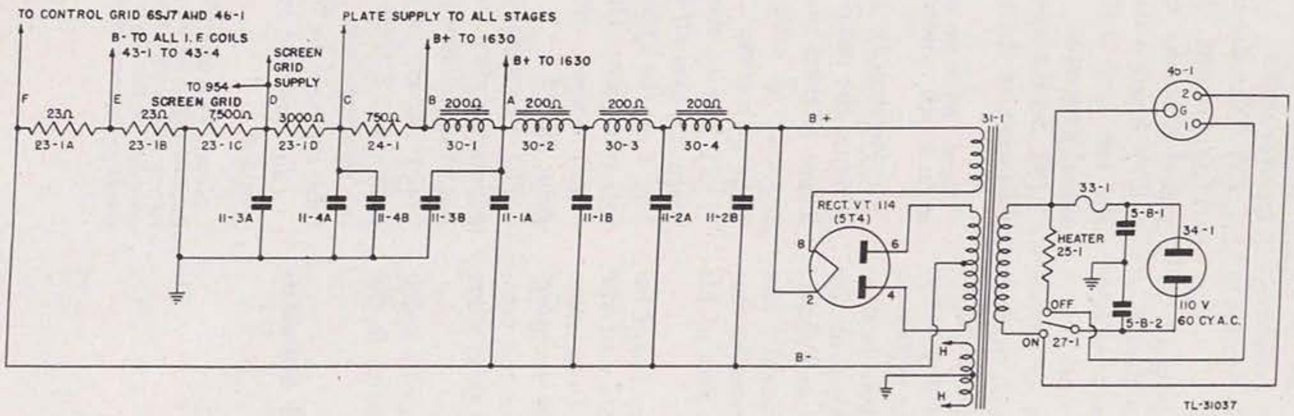


Figure 64. Receiver BC-404-C, schematic of power supply.

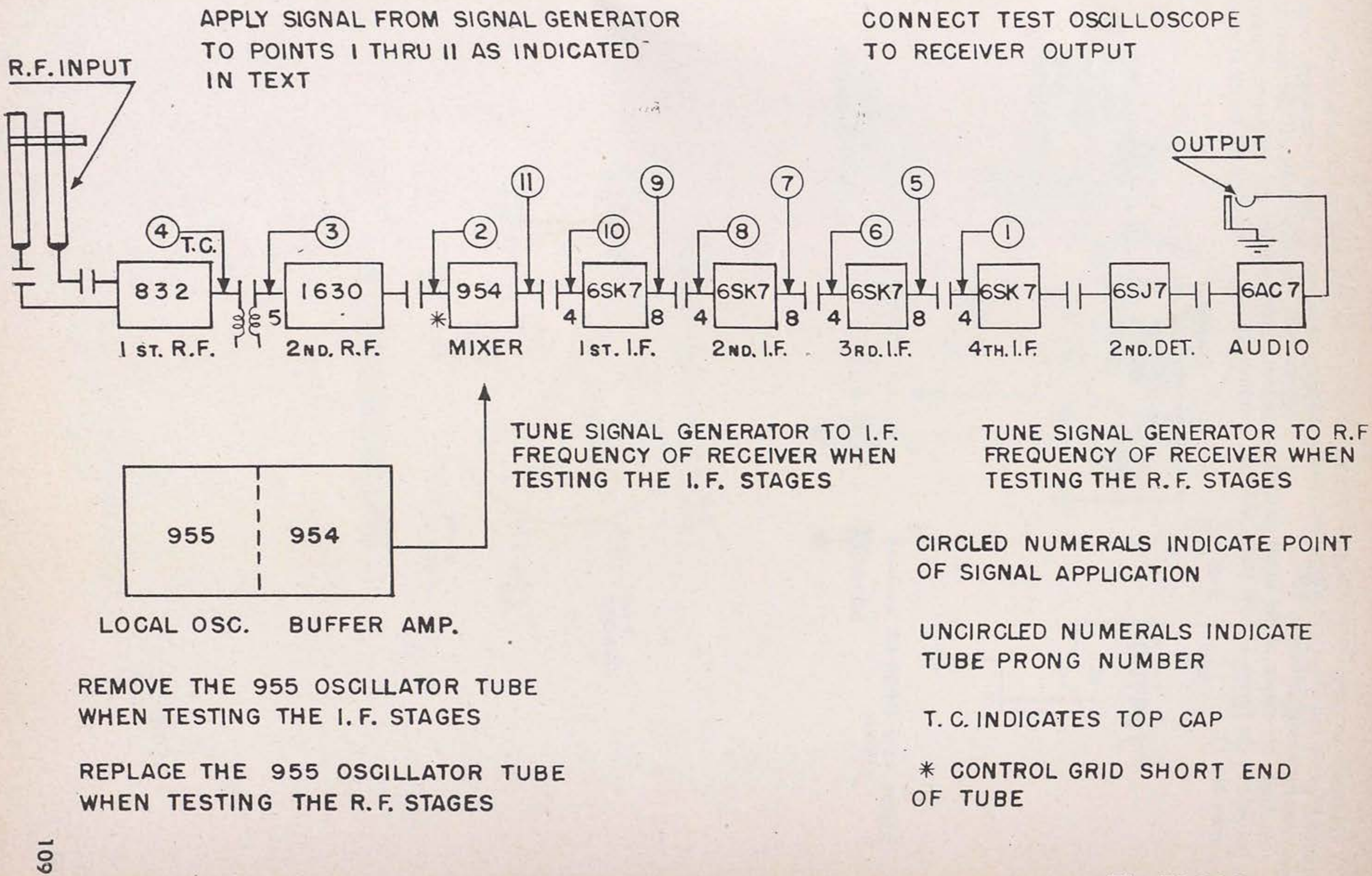


Figure 65. Receiver BC-404-C, block diagram.

d. TESTING SECOND DETECTOR AND AUDIO STAGES (figs. 66 and 67). (1) Adjust the signal generator for maximum output.

(2) Apply the output of the signal generator to the grid of the fourth i-f tube (tube prong 4, test point No. 1).

(3) If an abnormal indication is obtained on the test scope, test the tubes in the stages, including the 6SK7 fourth i-f tube. If the tubes are normal, apply voltage and resistance measurements to the stages, including the fourth i-f stage.

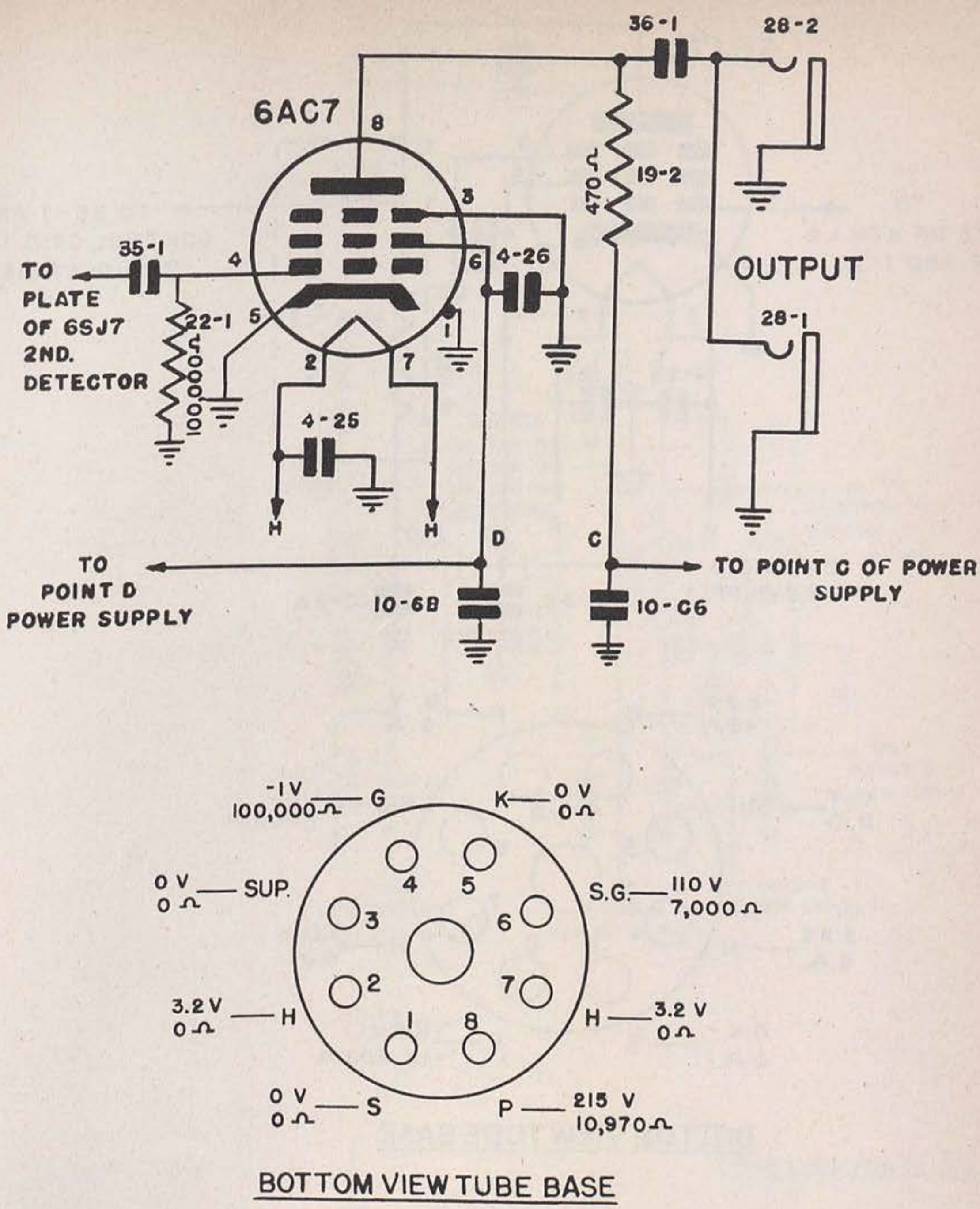


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Figure 66. Receiver BC-404-C, audio stage.

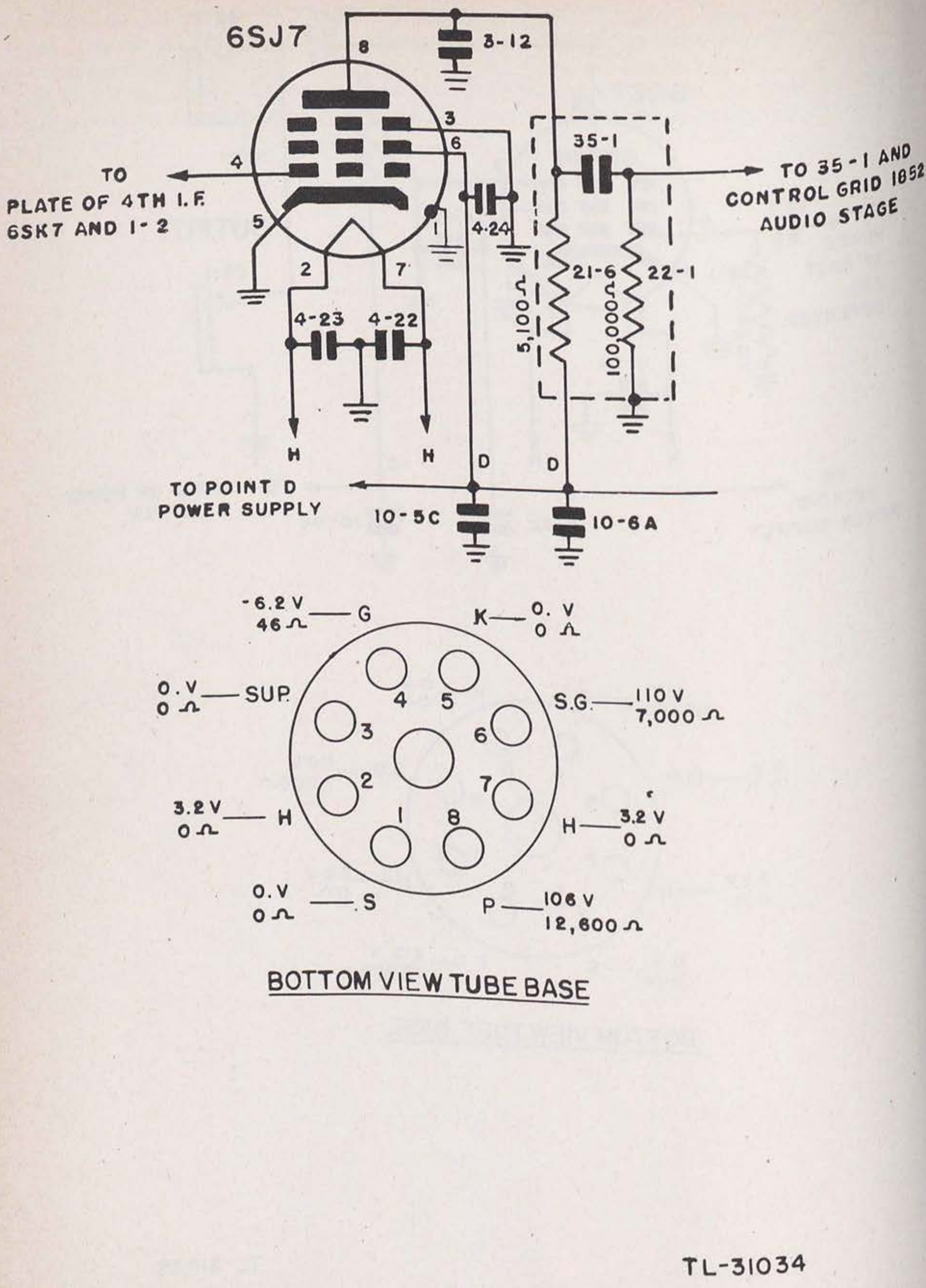

Figure 67. Receiver BC-404-C, second detector stage.

e. Testing i-f Sections and Mixer Stage (fig. 68). (1) Apply the output of the signal generator to the grid of the 954 mixer tube (short end of the tube, test point No. 2).

(2) If an abnormal indication is obtained, apply signal substitution to the individual i-f stages (*i* above).

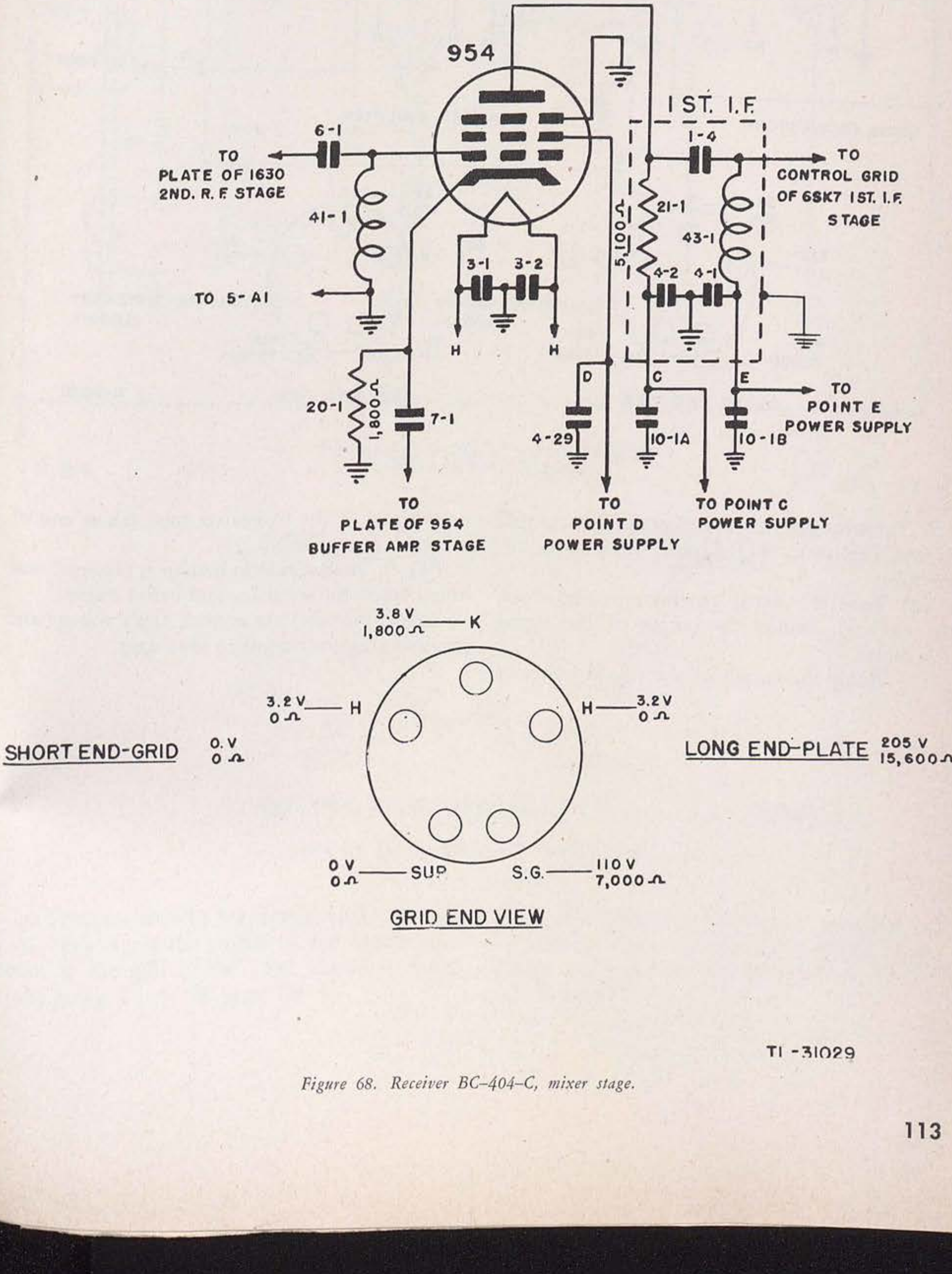

Figure 68. Receiver BC-404-C, mixer stage.

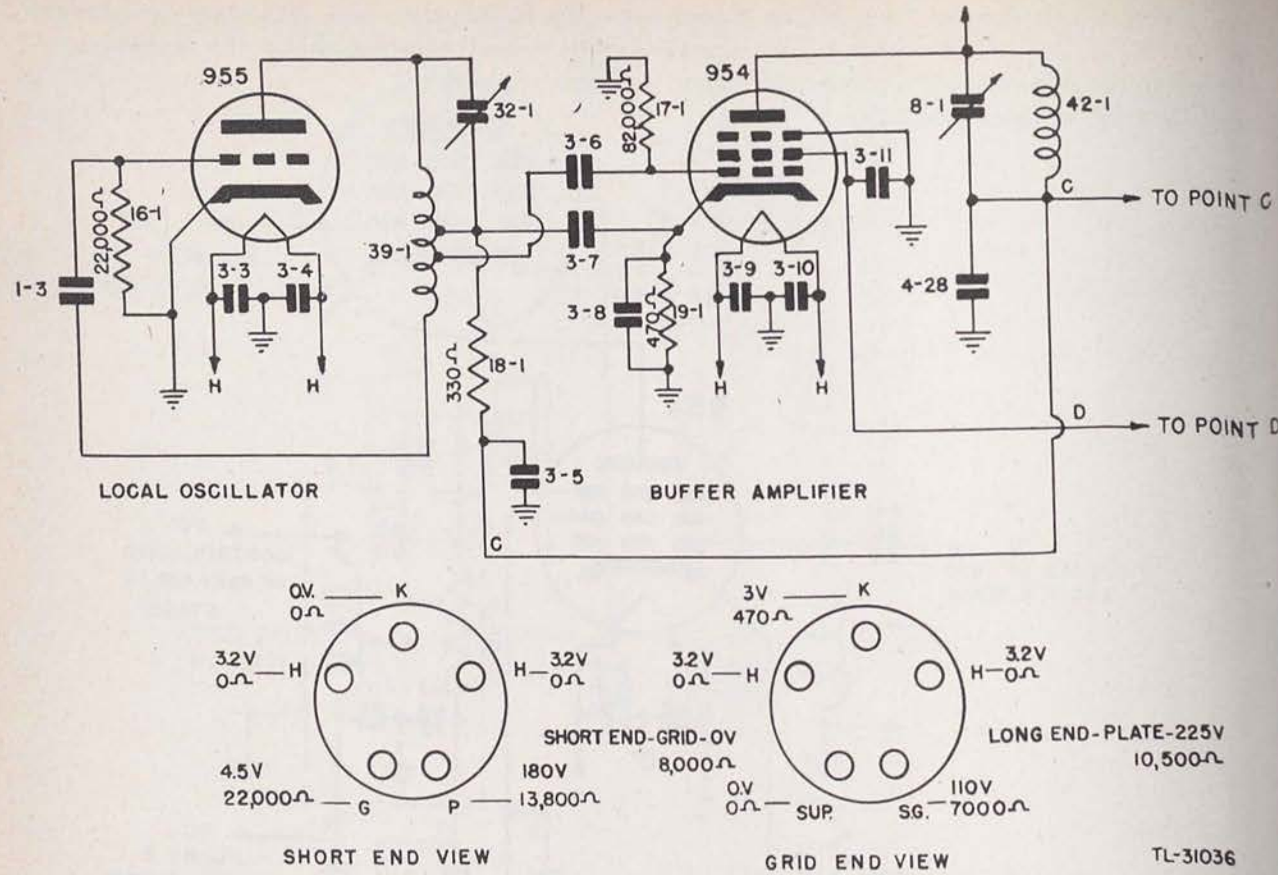

Figure 69. Receiver BC-404-C, local oscillator and buffer amplifier stages.

f. Testing Buffer and Local Oscillator Stages (fig. 69). (1) Replace the 955 oscillator tube.

(2) Tune the signal generator to the r-f of the receiver. Reduce the output of the signal generator.

(3) Apply the output of the signal generator to the grid of the 954 mixer tube (short end of the tube, test point No. 2).

(4) If an abnormal indication is obtained, test the tubes in the oscillator and buffer stages.

(5) If the tubes are normal, apply voltage and resistance measurements to the stages.

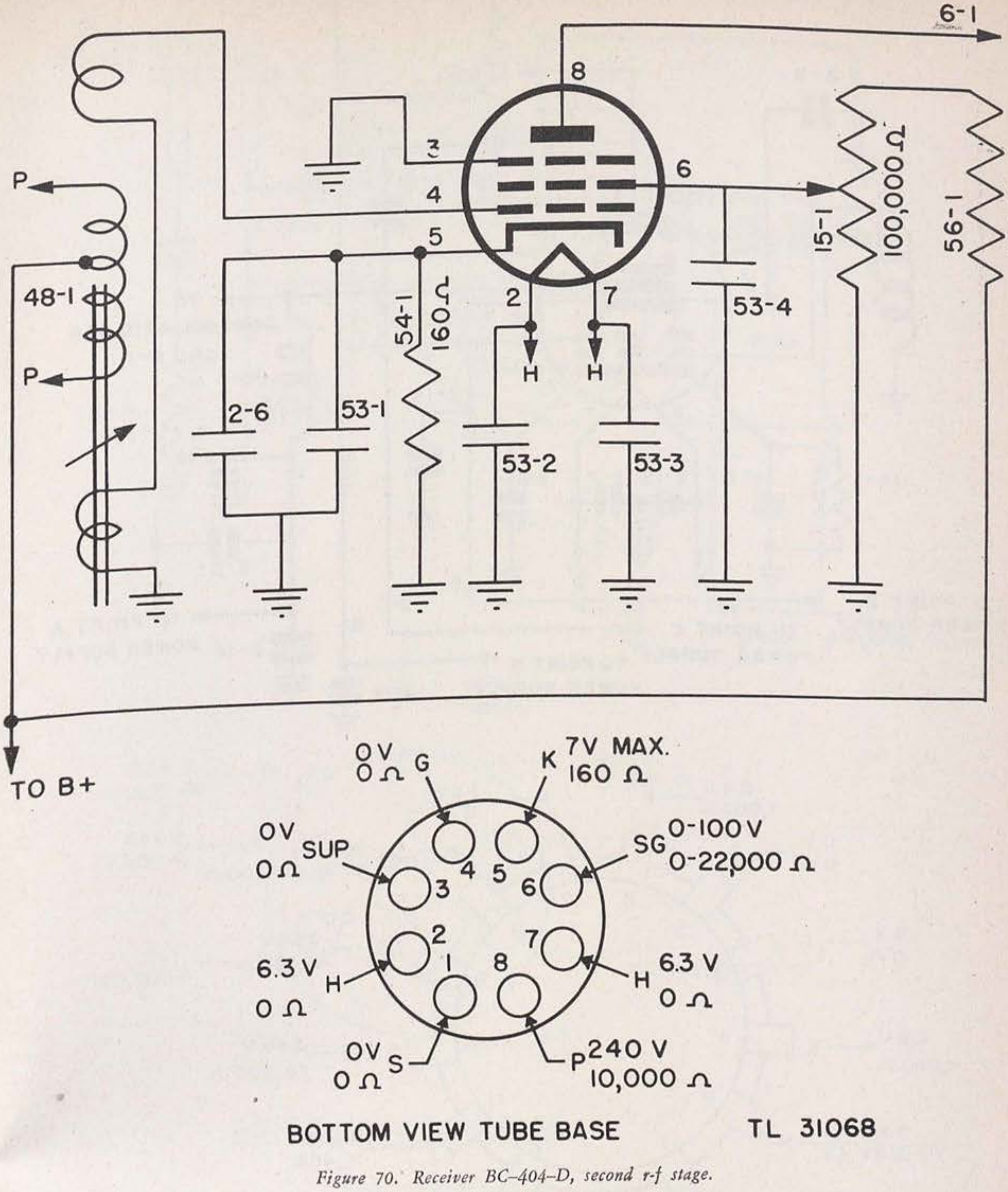

Figure 70. Receiver BC-404-D, second r-f stage.

g. TESTING SECOND R-F STAGE (figs. 70 and 71). (1) Apply the output of the signal generator to the grid of the 1630 second r-f tube (tube prong 4 or 5, test point No. 3).

(2) If an abnormal indication is obtained, test the second r-f tube. If the tube is normal, apply voltage and resistance measurements to the second r-f stage.

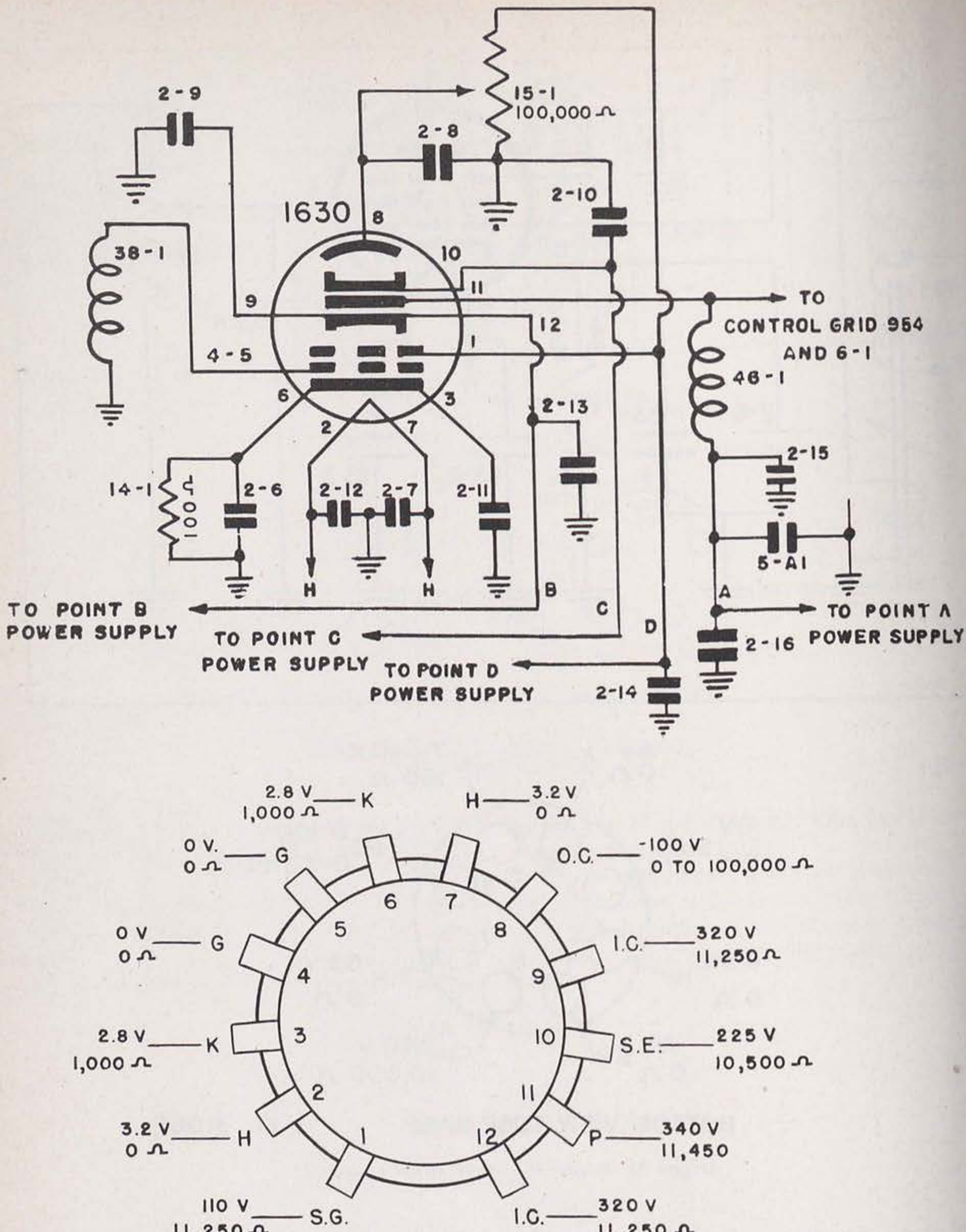

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Figure 71. Receiver BC-404-C, second r-f stage.

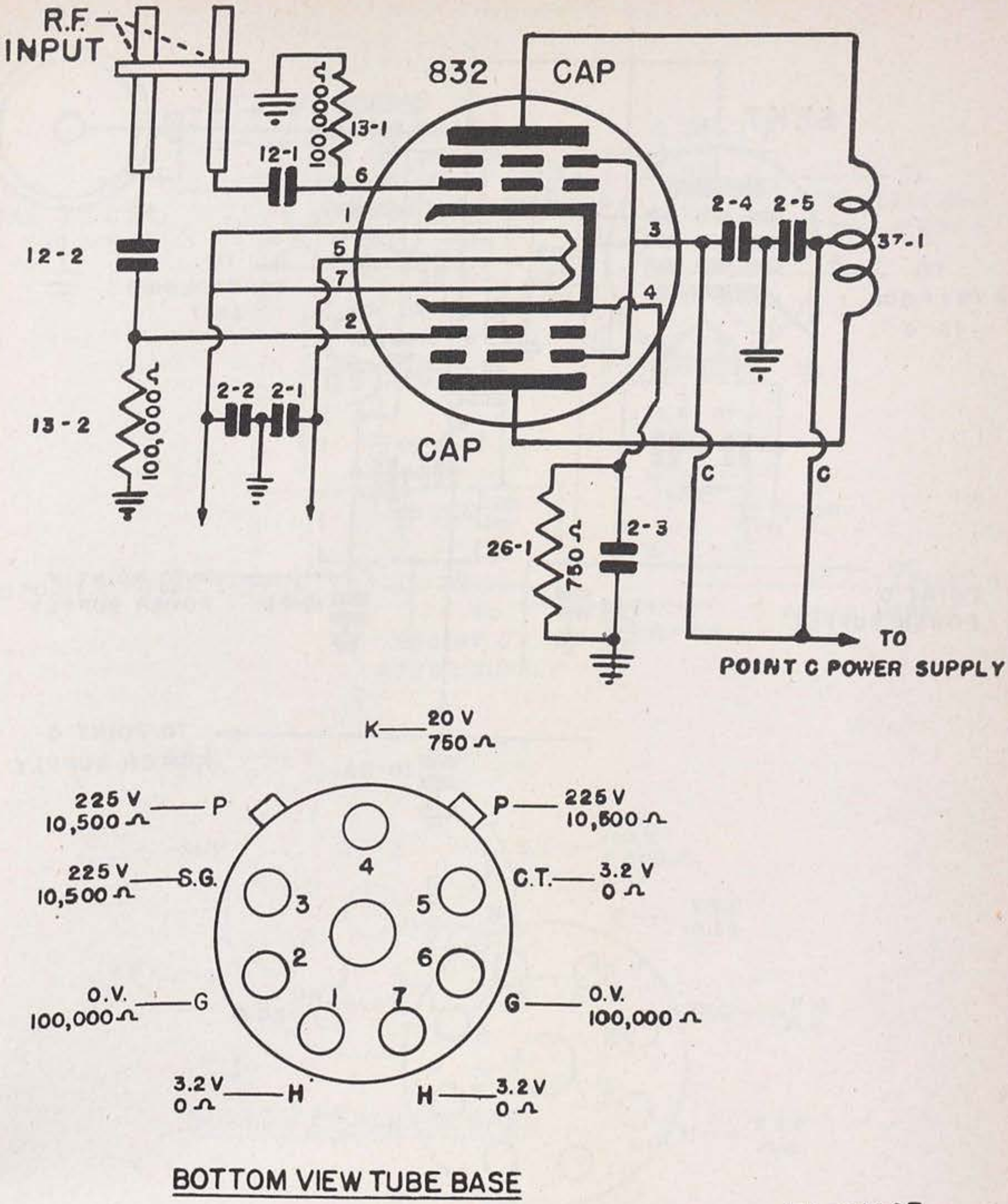


Figure 72. Receiver BC–404–C, first r-f stage.

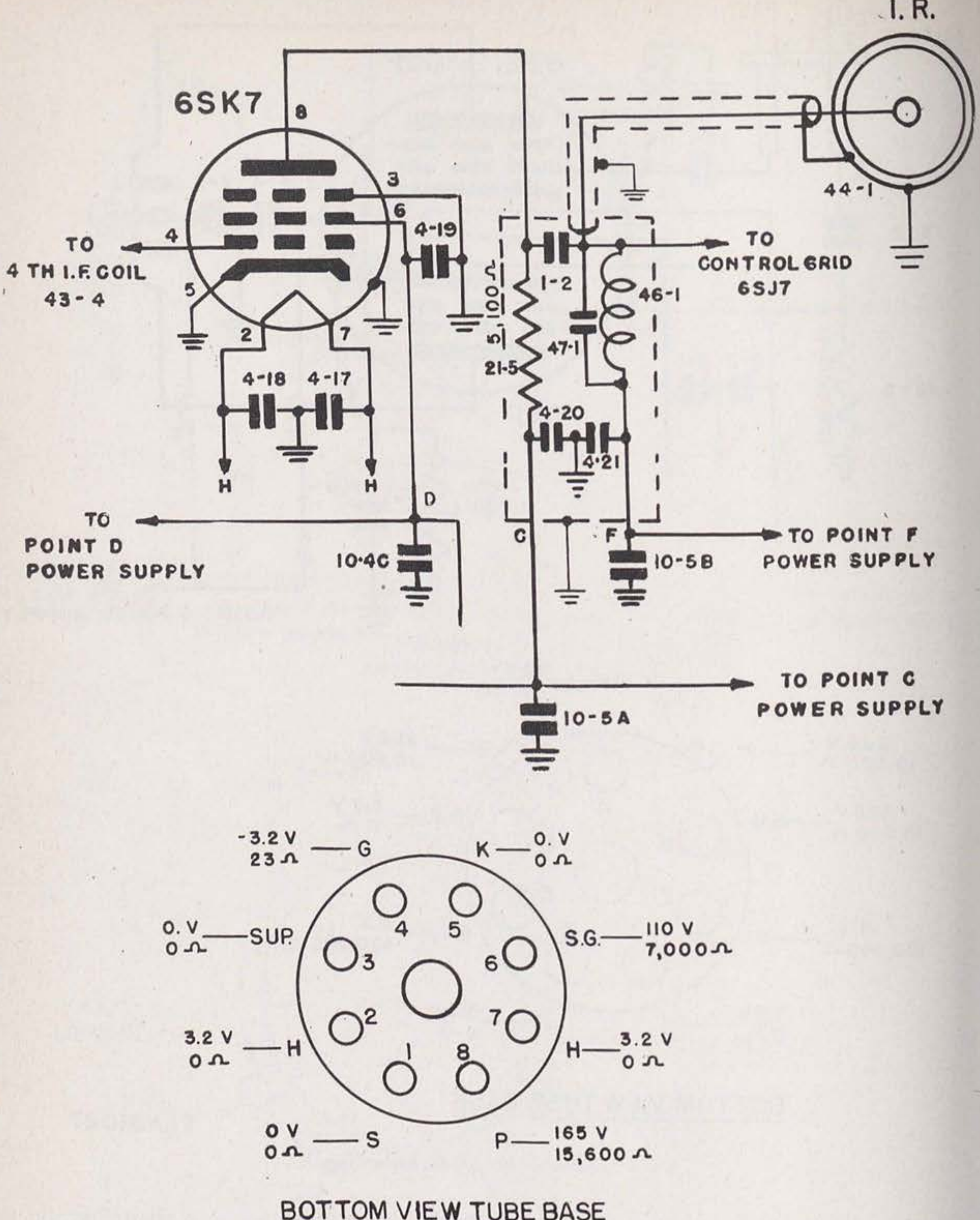
b. Testing First r-f Stage (fig. 72). (1) Remove the signal-generator ground test lead from the receiver chassis.

(2) Connect both output terminals of the signal generator to the input trombone of the receiver. The proper connecting point is about 8 inches from the receiver.

(3) Adjust the shorting bar on the trombone so that a maximum signal is shown on the test oscilloscope.

Note. The output of the signal generator should be reduced to approximately 5 microvolts.

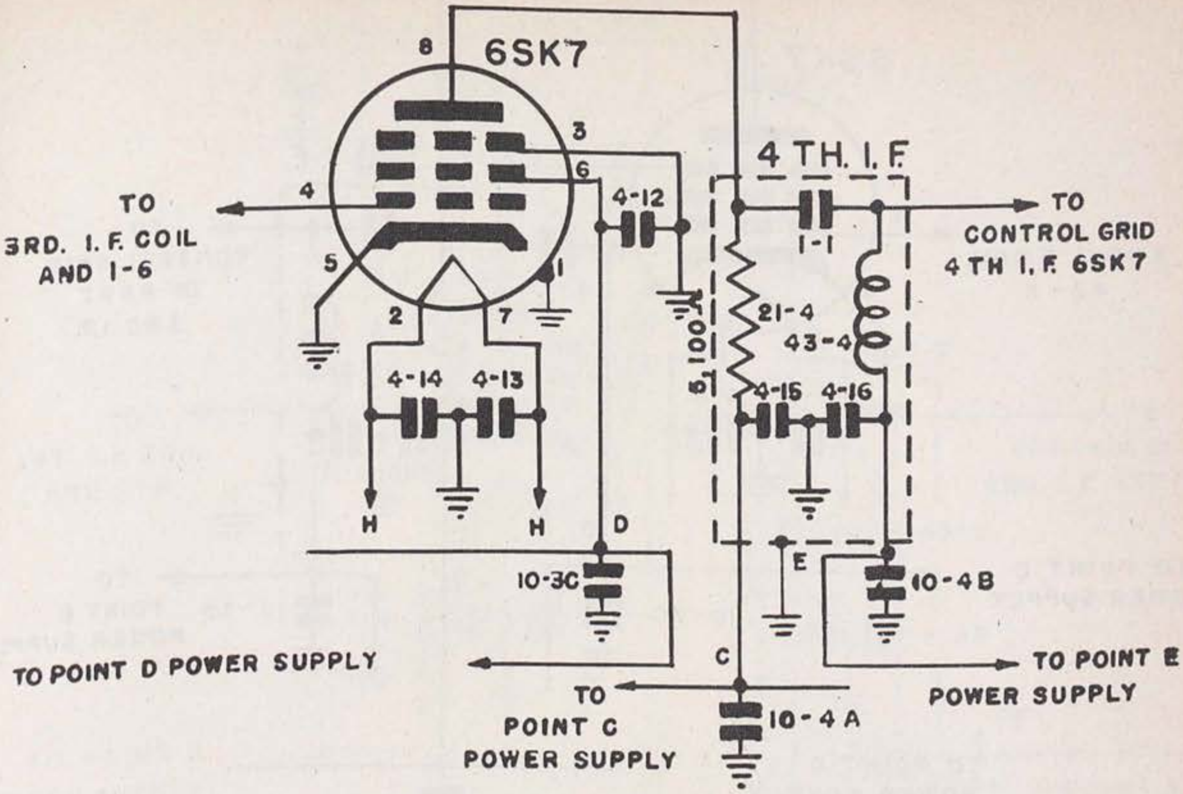
(4) If an abnormal indication is obtained, test the 832 tube. If the tube is normal, apply voltage and resistance measurements too the first r-f stage.

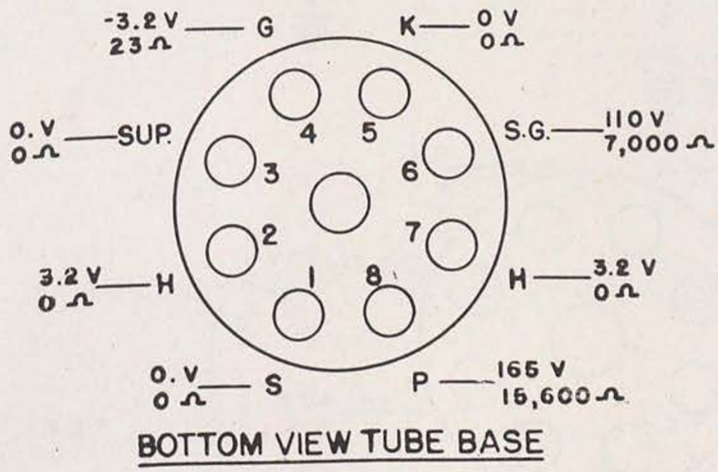


TL-31033

Figure 73. Receiver BC-404-C, fourth i-f stage.

i. TESTING INDIVIDUAL I-F STAGES (fig. 73). (1) Apply the output of the signal generator to the plate of the third i-f tube (tube prong 8, test point No. 5). If an abnormal indication is obtained, check the coupling between the third and fourth i-f stages.





TL-31032

Figure 74. Receiver BC–404–C, third i-f stage.

(2) Apply the output of the signal generator to the grid of the third i-f tube (tube prong 4, test point No. 6). If an abnormal indication is obtained, test the third i-f tube. If the tube is normal, apply voltage and resistance measurements to the third i-f stage.

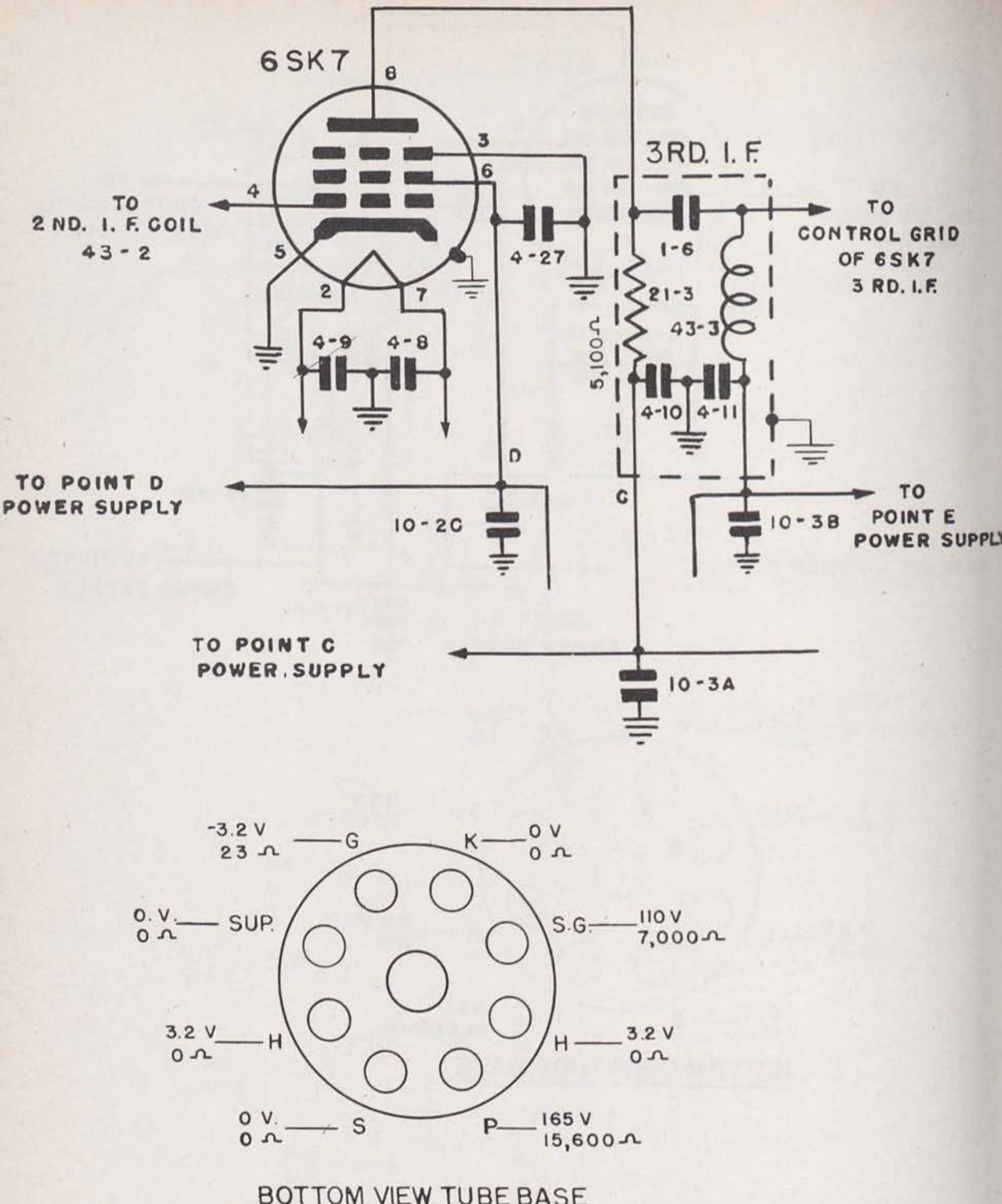


Figure 75. Receiver BC-404-C, second i-f stage.

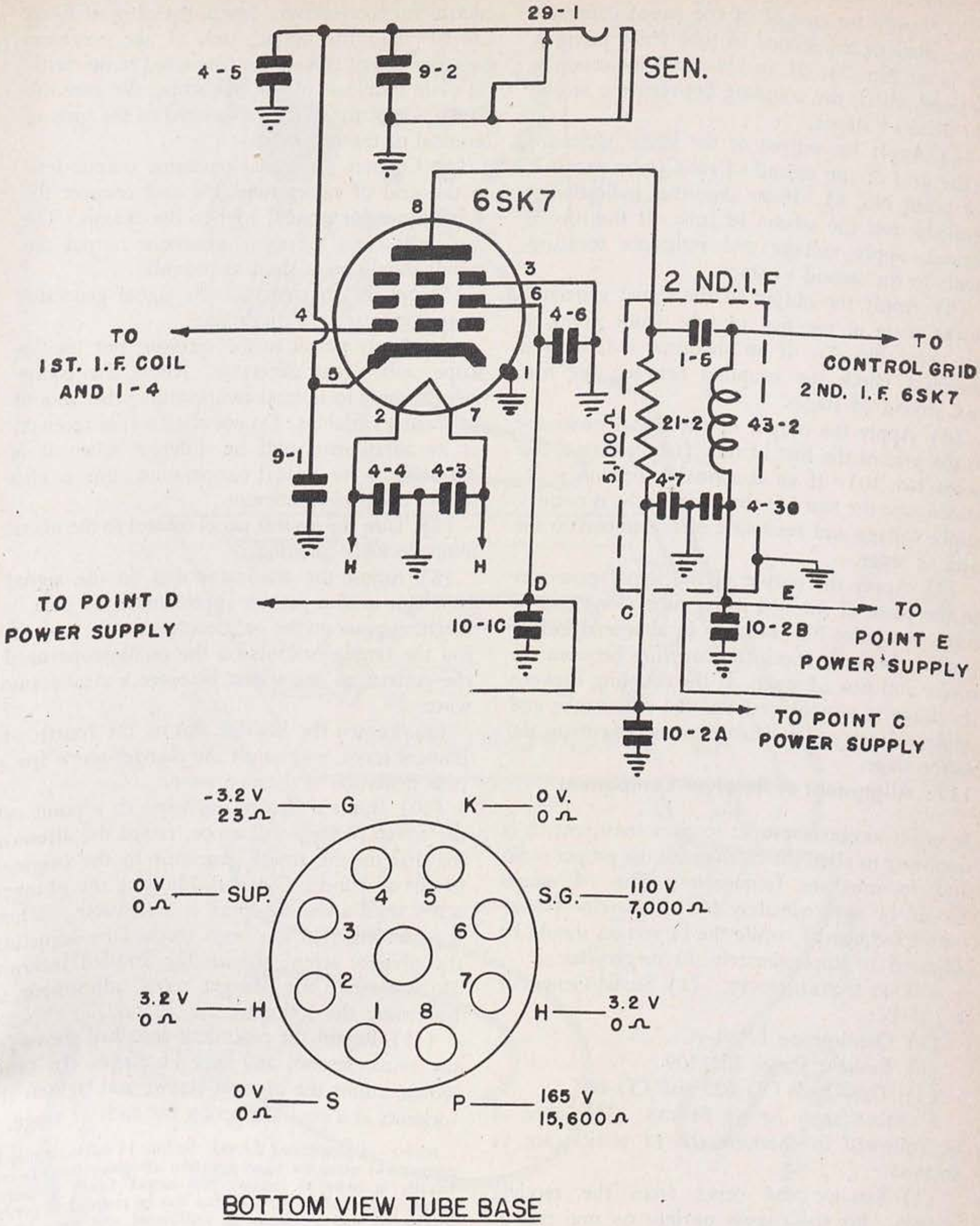


Figure 76. Receiver BC-404-C, first i-f stage.

(3) Apply the output of the signal generator to the plate of the second i-f tube (tube prong 8, test point No. 7). If an abnormal indication is obtained, check the coupling between the second and third i-f stages.

(4) Apply the output of the signal generator to the grid of the second i-f tube (tube prong 4, test point No. 8). If an abnormal indication is obtained, test the second i-f tube. If the tube is normal, apply voltage and resistance measurements to the second i-f stage.

(5) Apply the output of the signal generator to the plate of the first i-f tube (tube prong 8, test point No. 9). If an abnormal indication is obtained, check the coupling between the first and second i-f stages.

(6) Apply the output of the signal generator to the grid of the first i-f tube (tube prong 4, test point No. 10). If an abnormal indication is obtained, test the first i-f tube. If the tube is normal, apply voltage and resistance measurements to the first i-f stage.

(7) Apply the output of the signal generator to the plate of the 954 mixer tube (long end of tube, test point No. 11). If an abnormal indication is obtained, check the coupling between the mixer and first i-f stage. If the coupling between the stage is normal, test the 954 mixer tube and apply voltage and resistance measurements to the mixer stage.

111. Alignment of Receiver Component

In order to obtain proper receiver sensitivity, it is necessary to align the receiver for the proper radio and intermediate frequencies. The r-f stages should be approximately 106 megacycles (transmitter frequency), while the i-f section should be adjusted to approximately 20 megacycles.

a. Test Instruments. (1) Signal Generator I–122–B.

(2) Oscilloscope I–134–A.

(3) Resistor Panel BD–109.

(4) Test Cords CD–627 and CD–666.

b. Alignment of i-f Stages. The steps to be followed in checking the i-f section are as follows:

(1) Remove the cover from the receiver chassis. Set the chassis upright on one end as shown in figure 77.

(2) Remove the local oscillator tube 955 from its socket.

(3) Connect the receiver, the signal generator, oscilloscope, and resistor panel as shown in figure 77. Resistor Panel BD–109 is used as a sensitivity control for the receiver. Insert the plug of Cord CD–627 into the output jack of the receiver; the other end of this cord is connected to the vertical plate terminals of the test scope. Be sure the sleeve side of the plug is connected to the ground terminal of the test scope.

(4) Connect the signal-generator output lead to the grid of mixer tube 954 and connect the signal-generator ground lead to the chassis. The two leads from the signal-generator output terminals should be as short as possible.

(5) Set the frequency of the signal generator to approximately 20 megacycles.

(6) Apply power to the receiver, test oscilloscope, and signal generator. Allow the equipment to heat to normal temperature; this should be about 15 minutes. Do not align a *cold* receiver, as its adjustments will be different when it is operating at its normal temperature; this is also true of the signal generator.

(7) Turn the resistor panel control to the maximum clockwise position.

(8) Adjust the attenuator dial on the signal generator until a pattern approximately 1 inch in height appears on the oscilloscope screen, and adjust the timing controls on the oscilloscope until the pattern on the screen becomes a steady sine wave.

(9) Loosen the knurled nut of the fourth i-f plunger screw, and adjust the plunger screw for a peak deflection of the sine wave.

(10) If the deflection increases to a point off the screen of the oscilloscope, retard the attenuator dial on the signal generator to the original height of 1 inch. Continue adjusting the plunger screw until a definite peak is discernible. When a peak deflection has been reached by adjusting the plunger screw, tighten the knurled locknut. Do not move the plunger screw adjustment in tightening the locknut.

(11) Repeat the procedure described above for the third, second, and first i-f stages. In other words, adjust the plunger screws and tighten the locknuts at a peak deflection for each i-f stage.

Note. In progressing through the four i-f stages, it may be necessary to retard the signal-generator attenuator controls continually in order to maintain the proper 1-inch deflection. Likewise, the resistor panel control may be retarded to prevent overloading and to obtain an undistorted sine wave at the peak setting. When peaking the last three stages, the sine wave becomes progressively blunt and ragged. This change in the pattern is caused by the admittance of a noise level and actually indicates an increase in the sensitivity of the receiver.

c. Sensitivity Test of i-f Stages. (1) When the four stages of the i-f section have been aligned, the sensitivity should read about 55 microvolts.

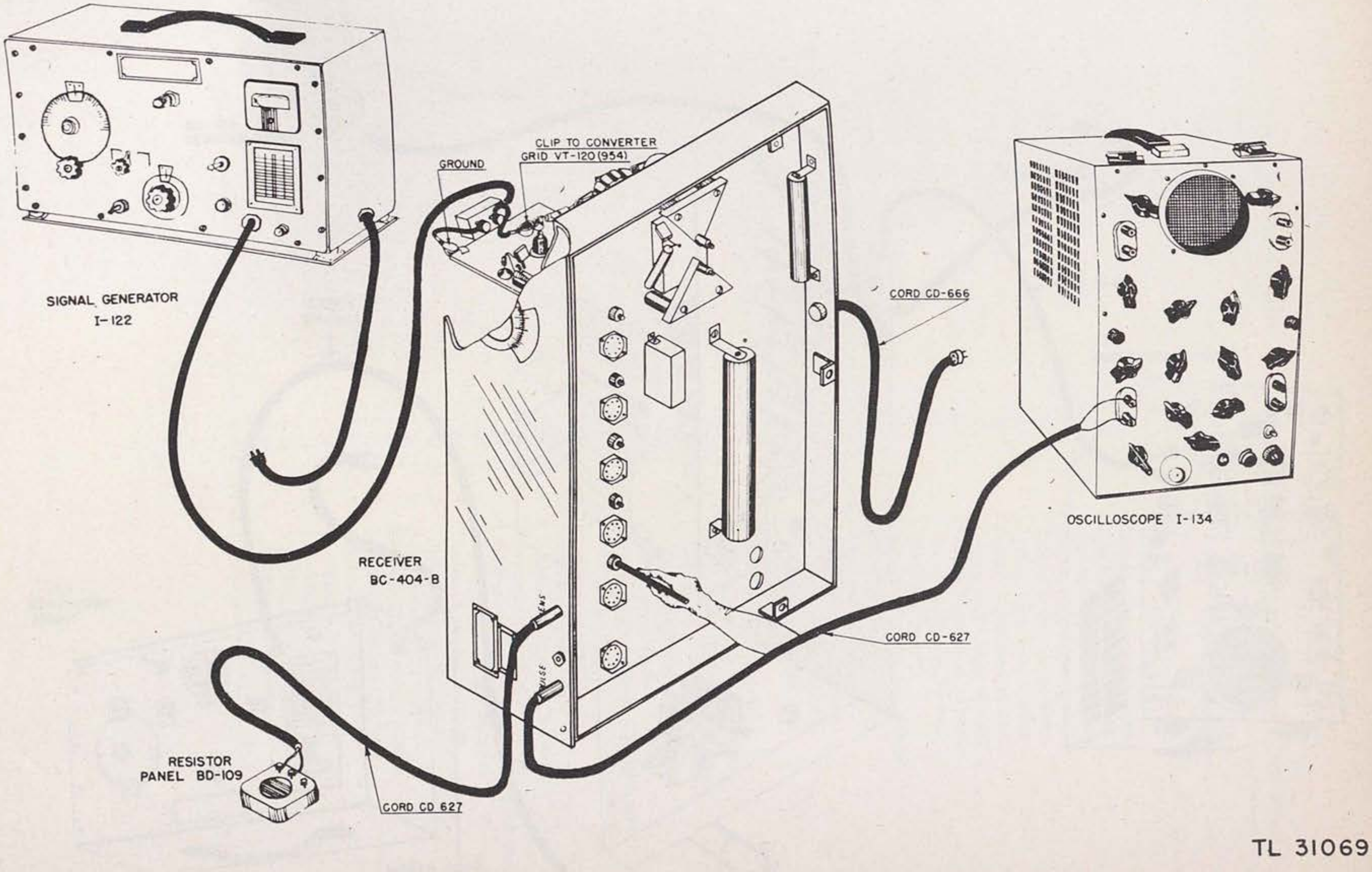


Figure 77. Receiver BC-404-C, alignment of i-f stages.

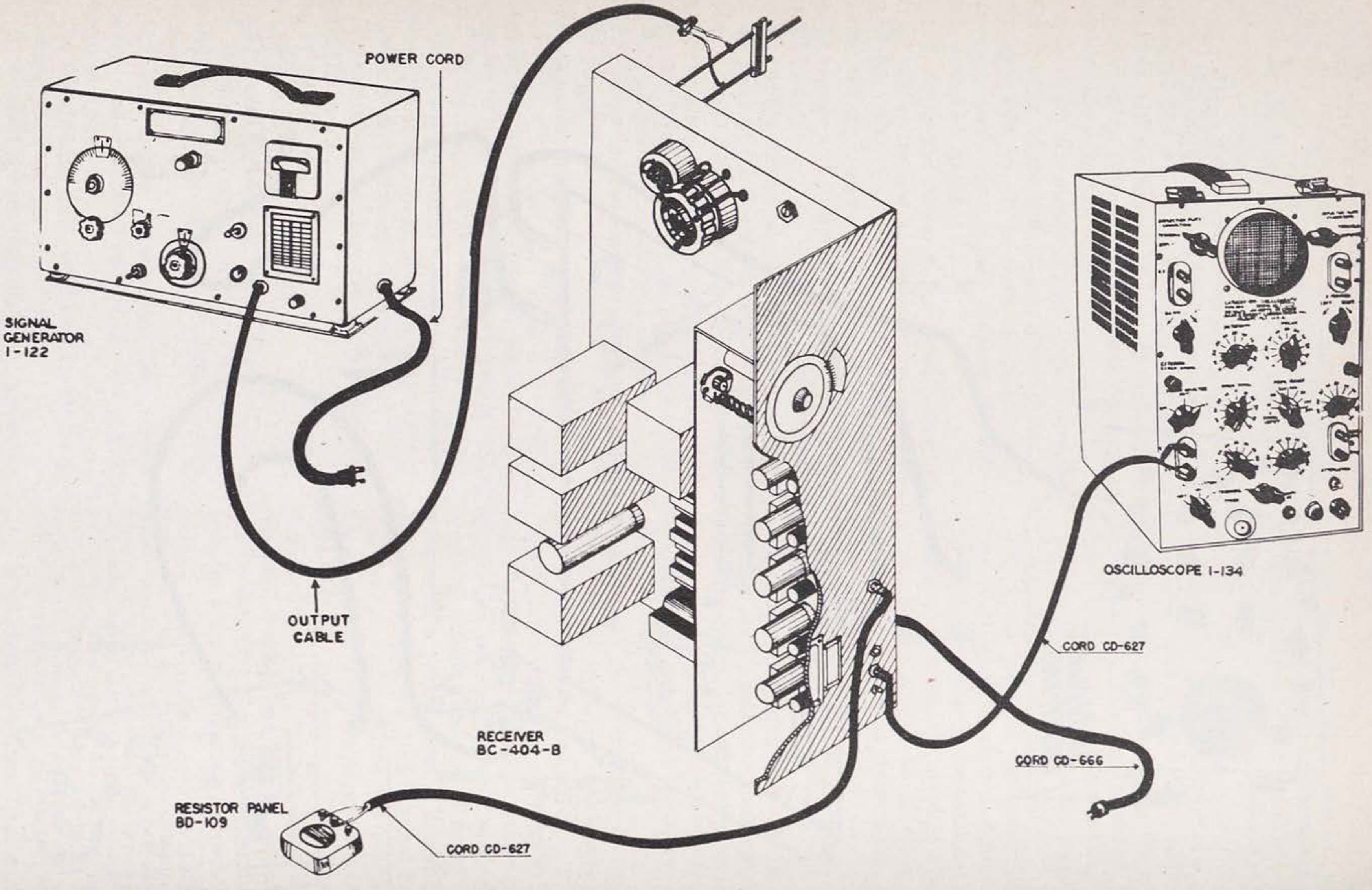


Figure 78. Receiver BC-404-B, alignment of r-f stages.

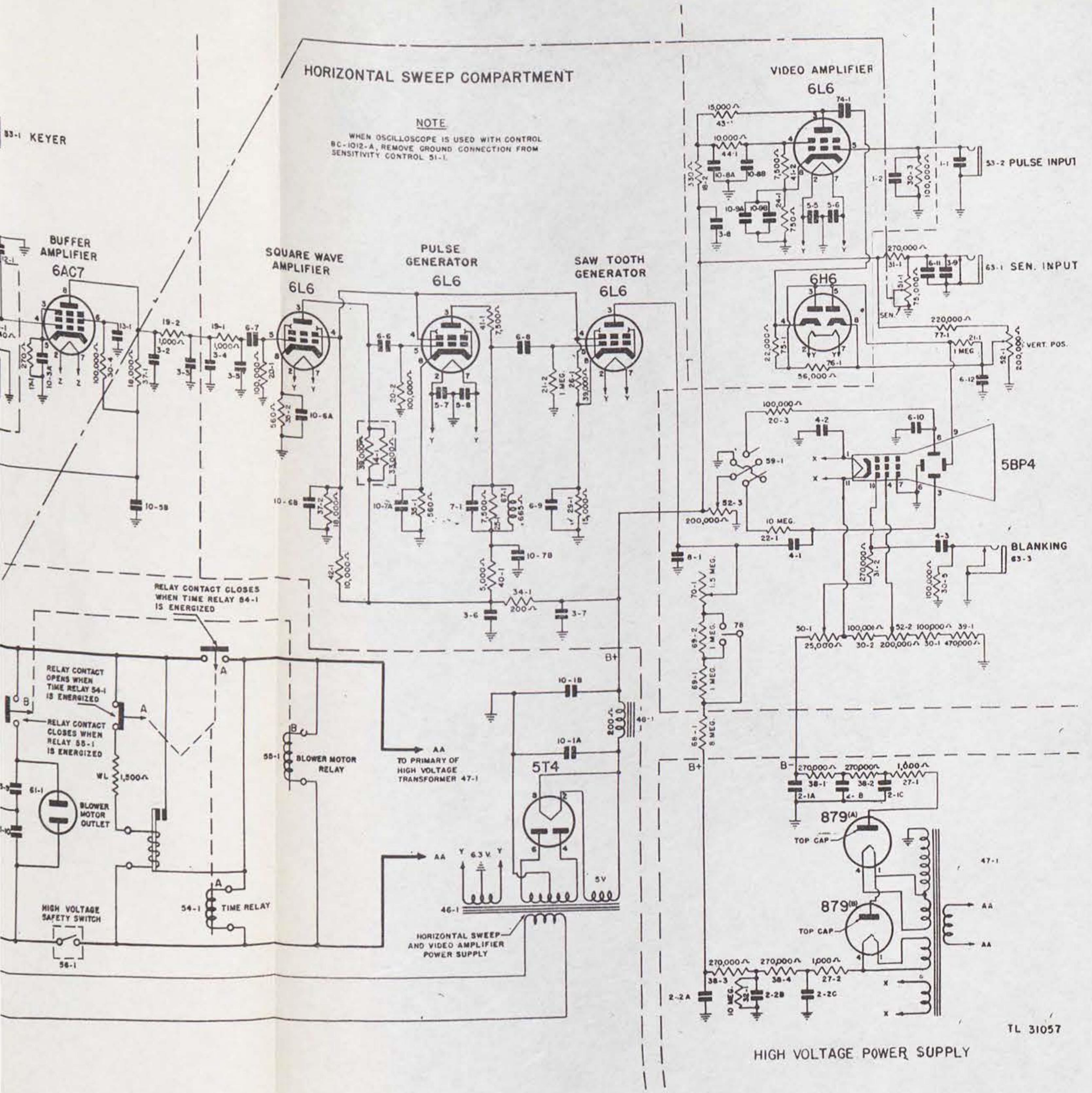


Figure 79. Oscilloscope BC-403-E, schematic.

APPARATUS LEGEND FOR OSCILLOSCOPE UNIT BC-403-E

Part No.	Quantity required	Name of part and description
1	2	Capacitor, 56 μμf, 500 volts.
2	2	Capacitor, A–2 μμf, 400 volts.
		B–2 μμf, 400 volts.
		C–2 μμf, 400 volts.
3	9	Capacitor, 0.001 μf, 500 volts.
4	3	Capacitor, 0.01 μf, 5,000 volts.
5	14	Capacitor, 0.01 μf, 400 volts.
6	7 (6–12)	Capacitor, 0.1 μf, 600 volts.
6	5 (1–5)	Capacitor, 0.1 μf, 400 volts.
7	1	Capacitor, 330 μμf, 500 volts.
8	1	Capacitor, 0.001 μf, 5,000 volts.
9	1	Capacitor (7–0.005 μf), 0.035 μf, 500 volts.
10	9	Capacitor, A–8 μf, 600 volts.
		B–8 μf, 600 volts.
11	1	Capacitor (matched pair), 0.073 μf, 250 volts.
12	1	Capacitor, 2 μf, 600 volts.
13	2	Capacitor, 0.5 μf, 600 volts.
14	1	Resistor, 18,000 ohms (1–39,000 ohms, 1–33,000 ohms, 2 watts, connected in parallel), 4 watts.
15	1	Resistor, 300 ohms, 50 watts.
16	2	Resistor, 47 ohms, ½ watt.
17	1	Resistor, 270 ohms, ½ watt.
18	2	Resistor, 330 ohms, ½ watt.
19	2	Resistor, 1,000 ohms, ½ watt. (19–1, 19–2).
19	1	Resistor (2–2,000 ohms, ½ watt in parallel) 1,000 ohms, 1 watt.
20	5	Resistor, 100,000 ohms, ½ watt.
21	2	Resistor, 1 megohm, ½ watt.
22	1	Resistor, 10 megohms, ½ watt.
23	1	Resistor, 150 ohms, 1 watt.
24	1	Resistor, 750 ohms, 1 watt.
25	1	Resistor, 7,500 ohms, 1 watt.
26	1	Resistor, 39,000 ohms, 1 watt.
27	2	Resistor, 1,000 ohms, 1 watt.
28	1	Resistor, 390 ohms, ½ watt.
29	1	Resistor, 15,000 ohms, 1 watt.
30	5	Resistor, 100,000 ohms, 1 watt.
31	2	Resistor, 270,000 ohms, 1 watt.
32	1	Resistor, 10 megohms, 10 watts.
33	2	Resistor, 75 ohms, 2 watts.
34	1	Resistor, 200 ohms, 2 watts.
35	2	Resistor, 560 ohms, 2 watts.

APPARATUS LEGEND FOR OSCILLOSCOPE UNIT BC-403-E

Part No.	Quantity required	Name of part and description
36	1	Resistor, 10,000 ohms, 2 watts.
37	2	Resistor, 18,000 ohms, 2 watts.
38	4	Resistor, 270,000 ohms, 2 watts.
39	1	Resistor, 470,000 ohms, 5 watts.
40	1	Resistor, 5,000 ohms, 10 watts.
41	2	Resistor, 7,500 ohms, 10 watts.
42	1	Resistor, 10,000 ohms, 10 watts.
43	1	Resistor, 15,000 ohms, 10 watts.
44	1	Resistor, 10,000 ohms, 20 watts.
45	1	Resistor, 5,100 ohms, ½ watt.
46	2	Transformer (power).
47	1	Transformer (power, high voltage).
48	2	Reactor (choke).
49	2	Transformer (audio).
50	1	Potentiometer, 25,000 ohms.
51	1	Potentiometer, 75,000 ohms.
52	3	Potentiometer, 200,000 ohms.
53	2	Jack (open circuit).
54	1	Relay (110 volts, 60 cycles).
55	1	Relay, blower (110 volts, 60 cycles).
56	1	Switch, safety (high voltage).
57	1	Fuse, 5 amp.
58	1	Light, pilot (Mazda, No. 51, clear).
59	1	Switch, toggle, d.p.d.t.
60	1	Switch, s.p.d.t. (attached to potentiometer 51–1).
61	1	Outlet plug, a-c, female (for blower motor).
62	1	Receptacle (a-c input).
63	3	Jack (closed circuit).
64	4	Inductance, coil, 300 mh, 600 ohms.
65	1	Inductance, coil, 25 mh, 140 ohms.
66	1	Inductance coil, 1,870 mh (in shield) 2,600 ohms.
67	1	Inductance coil, 280 mh, 665 ohms.
68	1	Resistor, 8 megohm, 10 watts.
69	2	Resistor, 1 megohm, 1 watt.
70	1	Potentiometer, 1.5 megohm.
71	1	Resistor, 120,000 ohms, 1 watt.
72	1	Resistor, 82,000 ohms, ½ watt.
73	1	Resistor, 4,700 ohms, ½ watt.
74	1	Capacitor, 0.05 mfd, 600 volt.
75	1	Resistor, 22,000 ohms, 1 watt.
76	1	Resistor, 56,000 ohms, 1 watt.
77	1	Resistor, 220,000 ohms, 1 watt.

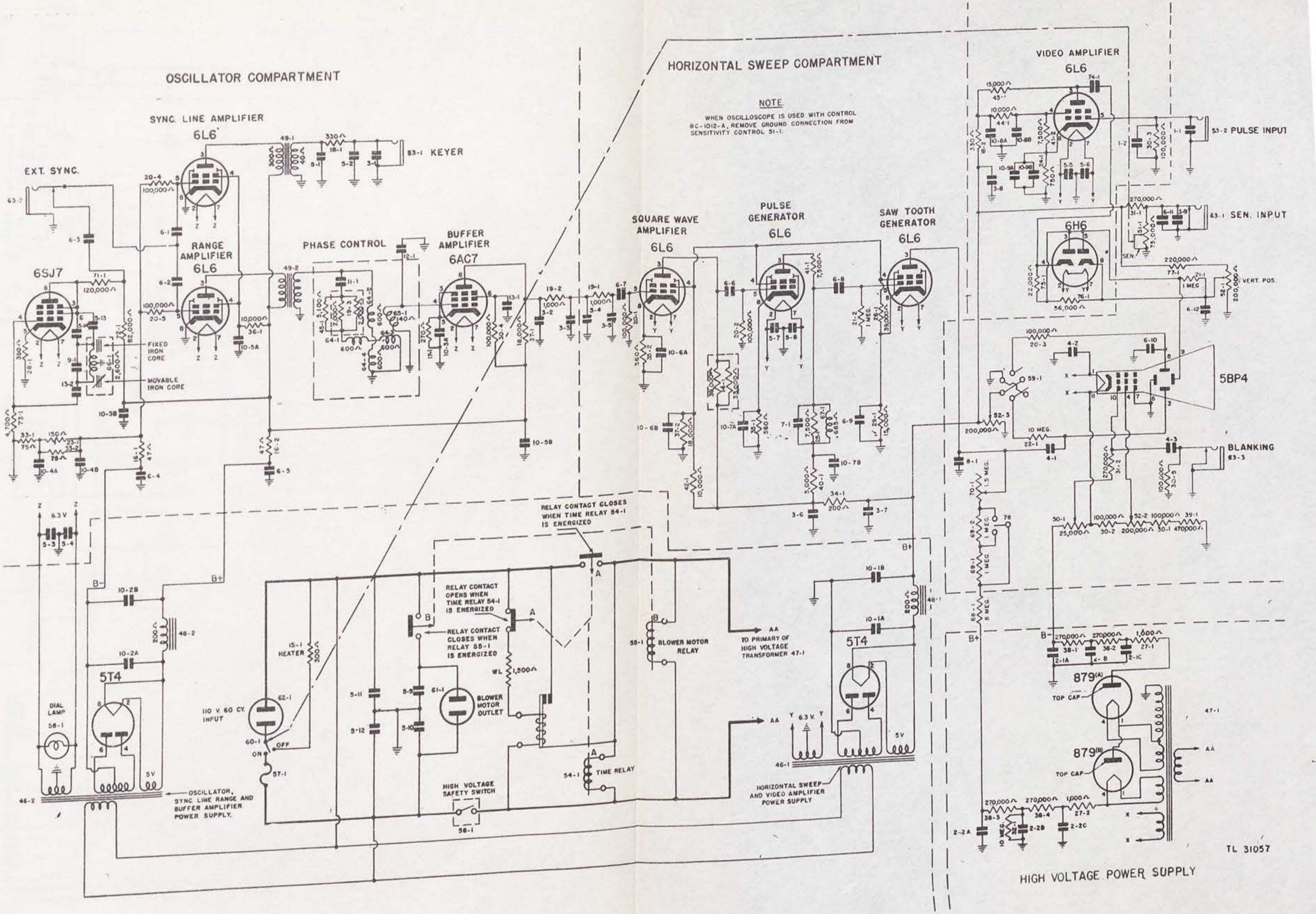


Figure 79. Oscilloscope BC-403-E, schematic.

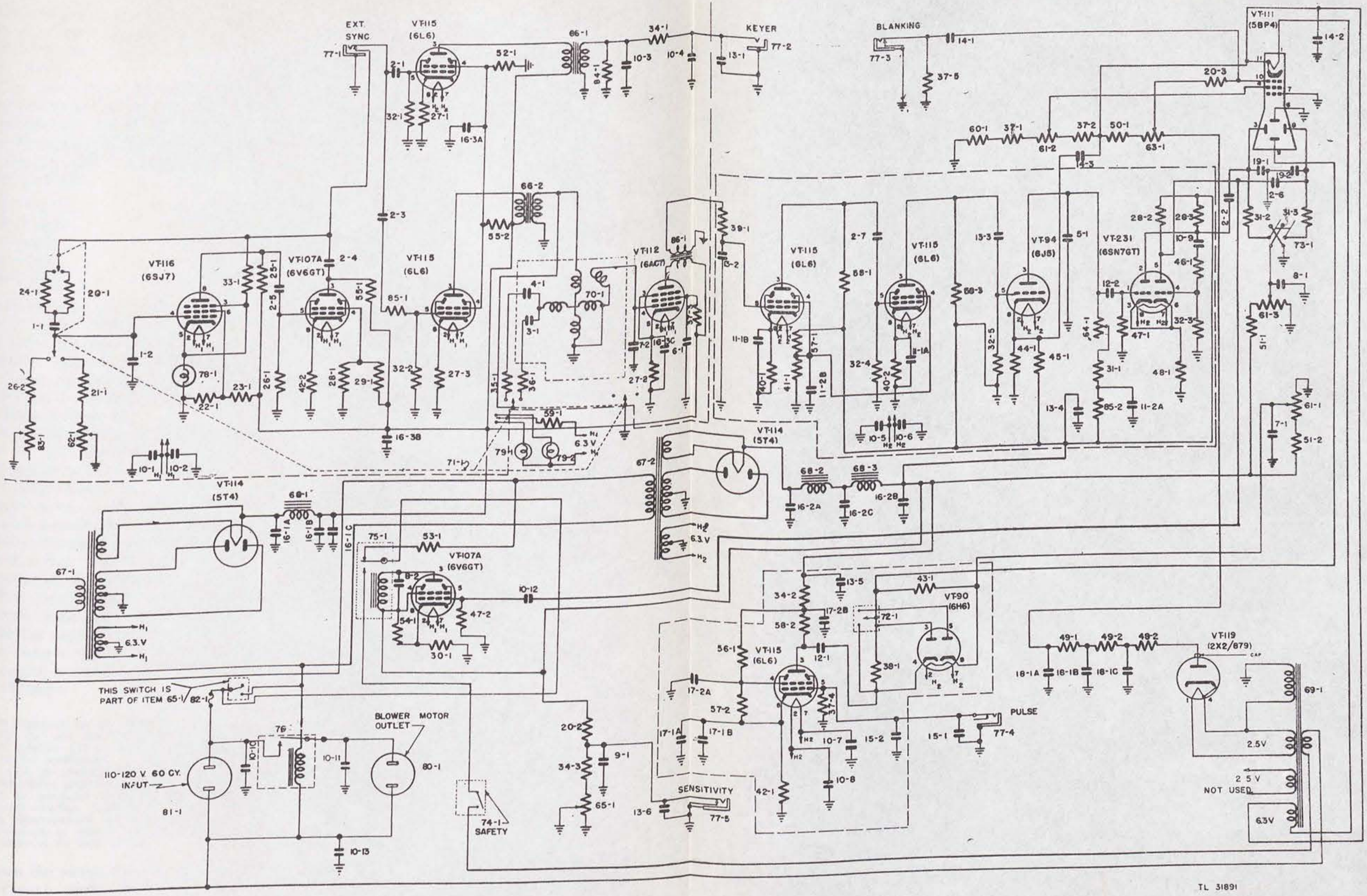


Figure 80. Oscilloscope BC-403-F, schematic.

This reading is shown on the attenuator dial of the signal generator. The sensitivity control, Resistor Panel BD–109, should be in the maximum clockwise position.

(2) The table below shows a stage-by-stage gain measurement of the four i-f stages. In taking these measurements, remove the signal generator lead from the mixer grid and ground, and connect them to the grid (No. 4 prong) and ground on the following stages:

4th i-f grid	for a 1-inch deflection	80,000 microvolts.
3rd i-f grid	for a 1-inch deflection	9,000 microvolts.
2d i-f grid	for a 1-inch deflection	1,000 microvolts.
1st i-f grid	for a 1-inch deflection	110 microvolts.
Mixer grid	for a 1-inch deflection	55 microvolts.

d. ALIGNMENT OF R-F STAGES. To align the r-f stages, proceed as follows:

(1) Install a trombone on the input terminals of the receiver. Replace the oscillator tube.

(2) Connect the signal-generator output lead and ground lead to arbitrary positions on the trombone as shown in figure 78.

(3) Set the frequency control dial on the signal generator to the transmitter frequency which should be approximately 106 megacycles. Set the receiver oscillator dial to 50.

(4) Apply power to all units and allow them to come up to normal operating temperature.

(5) Adjust the signal-generator attenuator control so that a clear sine wave of approximately 1 inch appears on the oscilloscope screen.

(6) Move the shorting bar and the signal-generator output leads along the trombone until a peak deflection appears on the oscilloscope. It may be necessary to retard the signal-generator attenuator control to maintain the 1-inch deflection on the oscilloscope.

NOTE. In beginning the r-f alignment, the adjustment of the attenuator dial and sensitivity control (Resistor Panel BD–109) are arbitrary and are done solely to obtain a *clear* sine wave on the oscilloscope. If the sensitivity control is used at full gain, the attending noise level will cause a confused and unworkable pattern to appear on the scope screen, even though the attenuator control on the signal generator may be properly retarded. Consequently, the sensitivity control and the signal-generator attenuator control must be adjusted simultaneously in order to secure a clear and workable sine-wave pattern on the scope screen.

(7) Insert the tuning wand in the local oscillator coil (39–1). Either the brass or iron end of the wand may be used at first. The tests and procedures used in conjunction with the wand are described in paragraph 37.

(8) Adjust the trimmer screw in capacitor 8–1 of the buffer coil (42–1) for a peak deflection.

(9) To align the second r-f coil (40–1), follow the tuning wand procedure described above for the local oscillator coil. Should the output gain indicated on the scope screen increase to a point off the screen during any of these operations, retard the signal-generator attenuator control in order to maintain the standard 1-inch deflection.

(10) In aligning the first r-f coil (37–1), again use the tuning wand and follow the same procedure.

(11) Finally, adjust the potentiometer (15–1) for a peak deflection.

e. SENSITIVITY OF R-F STAGES. If all the r-f stages have been aligned properly, the over-all sensitivity of the receiver component should be 3 or 4 microvolts for a 1-inch deflection on the test oscilloscope screen.

112. Oscilloscope, Time Delay Relay 54-1 (figs. 79 and 80)

a. ABNORMAL CONDITION. Oscilloscope time delay relay 54–1 is not heard closing.

b. PROBABLE CAUSES. (1) Lack of a-c power to the oscilloscope unit.

(2) Defective a-c power switch 60–1.

(3) Defective high-voltage safety switch 56.

(4) Defective time delay relay 54–1.

c. TEST INSTRUMENT. Analyzer, I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

NOTE. Throw the a-c power ON switch and note whether the dial indicator lamp glows. If the indicator lamp glows, proceed with tests (3) and (4) below. If the dial lamp does not glow, proceed with tests (1) and (2) below.

(1) *Testing a-c power to the oscilloscope unit.* Follow procedure outlined in paragraph 113*d*(1).

(2) *Testing a-c power switch 60–1.* See paragraph 113*d*(6).

(3) *Testing high-voltage safety switch.* See paragraph 114*d*(5).

(4) *Testing time delay relay 54–1.* (*a*) Remove the oscilloscope unit from its case.

(*b*) Check for continuity across resistor WL of the time delay relay.

(*c*) Normal resistance is 1,500 ohms. If no resistance indication is obtained, replace the resistor.

OSCILLOSCOPE BC-403-F, VOLTAGE AND RESISTANCE MEASUREMENTS

Tube		Prong No.	Element	Volts to ground	Ohms to ground
6SJ7	Oscillator 1st Section	1	Shield	0	0
		2	Heater	3.15 ac	0
		3	Sup grid	2.5	340
		4	Grid	0	320,000
		5	Cathode	2.5	340
		6	Screen	88	20,000
		7	Heater	3.15 ac	0
		8	Plate	250	65,000
6V6GT	Oscillator 2d Section	1	N.C.	......	......
		2	Heater	3.15 ac	0
		3	Plate	178	26,000
		4	Screen	290	19,000
		5	Grid	0	560,000
		6	N.C.	......	......
		7	Heater	3.15 ac	0
		8	Cathode	20	780
6L6	Keyer Amplifier	1	Shield	0	0
		2	Heater	3.15 ac	0
		3	Plate	360	17,000
		4	Screen	220	15,000
		5	Grid	0	95,000
		6	N.C.	......	......
		7	Heater	3.15 ac	0
		8	Cathode	14	250
6L6	Range Amplifier	1	Shield	0	0
		2	Heater	3.15 ac	0
		3	Plate	360	17,000
		4	Screen	220	15,000
		5	Grid	0	95,000
		6	N.C.	......	......
		7	Heater	3.15 ac	0
		8	Cathode	13	250
6AC7	Buffer Amplifier	1	Shield	0	0
		2	Heater	3.15 ac	0
		3	Sup grid	2.9	250
		4	Grid	0	440
		5	Cathode	2.9	250
		6	Screen	195	112,000
		7	Heater	3.15 ac	0
		8	Plate	370	17,000
6L6	Square-Wave Generator (1st)	1	Shield	0	0
		2	Heater	3.15 ac	0
		3	Plate	122	18,500
		4	Screen	138	7,000
		5	Grid	— .15	1,800
		6	N.C.	......	......
		7	Heater	3.15 ac	0
		8	Cathode	13	520

Tube	Prong No.	Element	Volts to ground	Ohms to ground
6L6 Square-Wave Generator (2d)	1	Shield	0	0
	2	Heater	3.15 ac	0
	3	Plate	242	19,000
	4	Screen	138	7,000
	5	Grid	—142	95,000
	6	N.C.	......	......
	7	Heater	3.15 ac	0
	8	Cathode	11	580
6J5 Saw-Tooth Generator	1	Shield	0	0
	2	Heater	3.15 ac	0
	3	Plate	145	820,000
	4	N.C.	......	......
	5	Grid	—3.9	105,000
	6	N.C.	......	......
	7	Heater	3.15 ac	0
	8	Cathode	88	7,000
6SN7GT Push-Pull Inverting Amplifier	1	Grid (1)	—.3	1,000
	2	Plate (1)	200	52,000
	3	Cathode	7	1,000
	4	Grid (2)	0	100,000
	5	Plate (2)	162	56,000
	6	Cathode	7	1,000
	7	Heater	3.15 ac	0
	8	Heater	3.15 ac	0
6L6 Video Amplifier	1	Shield	0	0
	2	Heater	3.15 ac	0
	3	Plate	280	19,000
	4	Screen	165	5,200
	5	Grid	.05	95,000
	6	N.C.	......	......
	7	Heater	3.15 ac	0
	8	Cathode	18	800
6H6 D-c Restorer	1	Shield	0	0
	2	Heater	3.15 ac	0
	3	Plate (1)	0	75,000
	4	Cathode (1)	8.8	13,000
	5	Plate (2)	6.7	75,000
	6	N.C.	......	......
	7	Heater	3.15 ac	0
	8	Cathode (2)	7	95,000
6V6GT Vacuum Tube Delay Relay	1	N.C.	......	......
	2	Heater	3.15 ac	0
	3	Plate	250	9,500
	4	Screen	330	4,000
	5	Grid	0	900,000
	6	N.C.	......	......
	7	Heater	3.15 ac	0
	8	Cathode	52	1,000

Tube	Prong No.	Element	Volts to ground	Ohms to ground
5T4	1	Shield	0	0
	2	Filament	420	4,500
	3	N.C.	......	......
	4	Plate	XX	70
Oscillator Compartment	5	N.C.	......	......
Full-Wave Rectifier	6	Plate	XX	70
	7	N.C.	......	......
	8	Filament	420	4,500
5T4	1	Shield	0	0
	2	Filament	X	17,000
	3	N.C.	......	......
	4	Plate	XX	70
Saw-Tooth Compartment	5	N.C.	......	......
Full-Wave Rectifier	6	Plate	XX	70
	7	N.C.	......	......
	8	Filament	X	17,000
879 Half-Wave	Cap	Plate	XX	2.5 meg
High-Voltage Rectifier	XXX	Filament	XX	350

N.C. No connection.
X Voltage across Capacitor 16–2B (the output of the filter) is 350 volts.
XX Take no voltage reading at this point.
XXX Make resistance reading from filament tap on Transformer 69–1.

(*d*) Check for continuity across the bimetallic element of the time delay relay. If no continuity is indicated, repair or replace the bimetallic element.

(*e*) Check for continuity across the relay coil terminals. If no continuity is indicated, replace the time delay relay.

113. Oscilloscope, Dial Lamp 58–1

a. Abnormal Condition. Dial lamp 58–1 does not glow.

b. Probable Causes. (1) Defective fuse 57–1.

(2) Defective dial lamp bulb.
(3) Defective socket and connections.
(4) Lack of a-c power to oscilloscope unit.
(5) Defective a-c input receptacle.
(6) Defective a-c power switch 60–1.
(7) Defective power transformer 46–2.

c. Test Instrument. Analyzer I–153–A.

d. Remedy. Proceed with the following tests until a defect has been located.

Note. Turn the a-c power switch of the oscilloscope unit to the ON position and note whether the blower unit is operating. Allow sufficient time for the time relay to energize. If the blower unit operates, proceed with tests (2), (3), and (7) below. If the blower unit does not operate, proceed with tests (1), (4), (5), and (6) below.

(1) *Testing fuse 57–1.* (*a*) Remove the fuse cartridge from the rear of the oscilloscope.

(*b*) Remove the fuse from the fuse holder. Check for continuity across the fuse terminals, or note whether the element within the fuse is defective. Replace the fuse if found defective after determining the cause of the trouble.

(2) *Testing dial lamp bulb.* Remove the dial lamp bulb from its socket and replace with a tested new bulb. If the new bulb does not glow, reinsert the original into its socket.

Note. The lamp bulb may be tested by checking for continuity across the terminals of the lamp bulb.

(3) *Testing lamp socket and connections.* (*a*) Check the lamp socket terminals. Repair or replace any loose or broken connections.

(*b*) Check for a-c voltage indication across the terminals of the lamp socket, with the a-c power switch on. If voltage indication is obtained and the lamp bulb does not glow, replace the dial lamp socket.

(4) *Testing a-c power to oscilloscope unit.* (*a*) Remove the a-c supply cord from the oscilloscope unit.

(*b*) Check for a-c voltage across the terminals of the female plug of the a-c supply cord. If no voltage indication is obtained, check the a-c cord and plug, and the a-c supply from the distribution panel to the oscilloscope unit.

(5) *Testing a-c input receptacle.* (*a*) Check the terminals of the a-c input receptacle. Repair or replace any loose or broken connections.

(*b*) Remove the a-c input cord from the oscilloscope unit.

(*c*) Turn the a-c power switch to the ON position and check for continuity across the terminals of the a-c input receptacle. If no continuity is indicated, repair or replace the a-c input receptacle.

NOTE. Do not replace the a-c input receptacle until the a-c power switch has been tested and found normal.

(6) *Testing a-c power switch 60–1.* (*a*) Remove the a-c input cord from the oscilloscope.

(*b*) Check for continuity across the terminals of the a-c power switch. If no continuity is indicated, repair or replace the switch.

(7) *Testing power transformer 46–2.* (*a*) Remove the oscilloscope unit from its case.

(*b*) Remove the one lead from the 6.3-volt filament winding of the transformer.

(*c*) Check for continuity across the filament winding of the transformer. If no continuity is indicated, replace the power transformer.

(*d*) Check for continuity across the primary winding of the transformer. If no continuity is indicated, replace the transformer.

NOTE. One of the primary leads must be removed from the circuit.

114. Oscilloscope, Blower Motor Unit

a. ABNORMAL CONDITION. Oscilloscope blower motor unit not operating.

b. PROBABLE CAUSES. (1) Defective blower-motor a-c input cord.

(2) Defective blower-motor.

(3) Defective blower-motor thermal overload breaker.

(4) Defective blower-motor a-c input receptacle.

(5) Defective high-voltage safety switch.

(6) Defective blower-motor relay 55–1.

(7) Defective time relay 54–1.

c. TEST INSTRUMENT. Analyzer I–153–A.

d. REMEDY. Proceed with the following tests until a defect has been located.

NOTE. Check the blower-motor a-c input receptacle for voltage output. If no voltage output is obtained, proceed with tests (4) through (7). If voltage output is obtained, proceed with tests (1) through (3).

(1) *Testing blower-motor a-c input cord.* (*a*) Check the terminals of the male plug on the a-c input cord. Repair or replace any loose or broken connections.

(*b*) Check the blower-motor a-c input cord for breaks or defects between the male plug and the blower-motor leads. Repair or replace cord if defective.

(2) *Testing blower motor.* (*a*) Check for continuity across the terminals of the male plug on the blower-motor a-c input cord.

(*b*) If continuity is not indicated, remove the cover from the thermal overload breaker.

(*c*) Untape blower-motor leads T1–T2 and T3–T4.

NOTE. Leads T1 and T2 are soldered together; and T3 and T4 are also soldered together. Check these leads for defects or breaks.

(*d*) Check for continuity across T1–T2 and T3–T4. If no continuity is indicated, repair or replace the blower-motor.

(*e*) If continuity is indicated, recheck the a-c input cord.

(3) *Testing blower-motor thermal overload breaker.* (*a*) Remove the thermal-overload breaker from the motor housing.

(*b*) Remove the bakelite cover from the rear of the thermal overload breaker.

(*c*) Remove one of the leads.

(*d*) Check for continuity across the terminal of the breaker. If no continuity is indicated, replace the thermal overload breaker.

(4) *Testing blower-motor a-c input receptacle.* (*a*) Remove the oscilloscope unit from its case.

(*b*) Check the blower-motor a-c input receptacle. Repair or replace any loose or broken connections.

(5) *Testing high-voltage safety switch.* (*a*) With the oscilloscope unit removed from its case, check the terminals of the safety switch. Repair or replace any loose or broken connections.

(*b*) Check for continuity across the terminals of the switch, with the switch button depressed. If no continuity is indicated, repair or replace the switch.

(6) *Testing blower-motor relay 55–1.* (*a*) Check the terminals of the relay. Repair or replace any loose or broken connections.

(*b*) Remove one of the leads from the relay coil terminals. Check for continuity across the relay coil terminals. If no continuity is indicated, repair or replace the blower-motor relay.

(7) *Testing time relay 54–1.* See paragraph 112*d*(4).

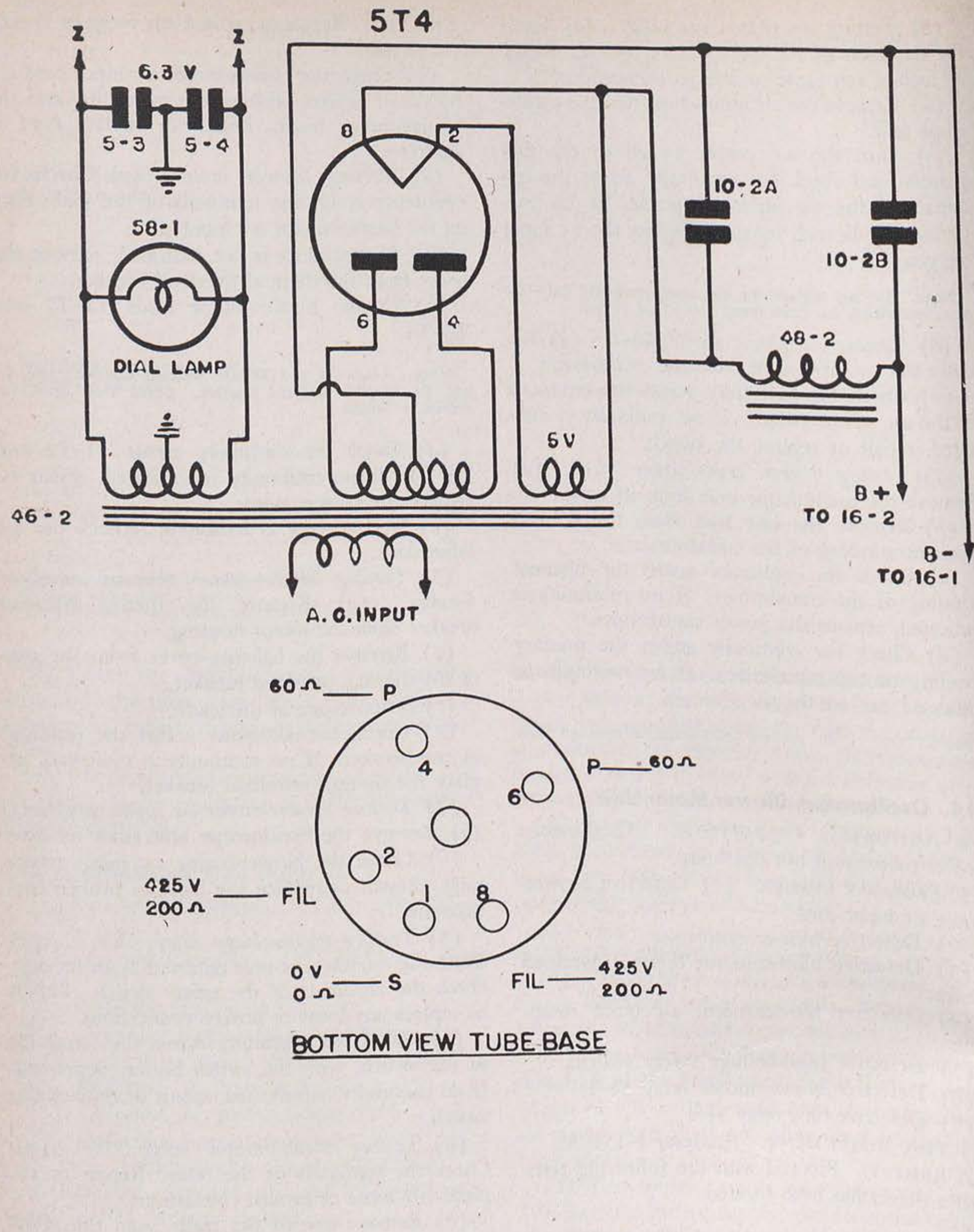


Figure 81. Oscilloscope BC–403–E, oscillator power supply stage.

115. Oscilloscope, Resistance Checks

Caution: Be sure to discharge capacitors before proceeding with any tests.

a. TESTING OSCILLATOR, POWER SUPPLY STAGE (fig. 81). (1) Remove and test the 5T4 rectifier tube. Apply the tests prods between tube prong 8 and the high side of capacitor 10–2B. Normal resistance is 200 ohms. If an indefinite resistance indication is obtained, filter choke 48–2 must be replaced.

(2) Apply test prods across capacitor 10–2B. Check for a shorted indication only. If a shorted indication is obtained, capacitor 10–2B must be replaced.

(3) Apply test prods across capacitor 10–2A. Check for a shorted indication. If a shorted indication is obtained, capacitor 10–2A must be replaced.

(4) Apply test prods across tube prongs 4 and 6 of the 5T4 rectifier tube socket. Check for a continuity indication. If an infinite resistance indication is obtained, the plate winding of transformer 46–2 is open-circuited, and the transformer 46–2 is open-circuited, and the transformer must be replaced.

(5) Disconnect one of the transformer 6.3-volt filament leads from the circuit. Connect the test prods across the 6.3-volt filament leads of transformer 46–2. Check for continuity. If an infinite resistance indication is obtained the transformer 6.3-volt filament winding is open-circuited, and the transformer must be replaced.

(6) Disconnect one of the transformer primary leads from the circuit. Connect the test prods across the primary leads of the transformer. Check for continuity. If an infinite resistance indication is obtained the primary winding of the Transformer 46–2 is open-circuited, and the transformer must be replaced.

b. TESTING HORIZONTAL SWEEP AND VIDEO POWER STAGE (fig. 82). (1) Remove and test the 5T4 rectifier tube. Apply test prods between tube prong 8 and the high side of capacitor 10–1B. Normal resistance indication should be 200 ohms. If an infinite resistance indication is obtained, the filter choke 48–1 must be replaced.

(2) Apply test prods between the high side of capacitor 10–1B and ground. Check for a shorted indication only. If a shorted indication is obtained, capacitor 10–1B must be replaced.

(3) Apply test prods between the high side of capacitor 10–1A and ground. Check for a shorted indication only. If a shorted indication is obtained, capacitor 10–1A must be replaced.

(4) Apply test prods between tube prongs 2 and 8 of the rectifier tube socket. Check for a continuity indication. If an infinite resistance indication is obtained, the 5-volt filament winding of power transformer 46–1 is open-circuited, and the transformer must be replaced.

(5) Apply test prods between tube prongs 4 and 6 of the 5T4 Rectifier tube socket. Check for a continuity indication. If an infinite resistance indication is obtained, transformer 46–1 must be replaced.

(6) Disconnect one of the transformer 6.3-volt filament leads from the circuit. Connect the test prods across the transformer 6.3-volt filament leads. Check for continuity. If an infinite resistance indication is obtained, the transformer 6.3-volt filament winding is open-circuited and the transformer must be replaced.

(7) Disconnect one of the transformer primary leads from the circuit. Connect the test prods across the primary leads of the transformer. Check for continuity. If an infinite resistance indication is obtained, the primary winding of transformer 46–1 is open-circuited, and the transformer must be replaced.

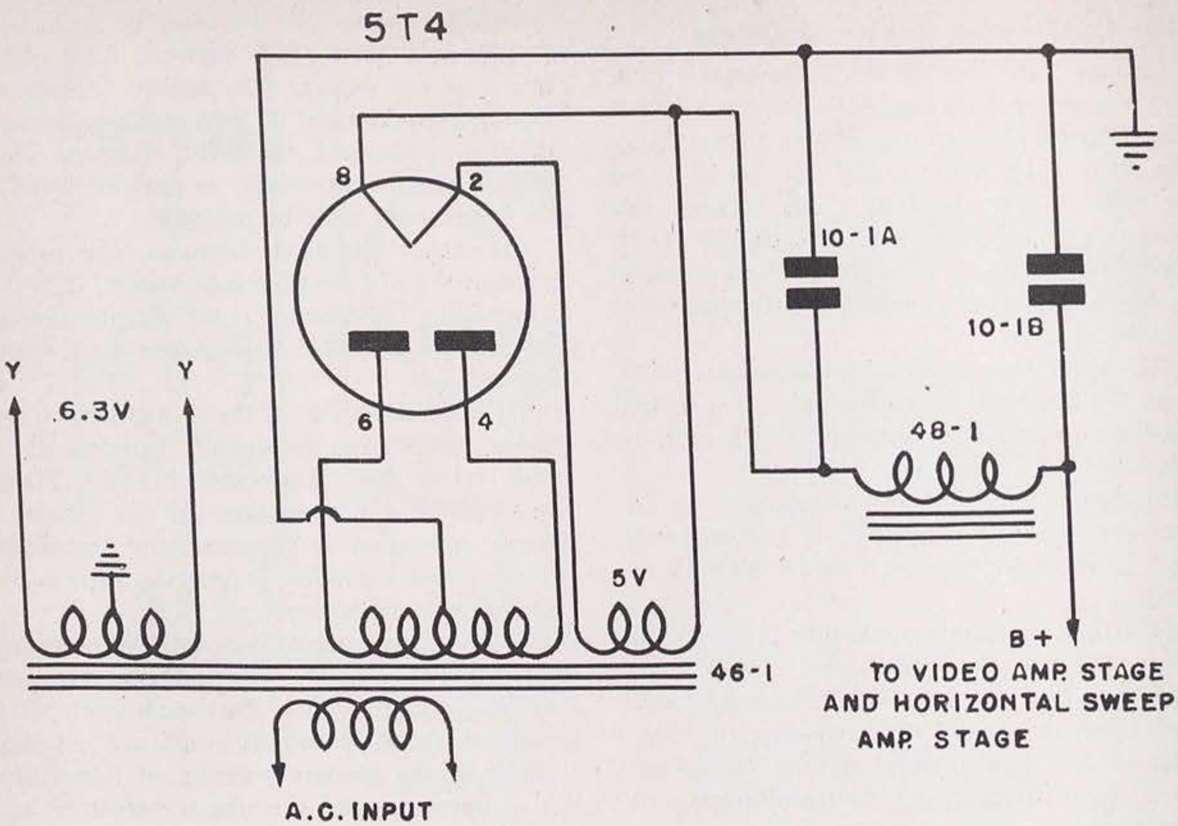
c. TESTING 879 HIGH-VOLTAGE RECTIFIER STAGE (fig. 83). (1) *879 Rectifier tube (A)*. (*a*) Apply test prods between the top cap of 879 rectifier tube (A) and the high side of capacitor 2–1A. Normal resistance indication should be 541,000 ohms. If an infinite resistance indication is obtained, check resistors 27–1, 38–2, and 38–1 for an open circuit.

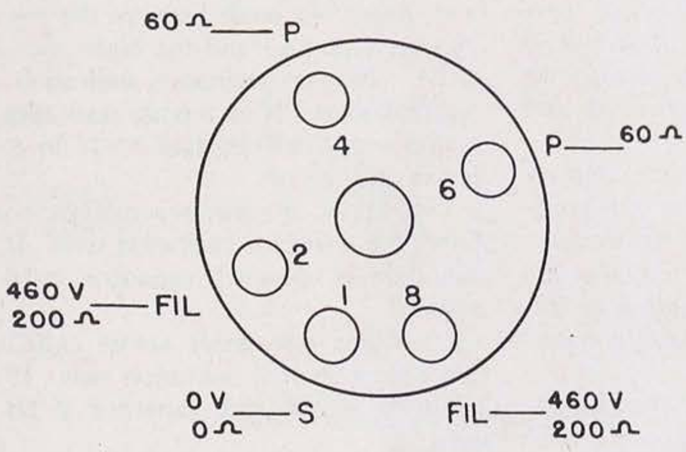
(*b*) Apply test prods across capacitor 2–1A. Check for a shorted indication only. If a shorted indication is obtained, capacitor 2–1A must be replaced.

(*c*) Apply test prods across capacitor 2–1B. Check for a shorted indication only. If a shorted indication is obtained, capacitor 2–1B must be replaced.

(*d*) Apply test prods across capacitor 2–1C. Check for a shorted indication only. If a shorted indication is obtained, capacitor 2–1C must be replaced.

(*e*) Remove the 879 rectifier Tube (A). Apply test prods between tube prongs 1 and 4. Check for a continuity indication. If an infinite resistance indication is obtained, check the tube socket prongs and the secondary terminals of high-voltage transformer 47–1 for loose or broken connections. If the connections are normal, the filament winding of high-voltage transformer 47–1 supplying





BOTTOM VIEW TUBE BASE

TL-31054

Figure 82. Oscilloscope BC–403–E, power supply for horizontal sweep and video amplifier.

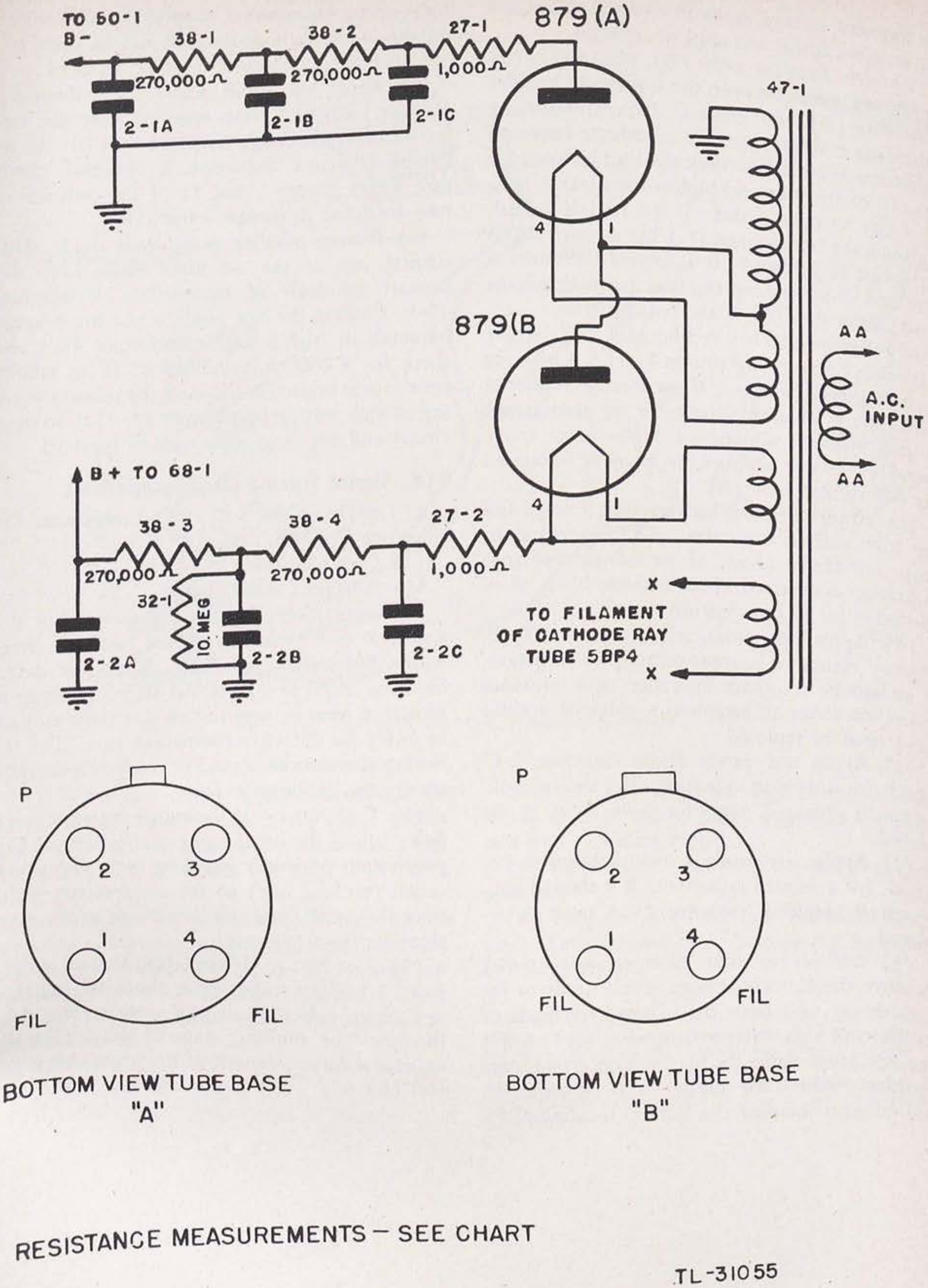


Figure 83. Oscilloscope BC-403-E, high-voltage power supply.

the filament voltage to the 879 (A) rectifier tube has an open circuit and must be replaced.

(2) *879 Rectifier tube (B)* (fig. 83). (*a*) Apply test prods between the top cap of rectifier tube 879 (B) and ground. Normal resistance indication is 6,000 ohms. If an infinite resistance indication is obtained, check the lead between the top cap of the tube and high-voltage transformer 47–1 for an open circuit. If the lead is normal, high-voltage transformer 47–1 has an open circuit and must be replaced. If a shorted indication is obtained, check the top cap lead and high-voltage transformer 47–1 for a shorted condition.

(*b*) Remove the 879 rectifier tube (B). Apply test prods between tube prongs 1 and 4. Check for a continuity indication. If an infinite resistance indication is obtained, check for an open circuit in the filament winding of high-voltage transformer 47–1 that supplies the filament voltage to the 879 rectifier tube (B).

(*c*) Apply test prods between tube prong 4 and the high side of capacitor 2–2A. Normal resistance is 541,000 ohms. If an infinite resistance indication is obtained, check resistors 27–2, 38–4, and 38–3 for an open circuit.

(*d*) Apply test prods across capacitor 2–2B. Normal resistance is approximately 10 megohms. If an infinite resistance indication or a resistance indication above 10 megohms is obtained, resistor 32–1 must be replaced.

(*e*) Apply test prods across capacitor 2–C. Check for a shorted indication. If a shorted indication is obtained, capacitor 2–2C must be replaced.

(*f*) Apply test prods across capacitor 2–2A. Check for a shorted indication. If a shorted indication is obtained, capacitor 2–2A must be replaced.

(3) *Cathode-ray tube filament supply.* (*a*) Remove the filament-voltage supply leads to the cathode-ray tube from the filament terminals of oscilloscope high-voltage transformer 47–1. Apply the test prods across the high-voltage transformer terminals. Check for continuity. If no continuity indication is obtained, the filament winding of the high-voltage transformer supplying the filament voltage to the cathode-ray tube has an open circuit, and the transformer must be replaced.

(*b*) Apply test prods across the cathode-ray filament leads that were removed from the terminals of high-voltage transformer 47–1. If an infinite resistance indication is obtained, check tube socket prongs 1 and 11 of the cathode-ray tube for loose or broken connections.

(4) *Primary winding, transformer 47–1.* Disconnect one of the a-c input leads from the primary terminals of high-voltage transformer 47–1. Connect the test prods across the primary terminals of high-voltage transformer 47–1 and check for a continuity indication. If an infinite resistance indication is obtained, the primary winding of high-voltage transformer 47–1 has an open circuit, and the transformer must be replaced.

116. Signal Tracing Oscilloscope Unit

a. Test Instruments. (1) Cathode-ray Oscilloscope I–134–A.

(2) Cord CD–719.

(3) Adapter Cable CD–710.

b. Preliminary Tests. The purpose of this test is to isolate defects to one particular stage within the oscilloscope unit. When the defect has been traced to a particular stage, a voltage or resistance measurement test of this stage is made to locate the defective component part. The following observations should be made before signal tracing the oscilloscope unit.

(1) *Test No. 1.* If the signal output at keyer jack 53–1 of the oscilloscope unit is normal (approximately 35 volts) and there is no sweep indication (no base line) on the scope screen, signal trace the oscilloscope unit beginning at the range amplifier stage (fig. 84).

(2) *Test No. 2.* If the signal output at keyer jack 53–1 of the scope unit is abnormal and there is a sweep indication on the scope screen, check the sync. line amplifier stage of the oscilloscope unit for a defect; the rest of the scope unit is normal (fig. 84).

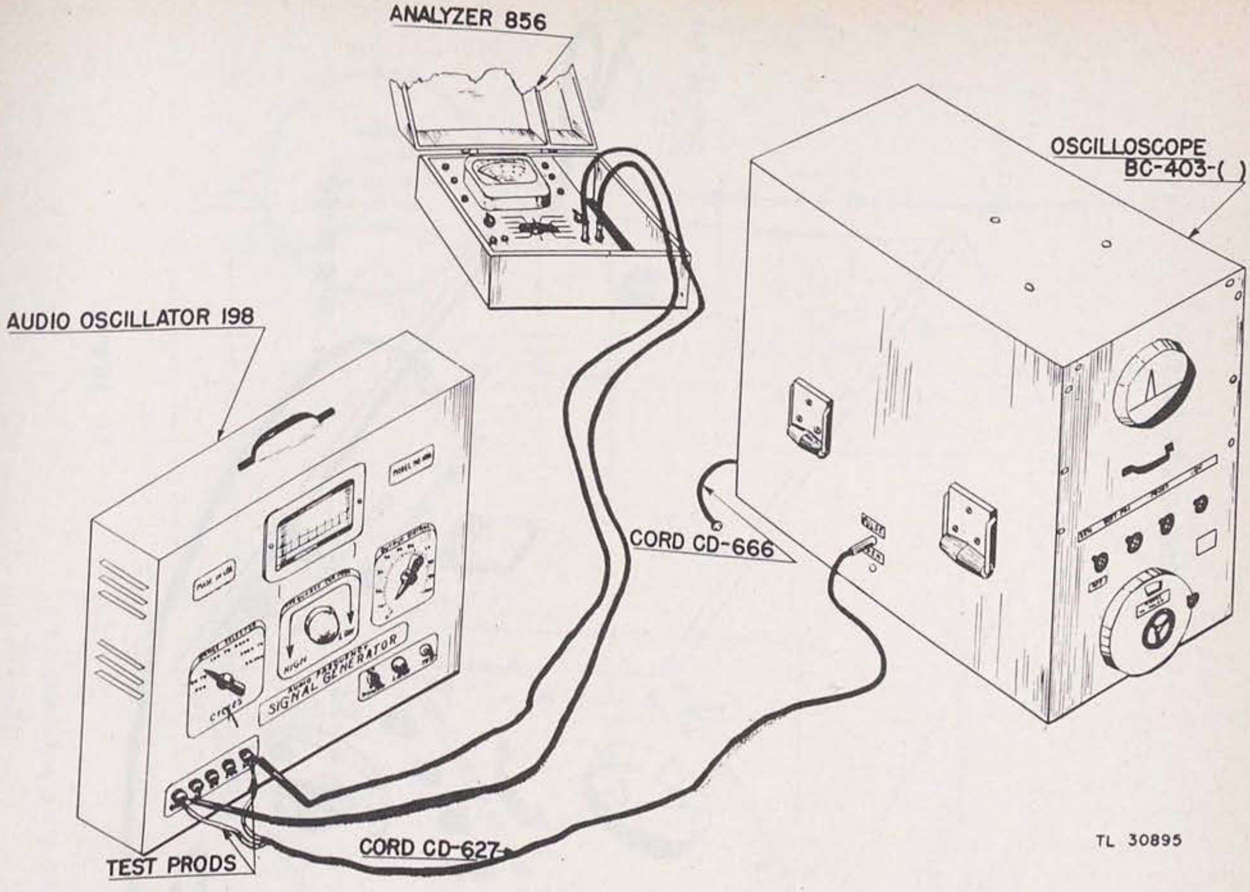


Figure 84. Oscilloscope BC–403–E, preliminary tests 1 and 2.

(3) *Test No. 3.* If no sweep indication is obtained on the scope screen and the signal output of the scope unit at jack 53–1 is abnormal, check the oscillator stage within the scope unit for a defect (fig. 85).

(4) *Test No. 4.* If the signal output of the scope unit at keyer output jack 53–1 is normal and there is a sweep indication on the scope screen but the main pulse or echoes have disappeared, check the video amplifier stage within the oscilloscope unit for a defect.

c. Preparatory Steps. (1) Remove the oscilloscope unit from its case.

(2) Lay the scope chassis over on its side.

Caution: Discharge the high-voltage capacitors in the high-voltage power supply in the scope unit with a shorting tool.

(3) Remove the cover from the oscillator compartment.

(4) Plug the a-c cord into the oscilloscope unit. Turn the unit on by turning the sensitivity control clockwise.

Note. Always use a 0.1- or 0.01-μf capacitor in series with the positive terminal (vertical plates) of the test scope and the stage under test. Never apply a direct potential to the vertical plates of the test scope, as this will overload the unit and cause an abnormal waveform indication to be obtained, thereby destroying the purpose of the signal-tracing test procedure.

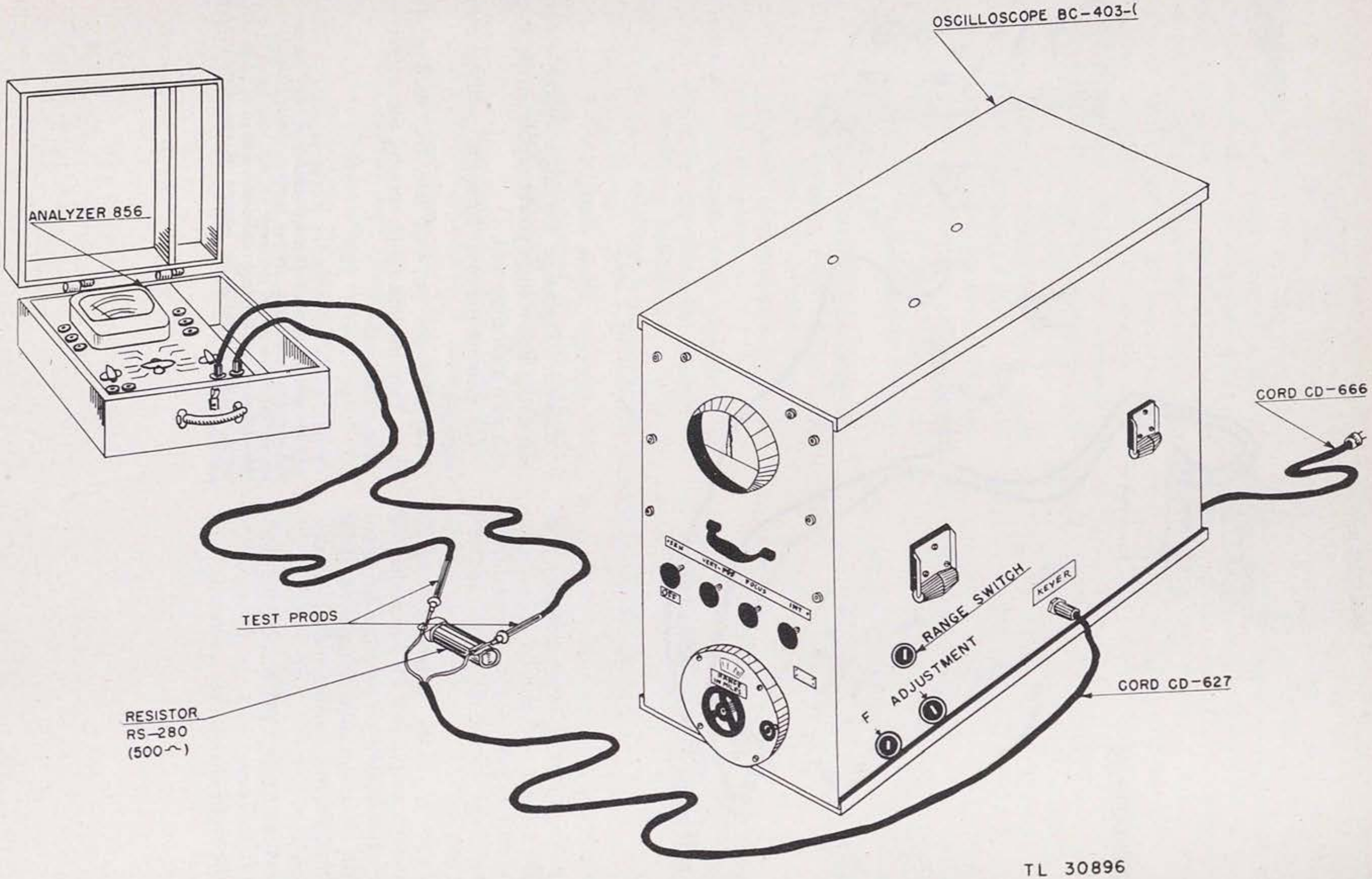


Figure 85. Oscilloscope BC-403-E, preliminary test 3.

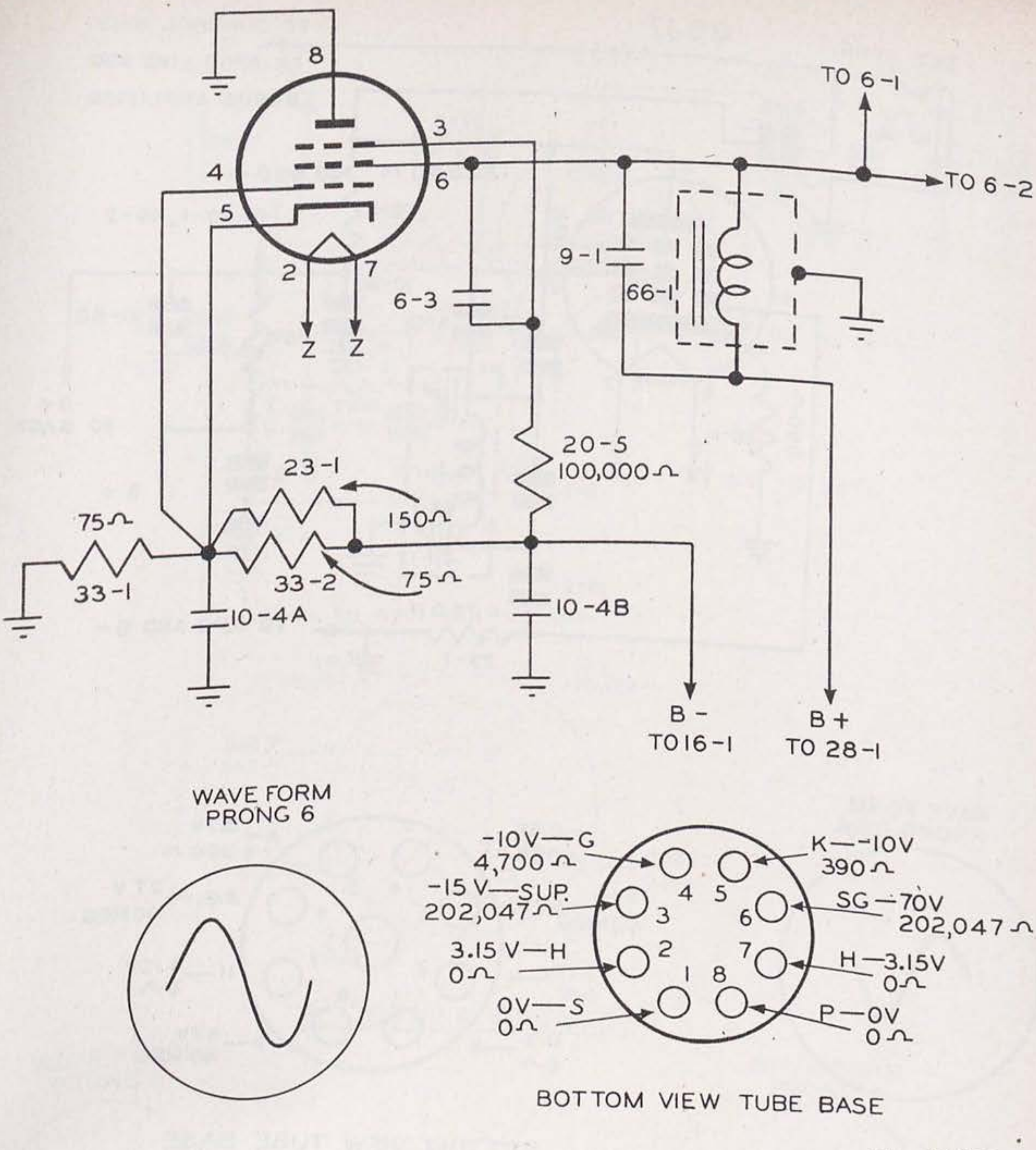


Figure 86. Oscilloscope BC-403-C, oscillator stage (transitron).

d. SIGNAL-TRACING PROCEDURE. (1) *Testing oscillator stage* (figs. 86 and 87). (*a*) Check for normal waveform indication between the plate (tube prong 8) and ground.

NOTE. If the oscillator stage is of the transitron type, check for normal signal indication between the screen (tube prong 3) and ground.

(*b*) If no waveform indication is obtained, test the stage.

(2) *Testing sync. line amplifier stage* (fig. 88). (*a*) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling Capacitors 6-1 and 6-2, and stage.

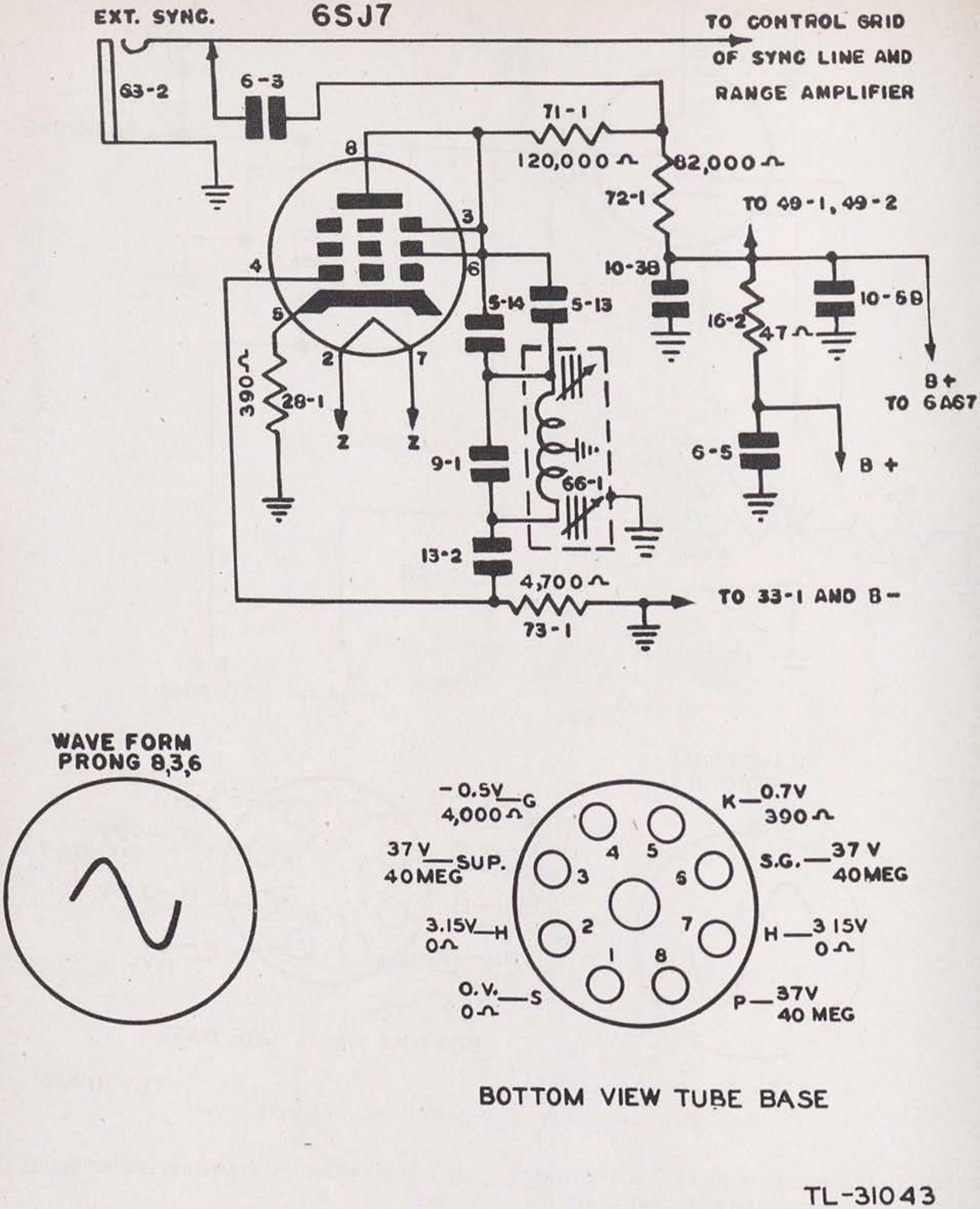


Figure 87. Oscilloscope BC-403-E, oscillator stage (triode).

(*b*) Check for normal waveform indication between the plate (tube prong 3) and ground. If no waveform indication is obtained, test the tube and stage.

(3) *Testing sync. line transformer 49–1* (fig. 88). (*a*) Check for normal waveform indication between the secondary winding of the transformer and ground.

(*b*) If no waveform indication is obtained, check the transformer and stage.

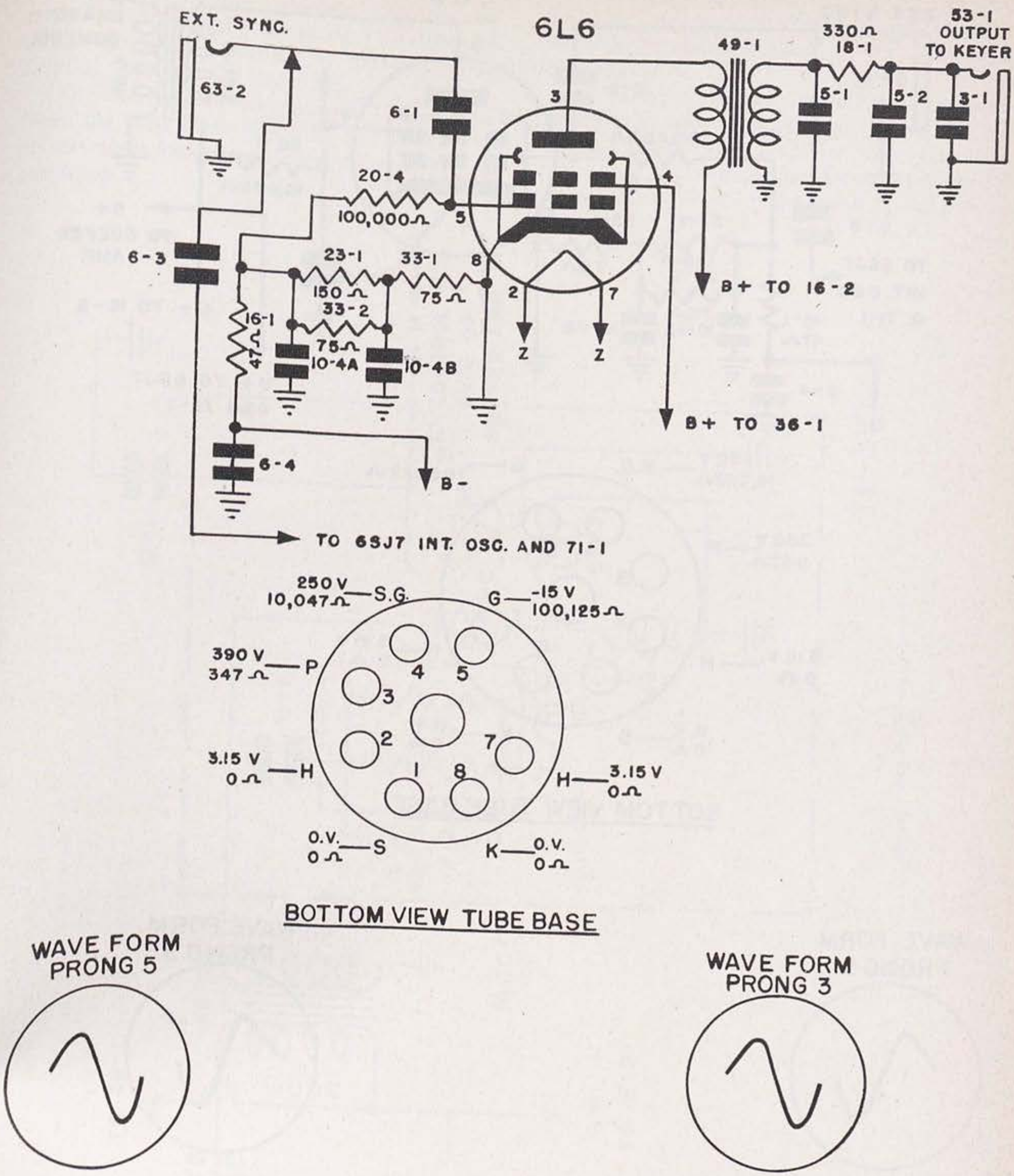


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Figure 88. Oscilloscope BC-403-E, sync. line amplifier stage.

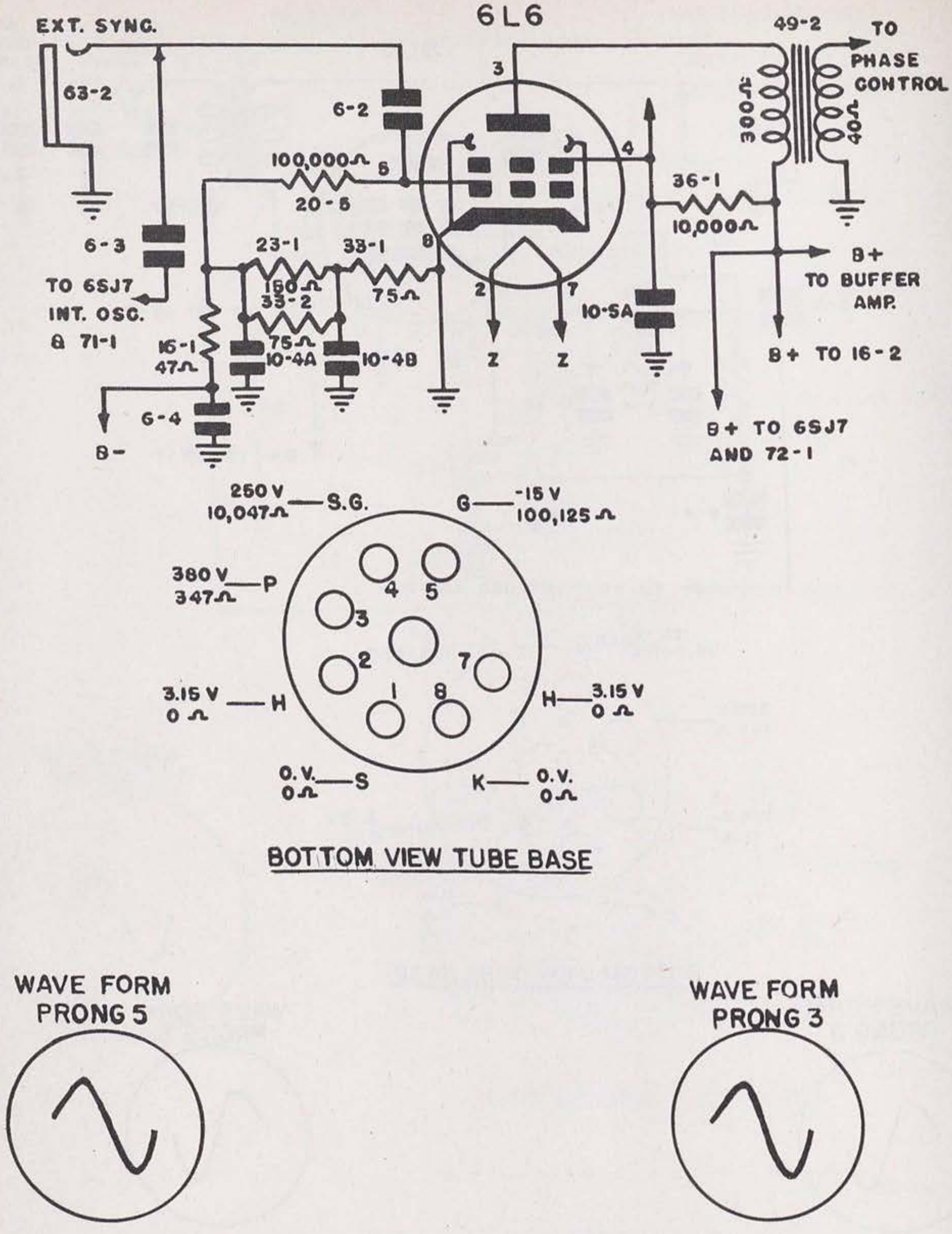

Figure 89. Oscilloscope BC-403-E, range amplifier stage.

(4) *Testing range amplifier stage* (fig. 89).

(*a*) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling Capacitor 6–2 and stage.

(*b*) Check for normal waveform indication between the plate (tube prong 3) and ground. If no waveform indication is obtained, test the tube and stage.

(5) *Testing range transformer 49–2* (fig. 90).

(*a*) Check for normal waveform indication between the secondary winding of the transformer and ground.

(*b*) If no waveform indication is obtained, check the transformer and stage.

(6) *Testing buffer amplifier stage* (fig. 91).

(*a*) Check for normal waveform indication between the control grid (tube prong 4) and ground.

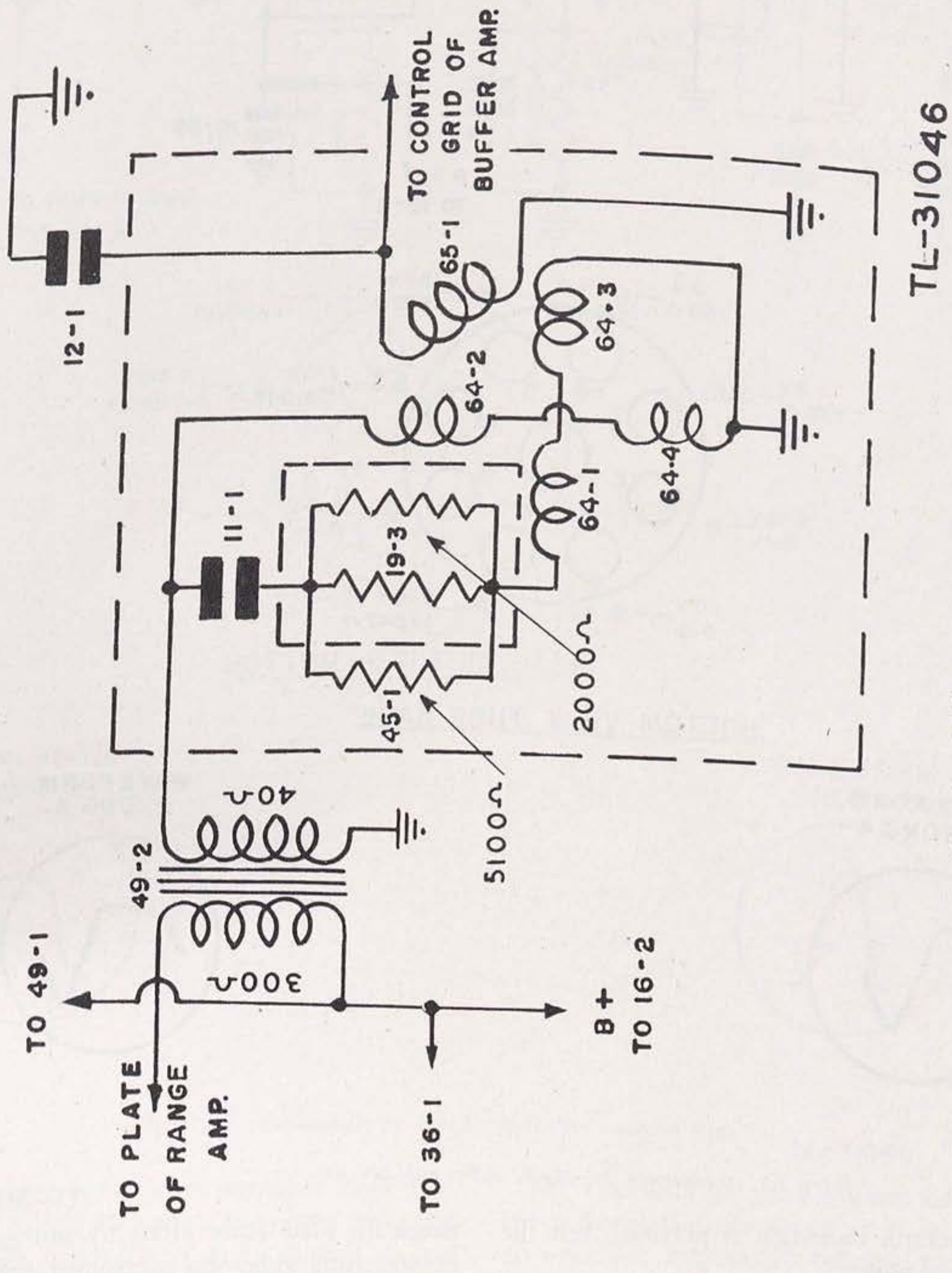

Figure 90. Oscilloscope BC–403–E, phasing unit.

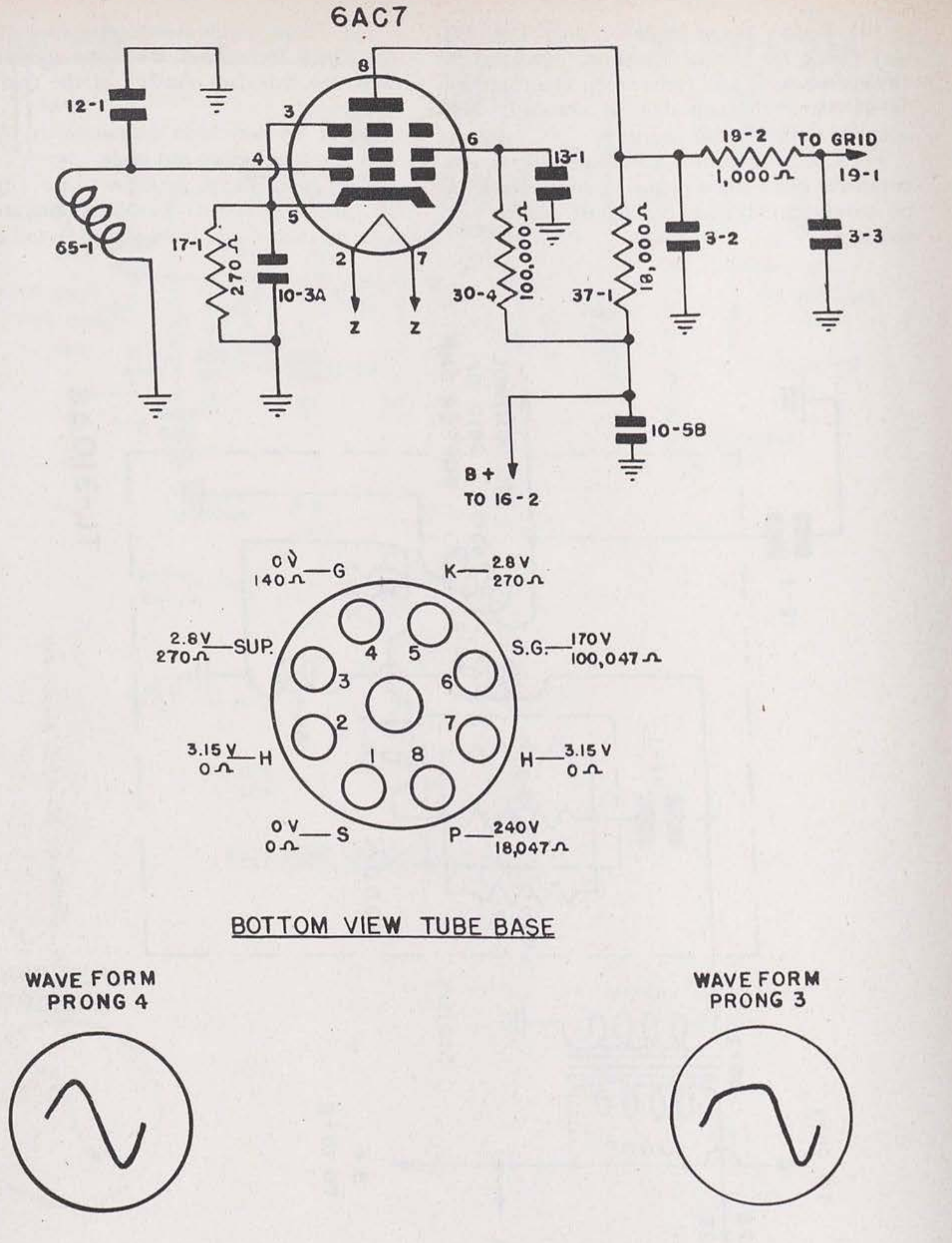

Figure 91. Oscilloscope BC–403–E, buffer amplifier stage.

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If no waveform indication is obtained, test the phase-control unit.

(*b*) Check for normal waveform indication between the plate (tube prong 8) and ground. If no waveform indication is obtained, test the tube and stage.

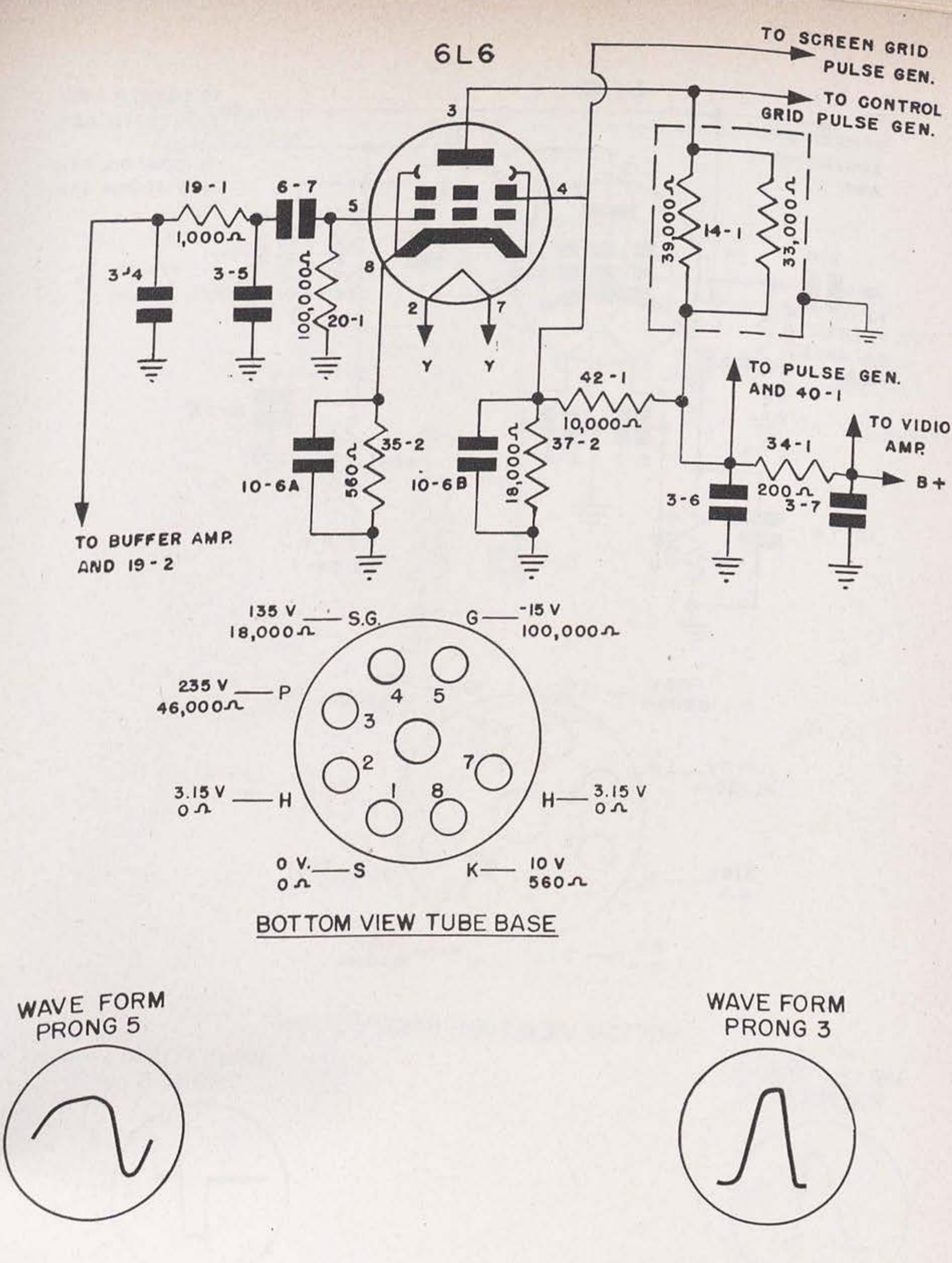

Figure 92. Oscilloscope BC-403-E, square-wave amplifier stage.

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(7) *Testing square-wave amplifier stage* (fig. 92). (*a*) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling Capacitor 6-7 and stage.

(*b*) Check for normal waveform indication between the plate (tube prong 3) and ground. If no waveform indication is obtained, test the tube and stage.

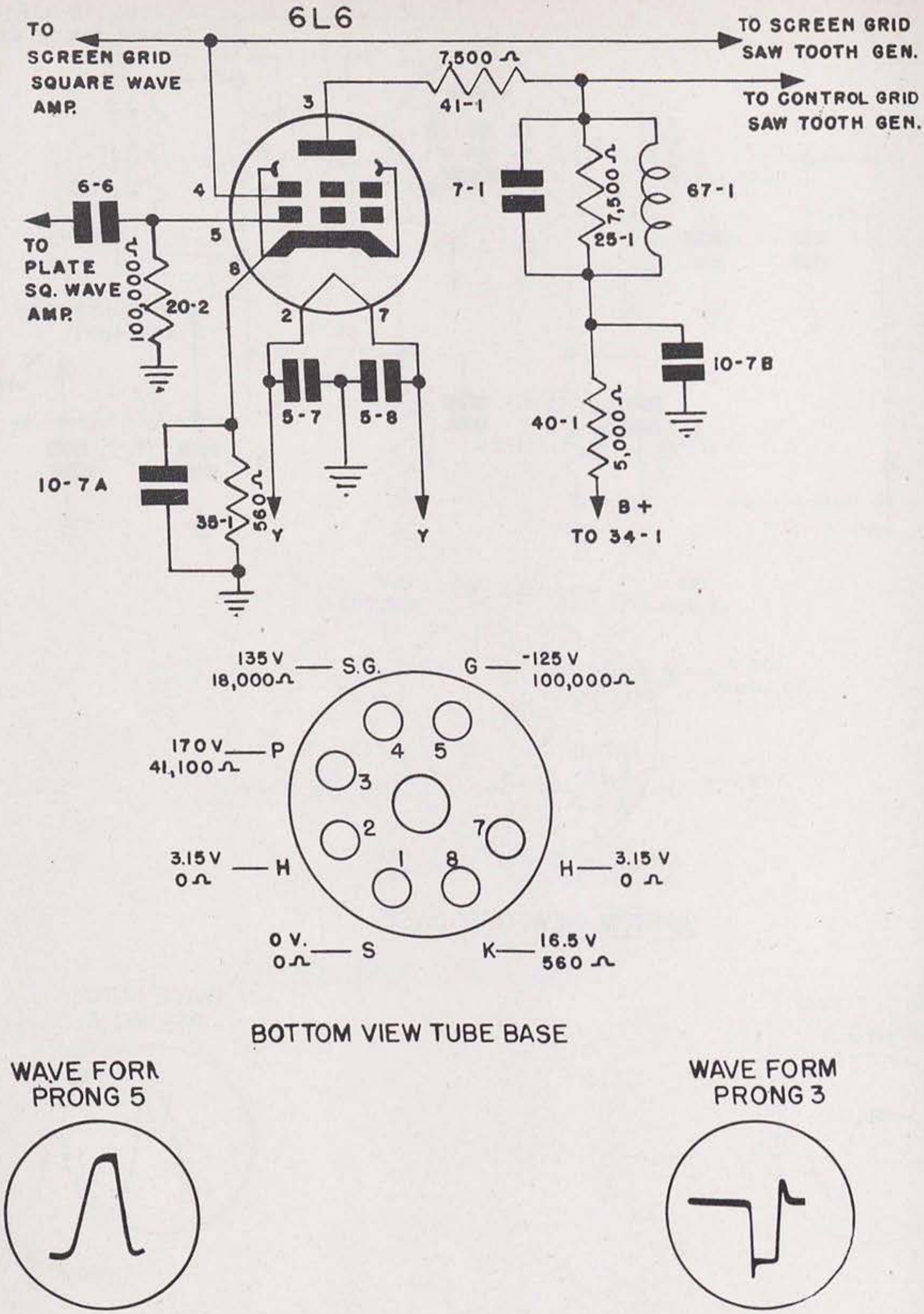

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Figure 93. Oscilloscope BC-403-E, pulse generator stage.

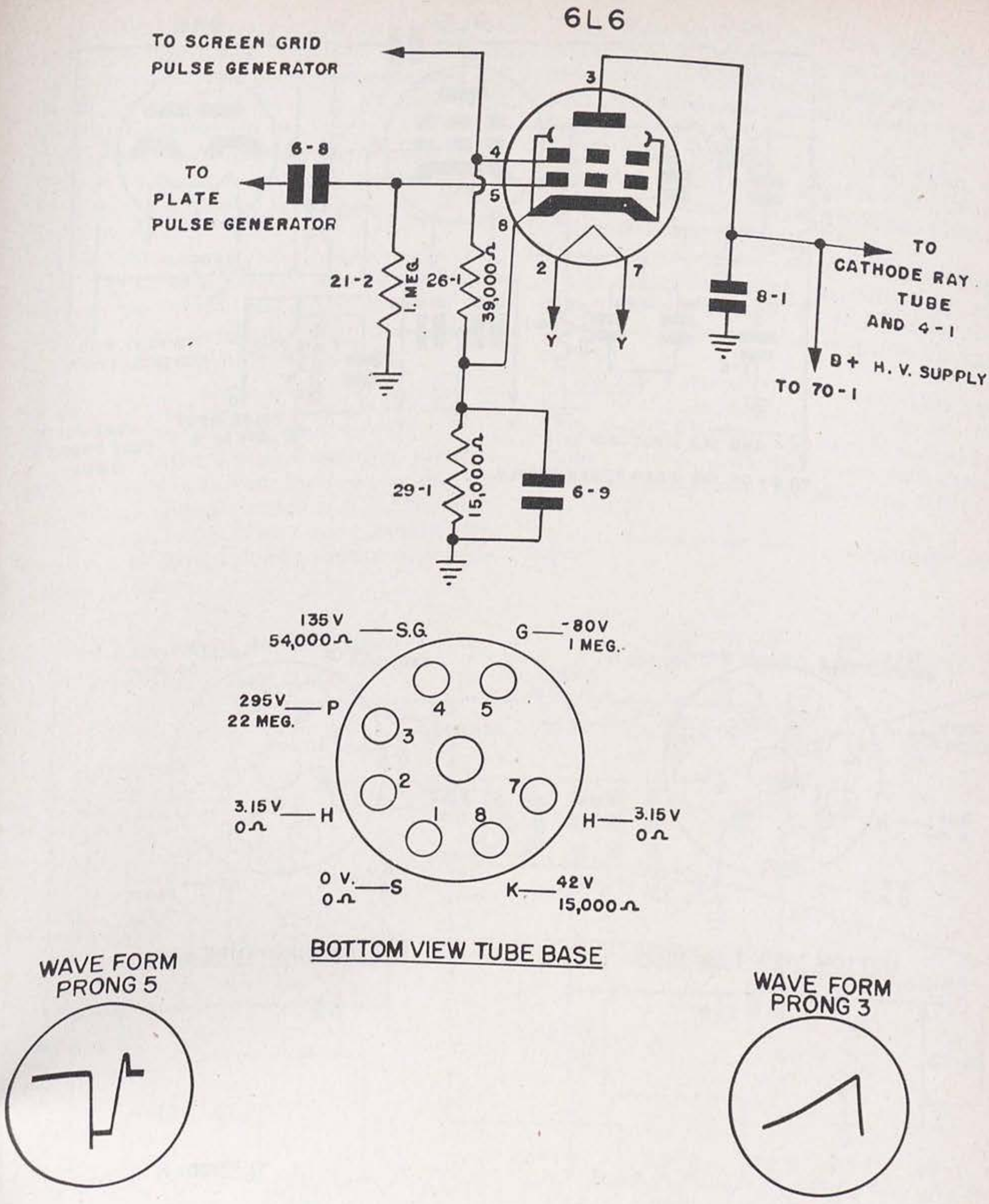

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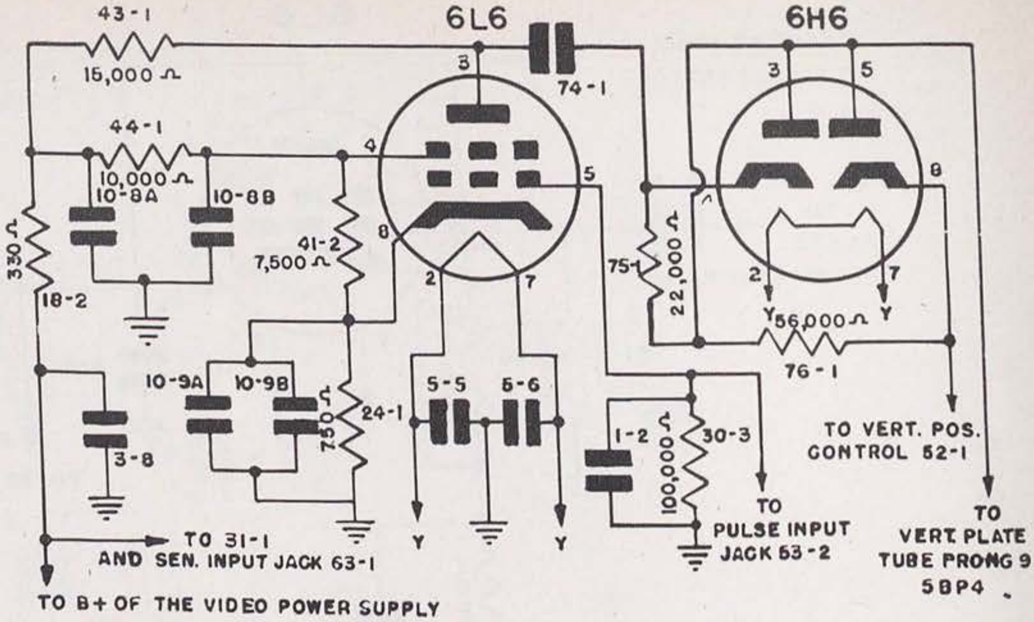
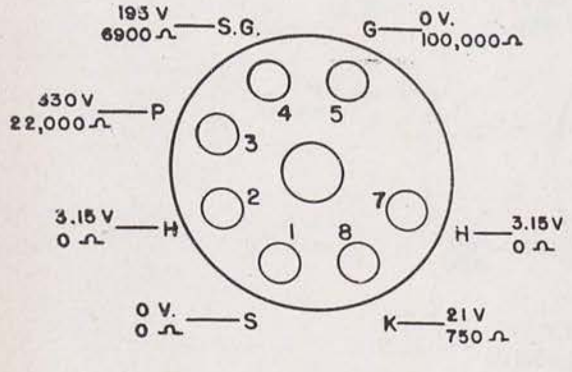
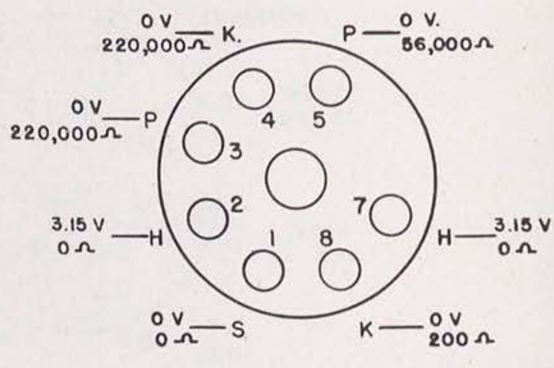
Figure 94. Oscilloscope BC-403-E, saw-tooth generator stage.





BOTTOM VIEW TUBE BASE



BOTTOM VIEW TUBE BASE

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Figure 95. Oscilloscope BC-403-E, video amplifier stage.

(8) *Testing pulse generator stage* (fig. 93). (*a*) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling Capacitor 6–6 and stage.

(*b*) Check for normal waveform indication between the plate (tube prong 3) and ground. If no waveform indication is obtained, test the tube and stage.

(9) *Testing saw-tooth-generator stage* (fig. 94). (*a*) Check for normal waveform indication between the control grid (tube prong 5) and ground. If no waveform indication is obtained, check coupling Capacitor 6–8 and stage.

NOTE. To check the final output of this stage, short out safety interlock switch 56–1. A piece of tape wrapped around the switch plunger will hold it in a closed position.

Caution: After a short warming-up period, a clicking sound will warn the operator that the high-voltage relay has closed and that the high-voltage circuit is now in operation. Exercise care, so as not to come in direct contact with high-voltage potentials.

(*b*) Check for normal waveform indication between the plate (tube prong 3) and ground, of the 6L6 tube in the saw-tooth-generator stage. If no waveform indication is obtained, test the tube and stage.

(10) *Video amplifier stage.* The video amplifier stage should not be signal traced. Use the voltage or resistance measurement procedure to analyze this stage (fig. 95).

(11) *Cathode-ray tube stage.* Due to the high-voltage potentials present, the cathode-ray tube stage should not be signal traced. Use the resistance measurement procedure only, for this stage (fig. 96).

(12) *Check over-all performance.* After completion of the signal-tracing procedure and the oscilloscope unit has been restored to normal operating condition, check the over-all performance of the oscilloscope unit. See paragraph 116*b*(1), (2), and (3).

NOTE. See figure 97 for waveforms of Oscilloscope BC–403–F.

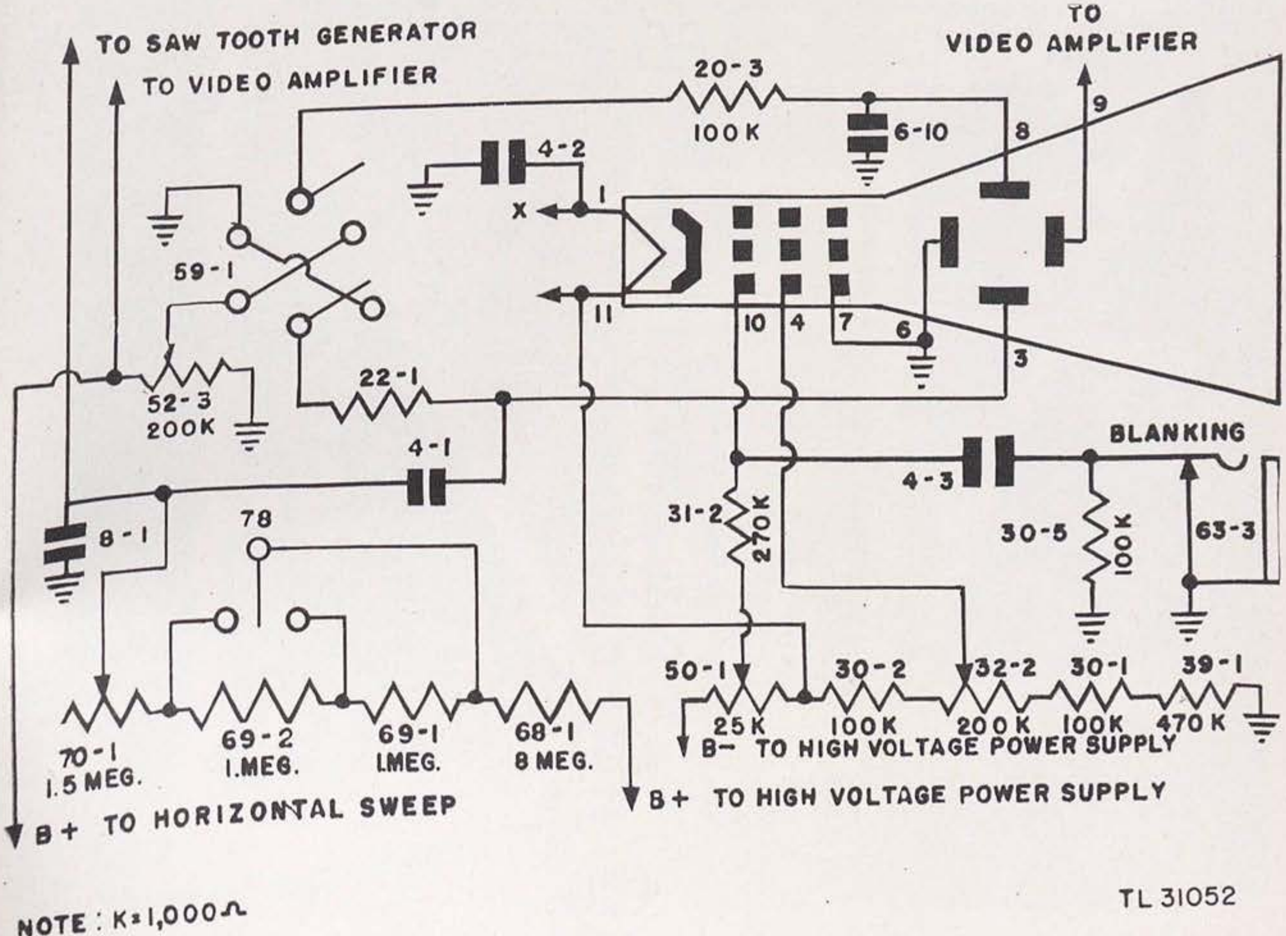


Figure 96. Oscilloscope BC–403–E, cathode-ray tube stage.

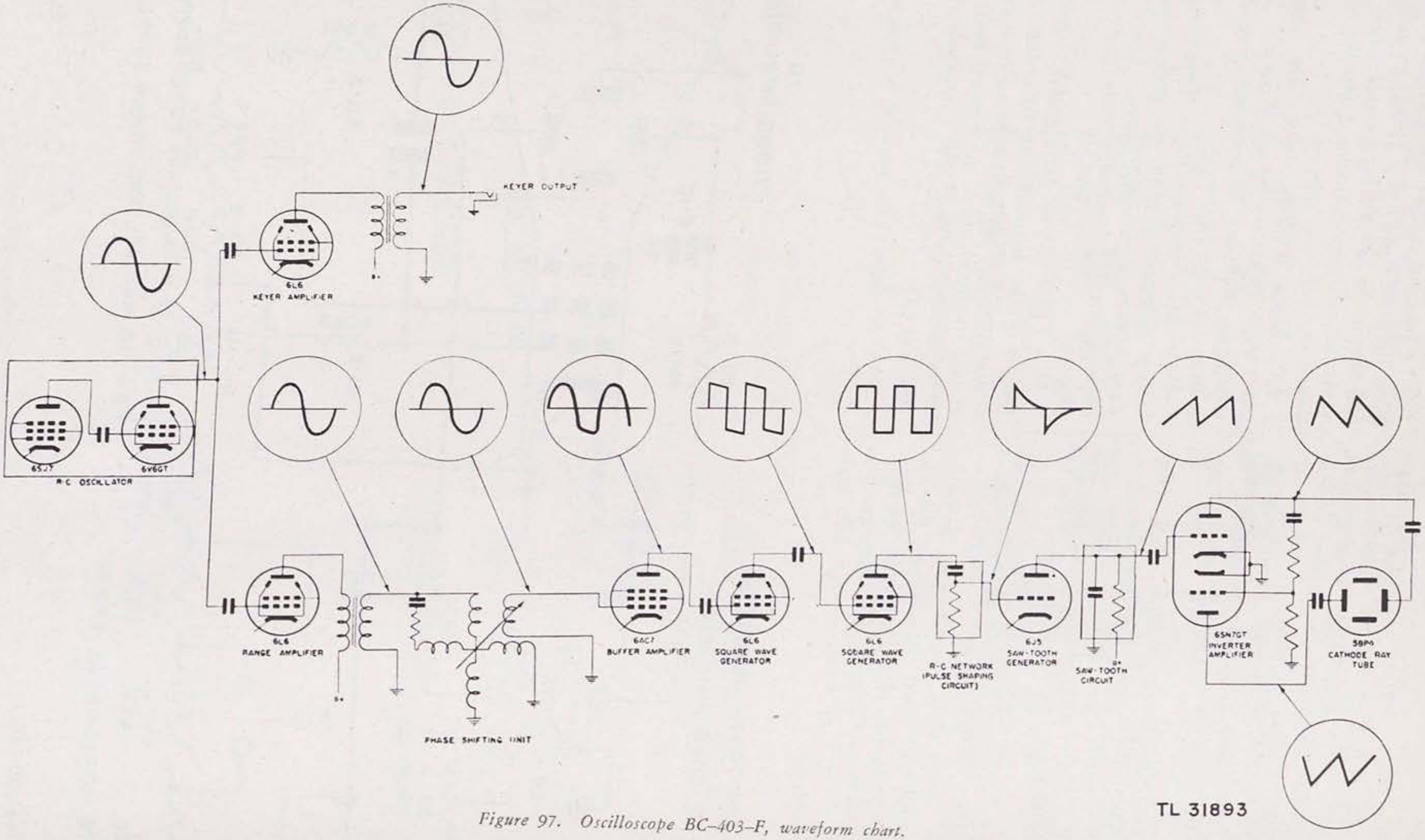


Figure 97. Oscilloscope BC–403–F, waveform chart.

CHAPTER 5

REMOVAL AND REPLACEMENT OF PARTS

Section I. GENERAL INFORMATION

117. Introduction

Chapter 5 is designed to help the trouble shooter remove and replace many listed parts in the *receiver, oscilloscope, transmitter, keyer, rectifier, water cooler, and antenna position control of Radio Sets SCR-270-(*) and SCR-271-(*).* For easy reference, the parts are listed in numerical order according to the particular component in which they are located. For example, if the repairman wishes to remove or replace rectifier current Transformer 28, he refers to Rectifier RA-60-A (sec. II), current transformer 28 (par. 128).

118. Replacement of Defective Parts

a. In some cases, it may not be necessary to replace a defective part with a new part. The trouble shooter may be able to repair the defect and reinsert the original part. There are some occasions when merely a portion of the part is defective, such as the series resistor in a socket assembly. In such instances, chapter 5 will provide the step-by-step procedure for removing and disassembling the part. When the part has been disassembled, the necessary repairs can be made. The part may then be assembled and inserted in the component

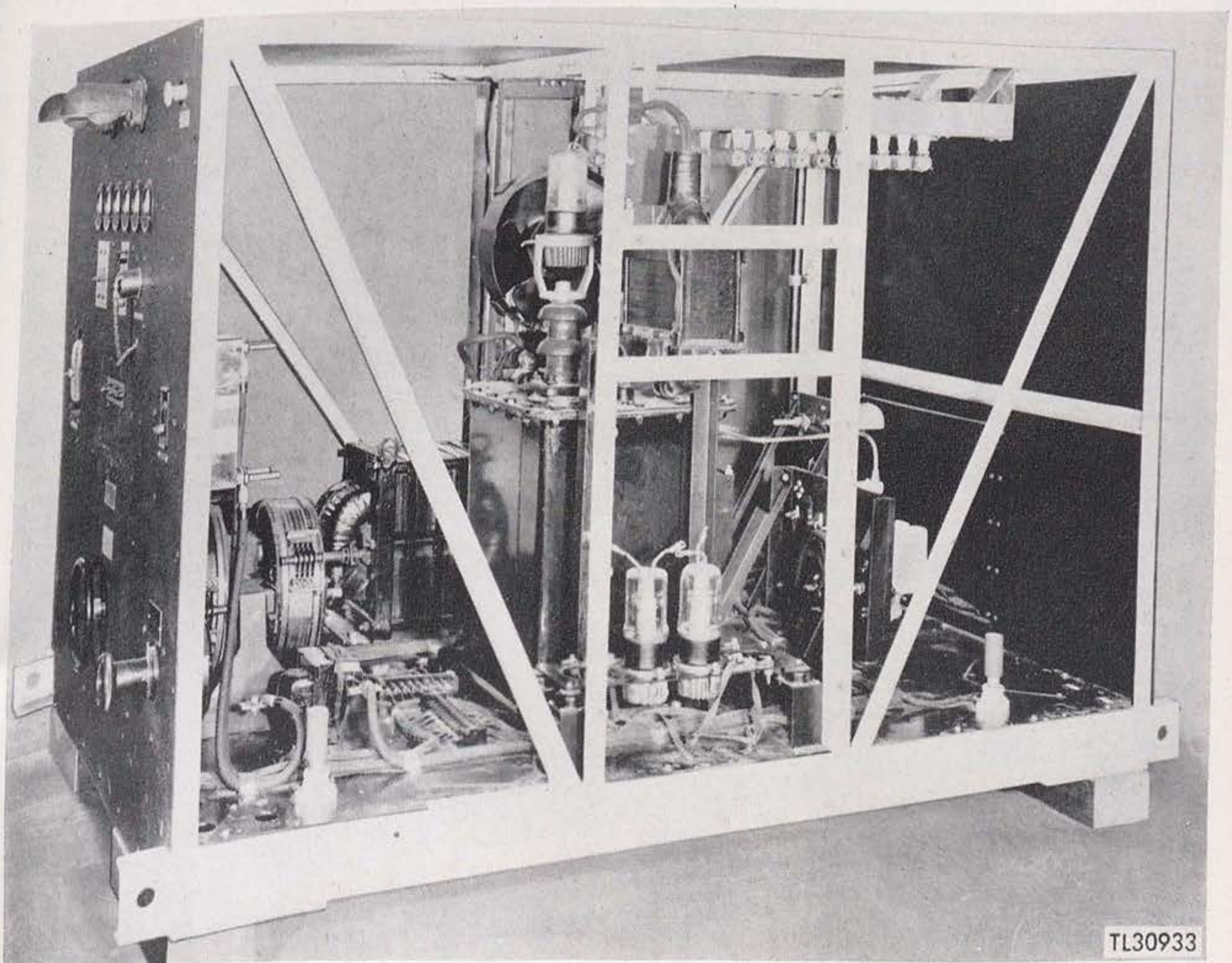


Figure 98. Rectifier RA-60-A, side panels removed.

as outlined in the procedure.

b. Chapter 5 may also be used for location purposes. Photographs and diagrams showing the location of each part will be helpful when performing the trouble shooting procedures outlined in chapter 4, or when studying the schematic diagrams of the various components.

119. Preliminary Procedure

a. Before removing or replacing any part, the trouble shooter should study the complete procedure, noting the tools required, the number of men necessary for the operation, and the precautions to be taken.

b. Neatness is an important factor in the speedy removal and replacement of parts. Nuts, bolts, washers, and other small parts should be placed in containers as they are removed. This precaution will prevent these parts from being lost or from falling inside a component and causing serious damage to equipment.

c. Carelessness in handling tools or in performing trouble shooting procedures may cause more damage than the original defect. Before removing or replacing any part, the technician should make sure that all power has been removed from the component and that all capacitors within the component have been discharged. He should also review the cautions listed in section II, chapter 1. Failure to follow these cautions may result in serious injury or loss of life.

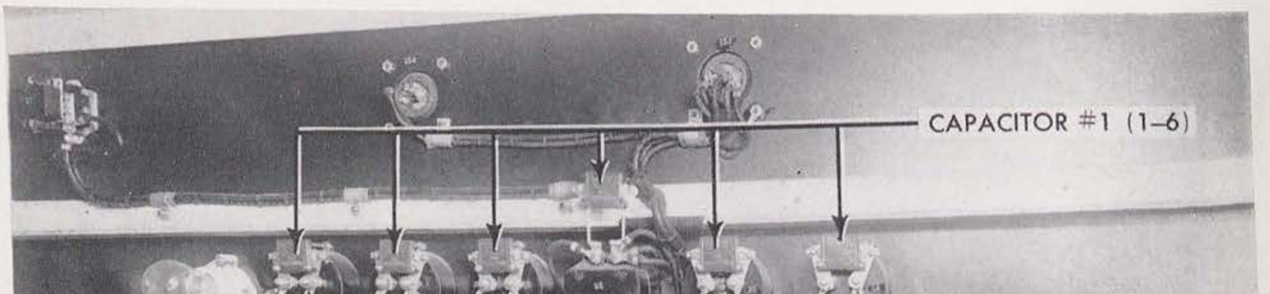


Figure 99. Rectifier RA-60-A, rear view of front panel.

120. Capacitor (Filter) 2

a. Tools Required. (1) One-inch socket wrench.

(2) Adjustable open-end wrench.

(3) Large screw driver.

(4) Drop light.

b. Removal.

Caution: All voltages must be removed from the rectifier.

(1) Remove the nut and lockwasher from the ground terminal of the capacitor.

(2) Remove the ground lead and clamp.

(3) Remove the bolts, lockwashers, and nuts from the clamp on the positive terminal of the capacitor.

(4) Loosen (do not remove) the screw from the insulated terminal of the filter reactor connected to the high-voltage terminal of the capacitor by the bus tube.

(5) Push the filter-reactor bus tube in a clockwise direction away from the positive terminal of the capacitor.

(6) Push the shorting-switch bus tube in a counterclockwise direction away from the positive terminal of the capacitor.

(7) Grasp the bleeder bus tube and remove it from the positive terminal of the capacitor.

(8) Remove high-voltage series resistor 9 from its clamp.

(9) Loosen the upper clamp mounting bolt.

(10) Lift the output bus tube away from the positive terminal of the capacitor.

(11) Remove the nut and lockwasher from the terminal of the capacitor.

(12) Remove the mounting clamp from the capacitor terminal.

(13) Remove the four mounting bolts holding the capacitor to the floor of the rectifier (the nuts are securely fastened below the floor of the rectifier).

(14) Remove the capacitor from the unit.

c. Replacement. Reverse above procedure to replace the capacitor.

121. Filament Rheostat 8

a. Tools Required. (1) Screw driver.

(2) Adjustable open-end wrench.

(3) Drop light.

b. Removal.

Caution: All voltages must be removed from the rectifier.

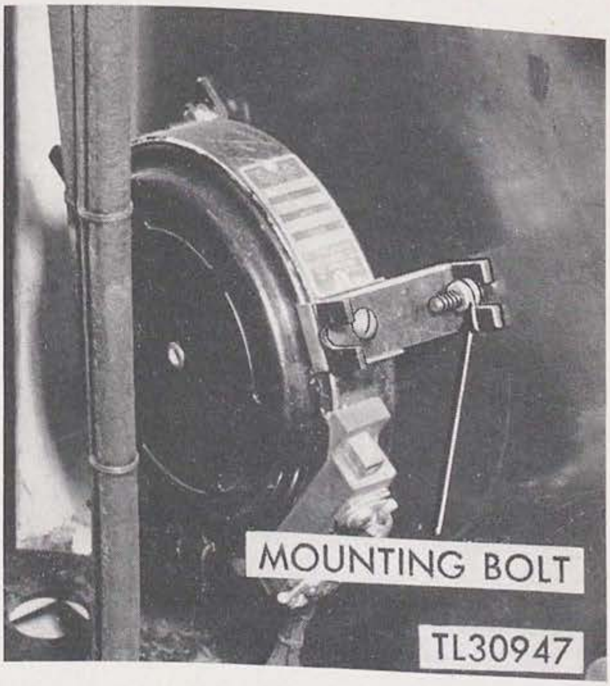


Figure 100. Rectifier RA-60-A, showing location of filament rheostat 8.

(1) Remove the mounting bolts, washers, and nuts (fig. 100).

(2) Grasp the filament rheostat (from the back) and move it slightly, away from the support.

(3) Turn the filament rheostat counterclockwise to expose the two terminals.

(4) Remove the bolts from the front and rear terminals.

(5) Remove and tag the leads.

(6) Lift the filament rheostat out of the unit.

(7) Remove the bolts from the mounting brackets.

(8) Remove the brackets and holders.

(9) Remove the cover plate.

c. Replacement. Reverse above procedure to install a new rheostat.

122. Key Switch 18 (fig. 101)

a. Tools Required. (1) Screw driver.

(2) Adjustable open-end wrench.

(3) Drop light.

b. Removal.

Caution: All voltages must be removed from the rectifier.

(1) *Lock.* (*a*) Remove the bolts from the right and left terminals.

(*b*) Remove and tag the leads.

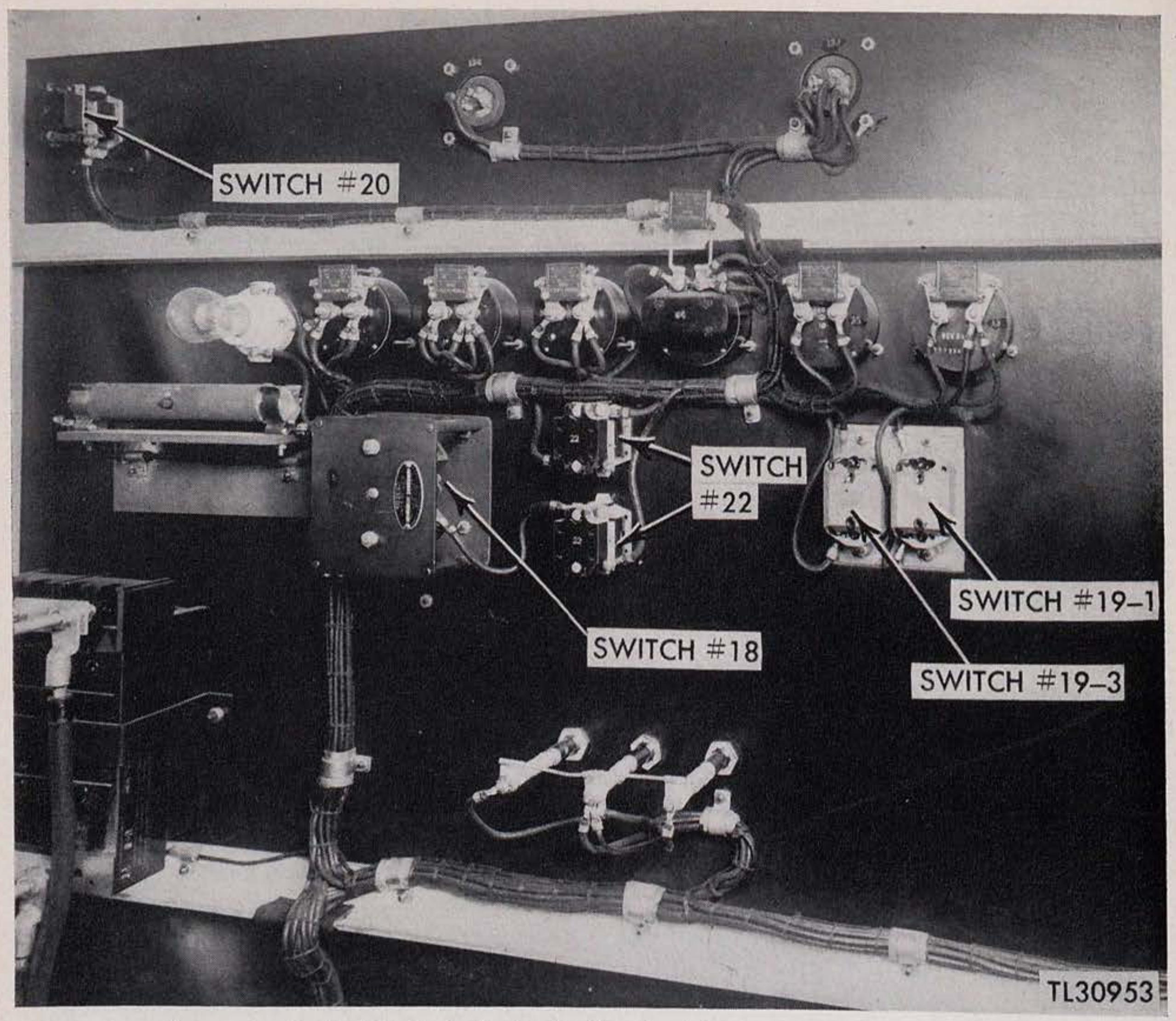


Figure 101. Rectifier RA–60–A, showing location of switches 18, 19 (1 and 3), 20, and 22.

(*c*) Remove the four front mounting bolts, washers, and nuts.

Caution: Be careful not to drop the washers and nuts.

(*d*) Remove the complete assembly from the front panel.

(*e*) Remove the four bolts from the lock mounting plate.

(*f*) Remove the two bolts holding the lock to the mounting plate and withdraw the lock.

(2) *Switch.* (*a*) Remove the two bolts from the switch.

(*b*) Withdraw the switch from the mounting plate.

(3) *Switch spring.* (*a*) Open the spring eye attached to the fixed mounting stub.

Caution: Open the eye slightly. The spring is easily broken.

(*b*) Grasp the spring and slide it over the fixed mounting stub.

(*c*) Remove the spring from the switch-arm mounting stub.

c. Replacement. Reverse above procedure to replace switch spring, switch, and lock.

123. Switches 19 (1–3) (fig. 101)

a. Tools Required. (1) Screw driver.

(2) Socket wrench.

b. Removal.

Caution: All voltages must be removed from the rectifier.

(1) Remove the two switch mounting bolts, nuts, and washers on the panel (figs. 101 and 102).

(2) Pull the switch away from the rear of the panel and turn it over.

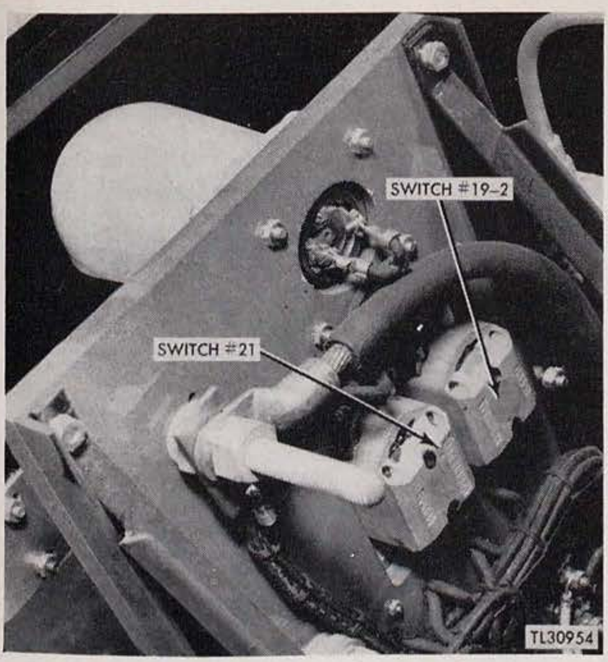


Figure 102. Rectifier RA-60-A, showing location of switches 19-2 and 21.

(3) Remove the bolts from the two terminals.
(4) Remove and tag the leads.
(5) Remove the switch.
c. Replacement. Reverse above procedure to install a new switch.

124. Emergency Stop Switch 20 (fig. 101)

a. Tools Required. (1) Screw driver.
(2) Drop light.
b. Removal.
Caution: All voltages must be removed from the rectifier.
(1) *Switch.* (*a*) Remove the bolts from the top and bottom terminals.
(*b*) Remove and tag the leads.
(*c*) Remove the bolt from the mushroom head.
(*d*) Remove the mushroom head.
(*e*) Remove the two self-tapping screws from the front panel.
(*f*) Remove the switch from the rear of the front panel.
(2) *Contact spring, plunger, and plunger spring.* (*a*) Remove the two bolts and lock-washers from the back of the switch.
(*b*) Push the plunger in.
(*c*) Grasp the contact and turn 1/4 turn. Remove the contact.
Caution: Hold one hand over the assembly to prevent losing the spring.
(*d*) Remove the contact spring from the assembly.
(*e*) Remove the plunger from the assembly.
(*f*) Remove the spring from the plunger.
c. Replacement. (1) *Contact spring, plunger, and plunger spring.* (*a*) Replace the spring on the plunger.
(*b*) Replace the plunger in the assembly.
(*c*) Replace the contact spring in the assembly.
(*d*) Holding the spring in place, push the plunger in, replace the contact, and turn it 1/4 turn.
(*e*) Replace the two bolts on the back of the switch.
(2) *Switch.* (*a*) Place the switch in proper position on the rear of the front panel.
(*b*) Replace the two self-tapping screws.
(*c*) Replace the mushroom head.
(*d*) Replace the bolt on the mushroom head.
(*e*) Replace the leads on the two terminals.
(*f*) Replace the bolts on the terminals.

125. Main Plate Transformer 25 (fig. 103)

a. Tools Required. (1) Screw driver.
(2) Socket wrenches.
(3) Adjustable open-end wrench.
(4) Gas pliers.
(5) Offset wrench.
b. Removal.

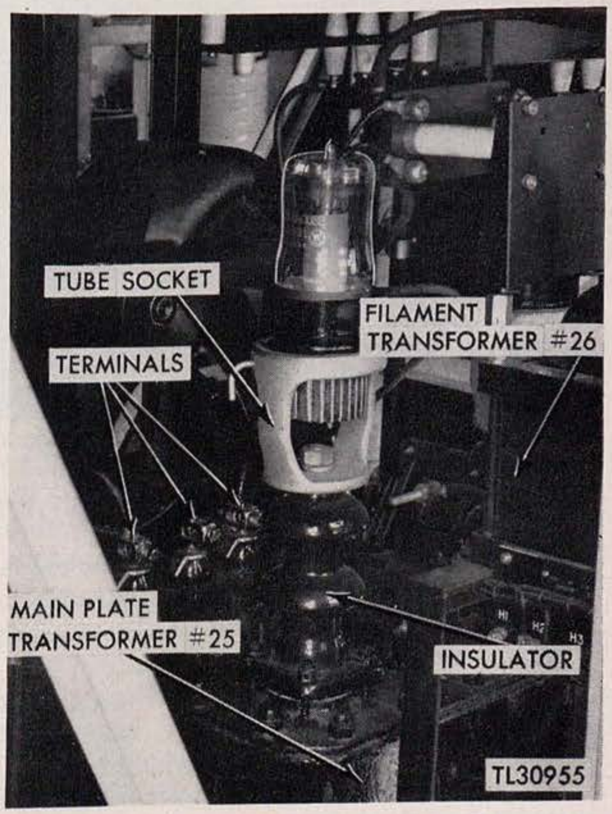


Figure 103. Rectifier RA-60-A, showing location of main plate transformer 25.

Caution: All voltages must be removed from the rectifier.

NOTE. Several men are needed for this operation.

(1) Remove the rectifier tubes (par. 132, WL–531 Tubes).

(2) Remove the filament transformer (par. 126).

(3) Remove the three clamps from the filament-transformer support.

(4) Lay the filament lead cables to one side and tag the leads.

(5) Remove the bolts holding the filament-transformer supports.

Caution: Take care to prevent the lockwashers and nuts from falling below the floor of the unit.

(6) Remove the filament-transformer supports.

(7) Loosen the screw clamps on the transformer terminals.

(8) Remove and tag the connections.

(9) Remove the nut and lockwashers holding the socket to the insulator.

Caution: Take care not to crack the insulator.

(10) Remove the tube sockets.

(11) Remove the nuts from the four bolts holding the insulator clamp to the top of the transformer.

(12) Remove the clamp (two pieces) and the gasket.

Caution: Be careful not to tear the gasket.

(13) Remove the insulator top cap by turning counterclockwise.

(14) Remove the insulator by prying it loose.

Caution: Be careful not to break the insulator.

(15) Lift the insulator out of the transformer.

(16) Remove the bolts holding the transformer to the floor of the unit (the nuts are welded to the bottom).

(17) Cover the cables on the floor of the unit with a board ½ inch thick.

(18) Tip the transformer slightly and place a roller underneath it.

(19) Slide the transformer out through the panel opening.

c. REPLACEMENT. (1) Cover the cables on the floor of the unit with a board ½ inch thick.

(2) Place the transformer on a roller and slide it through the panel opening.

(3) Tip the transformer off the roller in proper position on the floor of the unit. Remove the board.

(4) Replace the bolts holding the transformer to the floor of the unit.

(5) Replace the insulator.

(6) Replace the insulator top cap and turn it clockwise.

(7) Replace the clamp and gasket. Shellac the gasket.

(8) Replace the nuts on the four bolts holding the insulator clamp to the top of the transformer.

(9) Replace the tube sockets.

(10) Replace the nuts and lockwashers holding the sockets to the insulator.

Caution: Take care not to crack the insulator.

(11) Replace the connections.

(12) Tighten the screw clamps on the transformer terminals.

(13) Replace the filament-transformer supports.

(14) Replace the bolts, lockwashers, and nuts holding the filament-transformer supports.

(15) Replace the filament lead cables.

(16) Replace the three clamps on the filament-transformer support.

(17) Replace the filament transformer (par. 126).

(18) Replace the rectifier tubes (par. 132, WL–531 Tubes).

126. Filament Transformer 26 (fig. 104)

a. TOOLS REQUIRED. (1) Gas pliers.

(2) Offset wrench.

(3) Screw driver.

(4) Socket wrench.

b. REMOVAL.

Caution: All voltages must be removed from the rectifier.

(1) Remove the spare tubes from the rack.

(2) Remove the upper set of nuts and washers from the back of the secondary winding terminal strip.

(3) Remove and tag the transformer leads.

(4) Turn the knurled nuts counterclockwise. Remove and tag the tube filament leads.

(5) Remove the lower set of nuts from the back of the terminal strip.

(6) Remove the high-voltage filter-reactor bus tube.

(7) Remove the two nuts from the insulator panel and remove the panel.

(8) Remove the nuts from the transformer primary-terminal strip.

(9) Remove and tag the leads.

(10) Remove the two nuts and washers holding the filament transformer to the stand (under side).

(11) Cut off the strings holding the interlock wires to the filament stand.

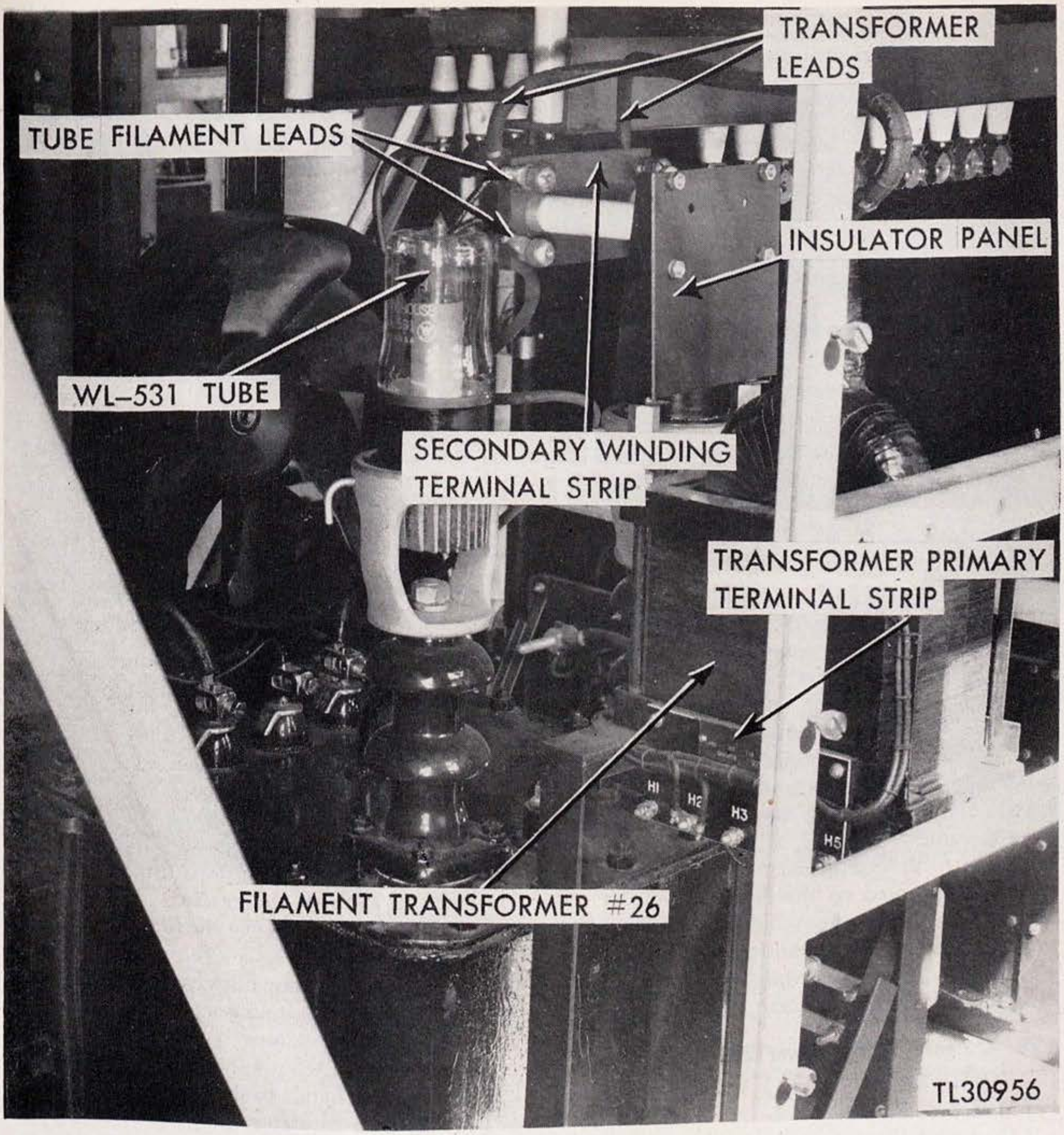


Figure 104. Rectifier RA–60–A, showing location of filament transformer 26 and WL–531 tubes.

(12) Remove the bolts, nuts, and lockwashers from the transformer frame mounting.

(13) Remove the clamp holding the interlock wires to the frame.

(14) Remove the bolts.

(15) Pull the wire out of the way.

(16) Grasp the transformer at the bottom and lift it out of the unit.

c. Replacement. Reverse above procedure to install a new filament transformer.

127. Variable Autotransformer 27 (fig. 105)

a. Tools Required. (1) Socket wrenches.

(2) Allen setscrew wrench.

b. Removal.

Caution: All voltages must be removed from the rectifier.

(1) Remove the nuts and lockwashers from the transformer terminals.

(2) Remove and tag the leads.

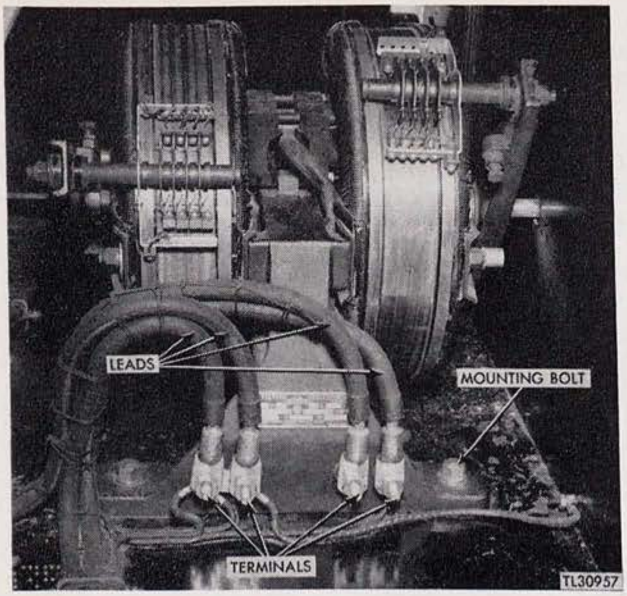


Figure 105. Rectifier RA–60–A, showing location of variable autotransformer 27.

(3) Loosen the setscrew on the high-voltage control handwheel and remove the wheel.

(4) Remove the bolts and lockwashers from the transformer mounting (the nuts are welded to the under side of the floor).

(5) Move the transformer away from the front panel until the shaft is free of the hole.

(6) The transformer may now be removed from the unit.

Caution: Be careful not to damage the cables and parts mounted on the floor of the unit. It may be necessary to remove any other parts which prevent removal of the transformer.

c. REPLACEMENT. Reverse above procedure to install a new autotransformer.

128. Current Transformer 28

a. TOOLS REQUIRED. (1) Long-nose pliers.

(2) Screw driver.

(3) Adjustable open-end wrench.

(4) Offset screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the rectifier.

(1) Remove the cotter pin from the pin on the terminal cover.

(2) Remove the pin by turning it until the center slot in the pin slides through the opening.

(3) Grasp the terminal block cover firmly and withdraw it from the clamps.

(4) Loosen the screw locks.

(5) Remove and tag the two leads.

(6) Remove the nuts, bolts, and lockwashers from the bus bar.

(7) Remove and tag the cables.

(8) Remove the four mounting bolts holding the current transformer to the floor of the rectifier unit (the nuts are welded to the floor).

(9) Lift out the transformer.

c. REPLACEMENT. Reverse above procedure to install a new transformer.

129. Filter Reactor 29 (fig. 106)

a. TOOLS REQUIRED. (1) Screw driver.

(2) Socket wrenches.

(3) Adjustable open-end wrench.

(4) Gas pliers.

(5) Drop light.

b. REMOVAL.

Caution: All voltages must be removed from the rectifier. When removing the bus tubes be careful not to break them.

NOTE. Two men are required for this operation.

(1) Remove the two bolts from the top of the insulated terminals.

(2) Loosen the bolt on the positive terminal of capacitor 2.

(3) Move the capacitor bus tube in a clockwise direction away from the reactor.

(4) Loosen the nut on the back of the filament-transformer terminal strip which holds the reactor bus tube.

(5) Move the filament-transformer bus tube clockwise away from the reactor.

(6) Remove the nut from the top of the reactor insulator.

(7) Remove the four nuts from the mounting brackets holding the insulators.

(8) Lift off the clamp.

(9) Push down the bolt inside the insulator.

(10) Use the hands to pry the insulator loose.

(11) Lift the insulator away from the mounting plate.

(12) Remove the washers (one lock, one metal, one fibre) by turning the insulator over in the hand.

(13) Remove the two bolts holding the insulator mounting plate to the reactor.

(14) Remove the mounting plate.

(15) Remove the four mounting bolts holding the reactor to the floor of the unit (the nuts are welded to the floor of the unit).

(16) Remove the heating element and socket.

(17) Place a ½-inch board over the cables on the floor of the unit.

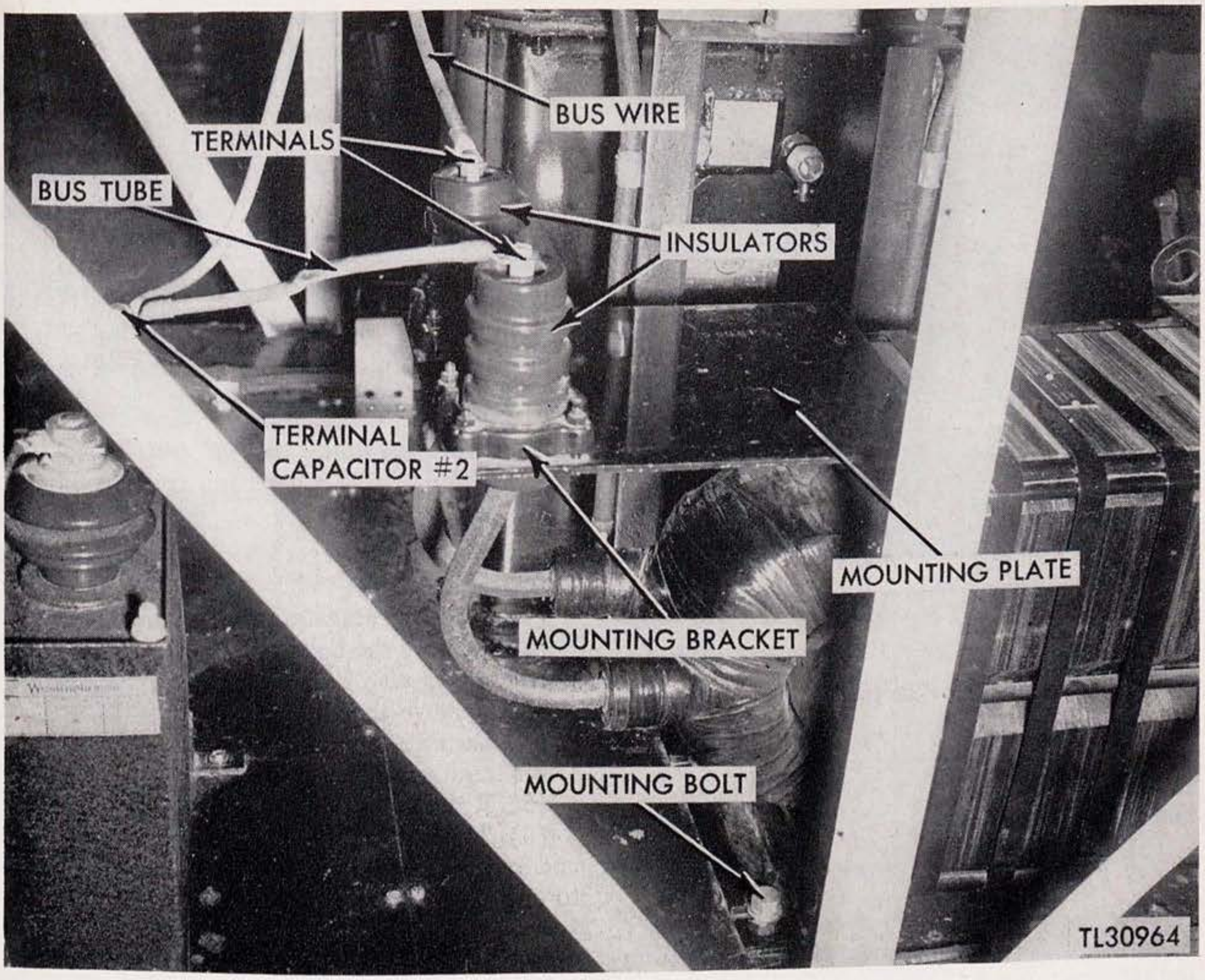


Figure 106. Rectifier RA-60-A, showing location of filter reactor 29.

(18) Place a roller under the reactor and remove from the unit (two men are preferable for this operation).

c. Replacement. (1) Place a ½-inch board over the cables on the floor of the unit.

(2) Place a roller under the new reactor and place in proper position in the unit.

(3) Replace the heating element and socket.

(4) Replace the four mounting bolts holding the reactor to the floor of the unit.

(5) Replace the insulator mounting plate.

(6) Replace the two bolts holding the mounting plate to the reactor.

(7) Replace the washers (one fibre, one metal, one lock) on the insulator.

(8) Replace the insulator on the mounting plate.

(9) Push the insulator mounting bolt up through the insulator.

(10) Replace the clamp.

(11) Replace the four nuts on the mounting brackets holding the insulators.

(12) Replace the nut on the top of the reactor insulator.

Caution: Do not tighten too much. It may crack the insulator.

(13) Move the filament-transformer bus tube back to the reactor.

(14) Tighten the nut on the back of the filament transformer which holds the reactor bus tube.

(15) Move the capacitor bus tube back to the reactor.

(16) Tighten the bolt on the positive terminal of capacitor 2.

(17) Replace the two bolts on the top of the insulated terminals.

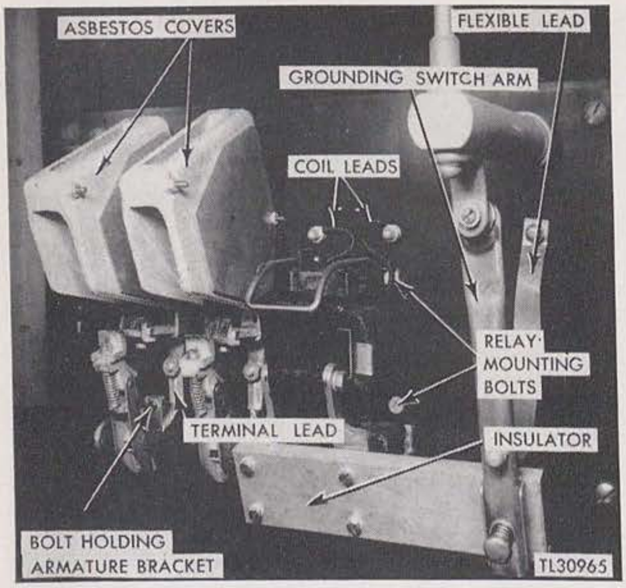


Figure 107. Rectifier RA–60–A, showing location of main contactor 36.

130. Main Contactor 36 (fig. 107)

a. TOOLS REQUIRED. (1) Offset wrench.

(2) Adjustable open-end wrench.

(3) Screw driver.

(4) Offset screw driver.

(5) Socket wrench.

(6) Drop light.

b. REMOVAL.

Caution: All voltages must be removed from the rectifier.

(1) *Relay.* (*a*) Remove the nut and lock-washer holding the terminal lead to the capacitor arm.

(*b*) Remove the lead.

(*c*) Remove the lower tapped bolt and loosen the upper tapped bolt holding the armature bracket.

(*d*) Turn the bracket away from the arm.

(*e*) Remove the bolt and nut holding the flexible lead to the grounding switch arm.

(*f*) Remove the front bolt and loosen the rear bolt which holds the fixed contact of the grounding switch to the insulator.

(*g*) Turn the contact around.

(*h*) Pull the relay armature sidewise from the relay.

(*i*) Pull the spring off the grounding switch arm.

(*j*) Remove the two nuts holding the coil leads. Remove the washers and leads.

(*k*) Tag the leads.

(*l*) Remove the four mounting bolts holding the relay to the mounting panel.

(*m*) Remove the relay.

(2) *Asbestos covers.* (*a*) Remove the tapped bolts from the side of the asbestos covers.

(*b*) Remove the tapped bolts below the asbestos cover clamp.

(*c*) Slip the clamp and covers off the contact.

c. REPLACEMENT. Reverse above procedure to replace asbestos covers and relays.

131. Overload Relay 37 (fig. 99)

a. TOOL REQUIRED. Screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the rectifier.

(1) Remove the glass cover from the relay.

(2) Remove the bolts holding the shorting bar on the upper set of terminals.

(3) Remove the shorting bar.

(4) Remove the bolts from the center and lower terminals.

(5) Remove and tag the leads.

(6) Take out the bolt holding the cable clamp and remove the clamp, gently pulling the wires to one side.

(7) Holding the relay in front, remove the upper mounting bolt.

Caution: Be careful. The mounting bolts are short.

(8) Remove the relay.

c. REPLACEMENT. Reverse above procedure to replace overload relay.

132. WL–531 Tubes

a. TOOL REQUIRED. Screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the rectifier.

(1) Remove the two thumbscrews on the filament-transformer terminal strip.

(2) Remove the leads.

(3) Loosen the thumb clamps holding the tube in the socket.

(4) Lift the tube out of the socket.

c. REPLACEMENT. Reverse above procedure to install new tube.

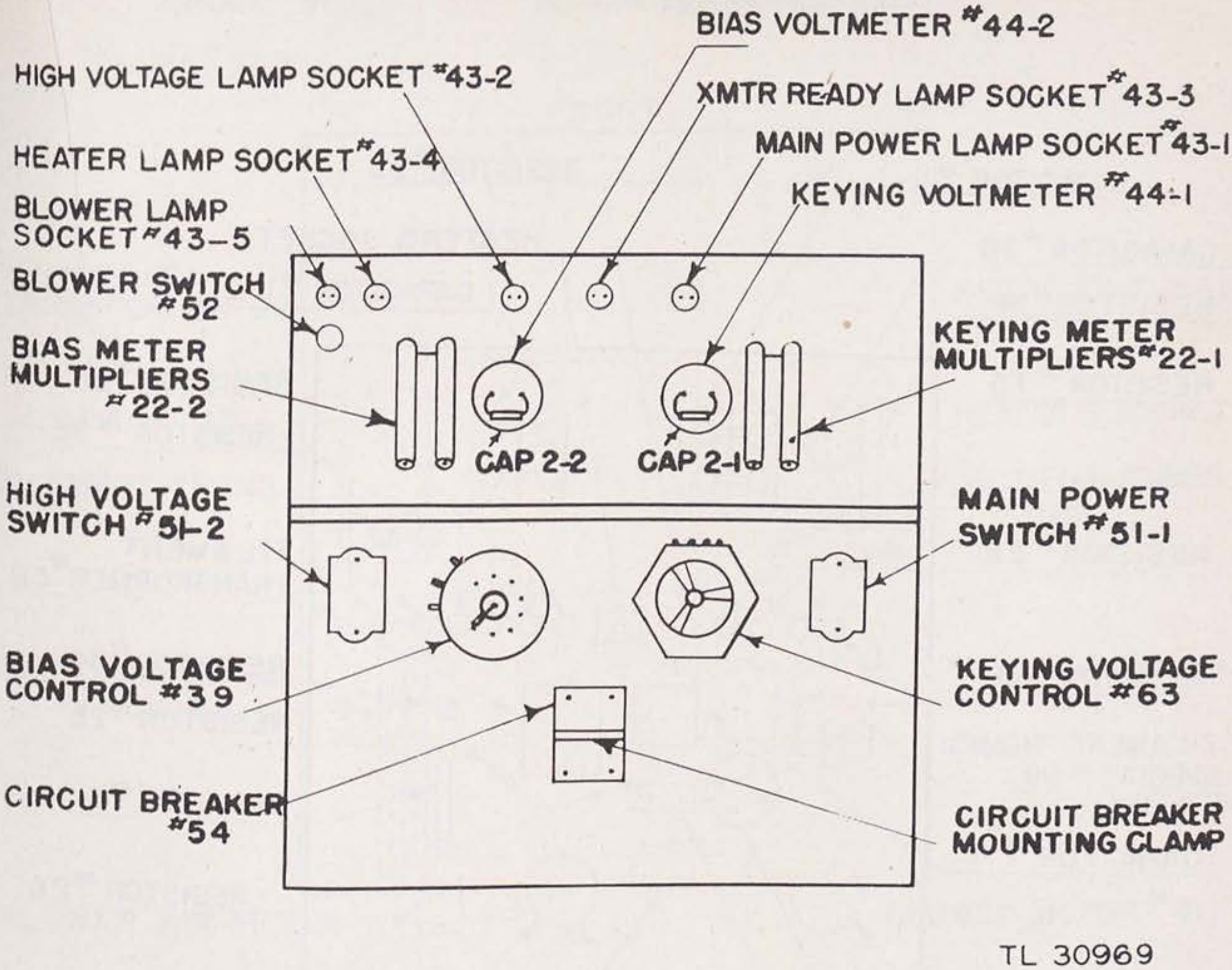


Figure 108. Keyer BC-758-A, location of parts, front panel (rear).

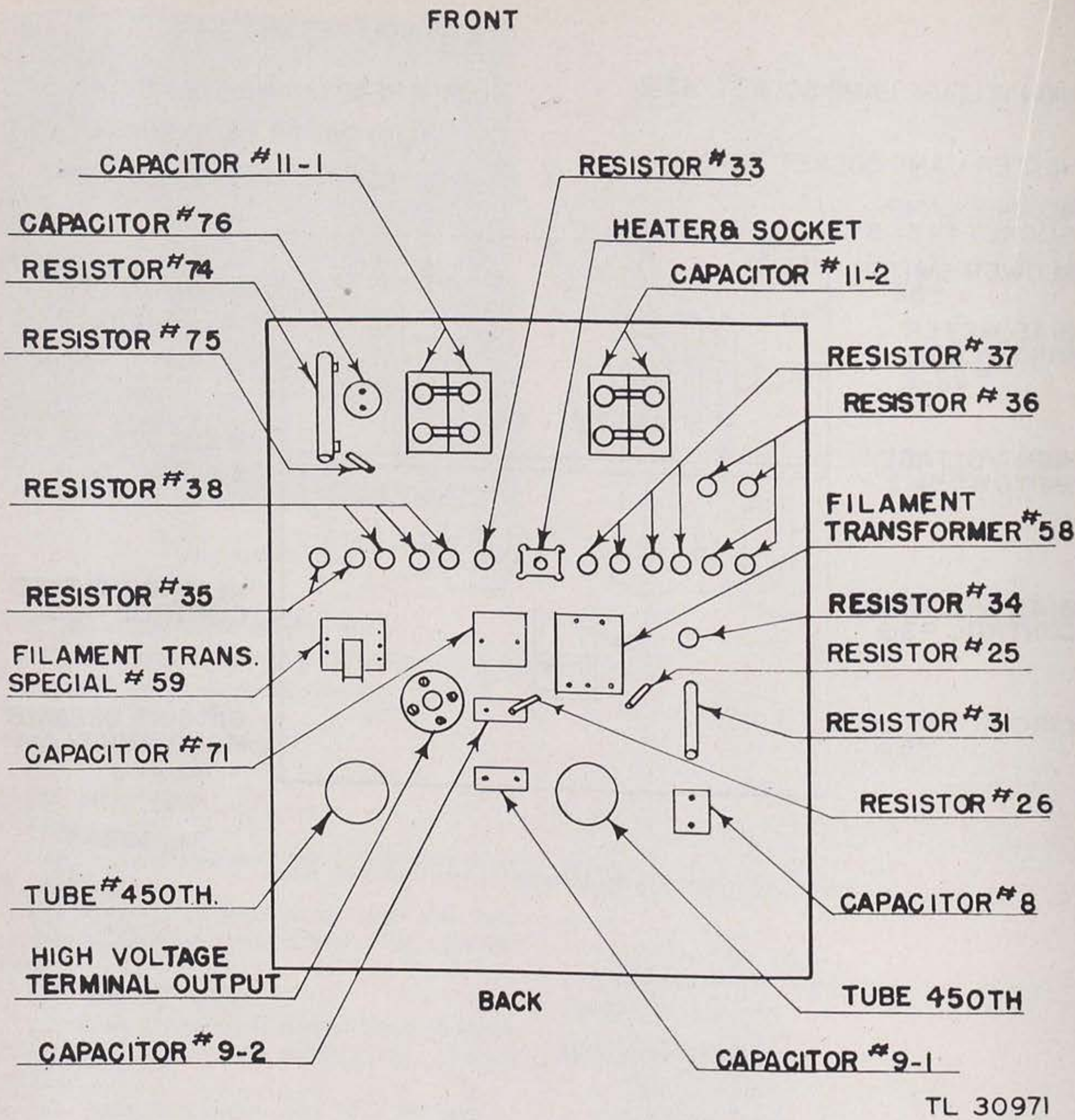


Figure 109. Keyer BC-758-A, location of parts, middle shelf.

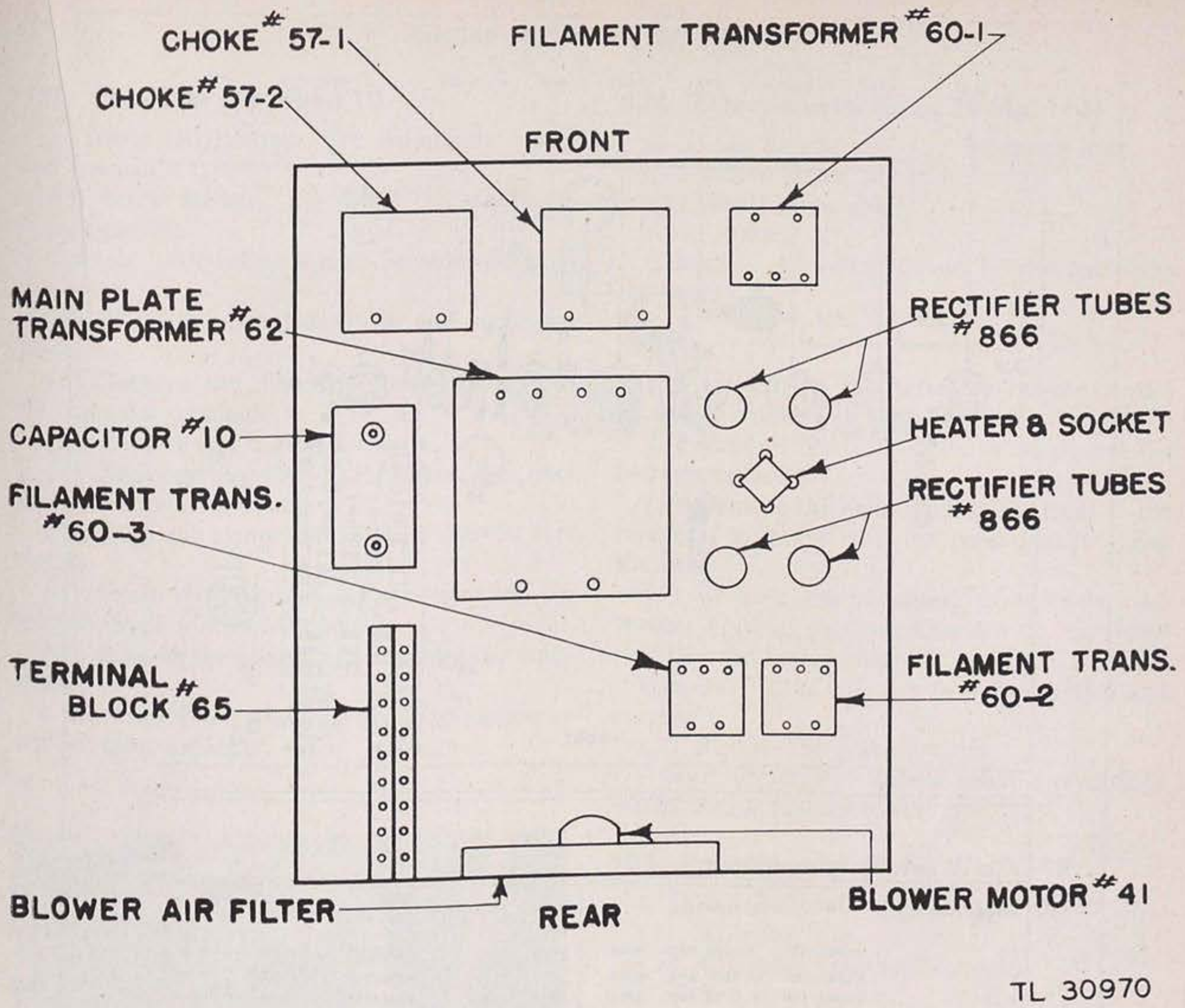
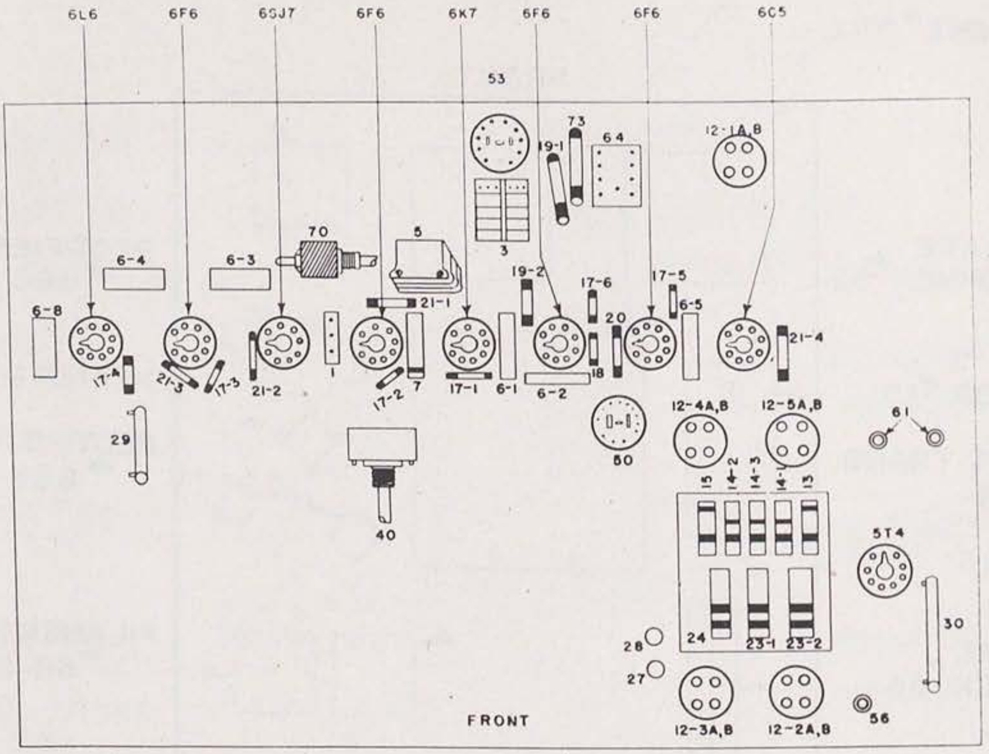


Figure 110. Keyer BC-758-A, location of parts, bottom shelf.



SCHEM. PART NO.	DESCRIPTION	SCHEM. PART NO.	DESCRIPTION
1	CAPACITOR (.0002 MFD) MICA	17-6	RESISTOR (100MΩ) ½ W
3	CAPACITOR 10-(.001 MFD MICA	18	RESISTOR (200MΩ) ½ W
5	CAPACITOR (3-03 MFD) MICA	19-1	RESISTOR (2000Ω) 1 W
6-1	CAPACITOR (.1 MFD) MICA	19-2	RESISTOR (2000Ω) 1 W
6-2	CAPACITOR (.1 MFD) MICA	20	RESISTOR (20000Ω) 1 W
6-3	CAPACITOR (.1 MFD) MICA	21-1	RESISTOR (50000Ω) 1 W
6-4	CAPACITOR (.1 MFD) MICA	21-2	RESISTOR (50000Ω) 1 W
6-5	CAPACITOR (.1 MFD) MICA	21-3	RESISTOR (50000Ω) 1 W
6-8	CAPACITOR (.1 MFD) MICA	21-4	RESISTOR (50000Ω) 1 W
7	CAPACITOR (.1 MFD) OIL	23-1	RESISTOR (200Ω) 2 W
12-1A B	CAPACITOR (8 MFD) FILTER	23-2	RESISTOR (200Ω) 2 W
12-2A B	CAPACITOR (8 MFD) FILTER	24	RESISTOR (2000Ω) 2 W
12-3A B	CAPACITOR (8 MFD) FILTER	27	RESISTOR (2500Ω) 10 W
12-4A B	CAPACITOR (8 MFD) FILTER	28	RESISTOR (5000Ω) 10 W
12-5A B	CAPACITOR (8 MFD) FILTER	29	RESISTOR (20000Ω) 20 W
13	RESISTOR (5000Ω) ½ W	30	RESISTOR (1000Ω) 20 W
14-1	RESISTOR (10000Ω) ½ W	40	POTENTIOMETER (250 MΩ)
14-2	RESISTOR (10000Ω) ½ W	50	SWITCH (SELECTOR)
14-3	RESISTOR (10000Ω ½ W	53	SWITCH
15	RESISTOR (15000Ω) ½ W	56	CHOKE
17-1	RESISTOR (100MΩ) ½ W	61	TRANSFORMER (POWER)
17-2	RESISTOR (100MΩ) ½ W	64	TRANSFORMER (AUDIO)
17-3	RESISTOR (100MΩ) ½ W	70	CAPACITOR (VARIABLE)
17-4	RESISTOR (100MΩ) ½ W	73	RESISTOR (250MΩ) 1 W
17-5	RESISTOR (100MΩ) ½ W		

TL 30972

Figure 111. Keyer BC–758–A, location of parts, top shelf.

133. Capacitor (1st Filter) 10

a. TOOLS REQUIRED. (1) Adjustable open-end wrench.

(2) Screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Turn the relay panel over and anchor in place.

(2) Remove the nuts and lockwashers from the capacitor terminals.

(3) Remove and tag the leads.

(4) Remove the bolts, lockwashers, and nuts from the mounting clamp.

(5) Raise the clamp and slide in over the terminals.

(6) Grasp the capacitor at the bottom and tip it back. Slide it out of the unit.

(7) Remove the ground bus bar from the capacitor.

c. REPLACEMENT. Reverse above procedure to replace filter capacitor.

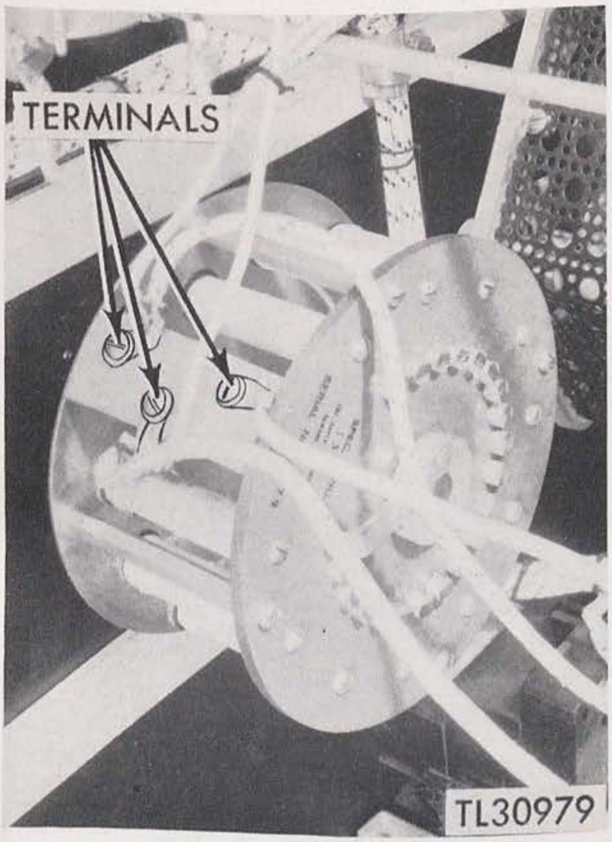


Figure 112. Keyer BC-758-A, removal of potentiometer 39.

134. Potentiometer (Bias) 39 (fig. 112)

a. TOOLS REQUIRED. (1) Soldering iron.

(2) Screw driver, $8\frac{1}{2}$-inch.

(3) Small screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

NOTE. Two operators are required for this procedure.

(1) Loosen the two setscrews on the control knob and remove the knob.

(2) Remove the panel plate by taking out the two tapped bolts.

(3) Remove the bolts holding the leads to the terminals 1, 2, and 3 of the potentiometer. Tag the leads.

(4) Remove the mounting bolts, nuts, and spacers holding the potentiometer to the front panel of the keying unit.

Caution: Take care not to drop the nuts and spacers.

(5) Remove the potentiometer.

c. REPLACEMENT. Reverse above procedure to install a new potentiometer.

135. Potentiometer (Pulse Width) 40

a. TOOLS REQUIRED. (1) Screw driver.

(2) Soldering iron.

(3) Adjustable open-end wrench.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Remove and tag the two leads from the terminals of the potentiometer.

(2) Loosen the setscrews holding the potentiometer shaft coupling to the shaft.

(3) Remove the nut and lockwasher holding the potentiometer to the mounting bracket.

(4) Remove the potentiometer.

c. REPLACEMENT. Reverse above procedure to replace potentiometer.

136. Blower 41

a. TOOLS REQUIRED. (1) Screw driver.

(2) Spintite wrench.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Remove the air filter.

(2) Remove the bolts holding the a-c input leads to the blower-motor terminals.

(3) Remove and tag the leads.

(4) Remove the bolts, nuts, and lockwashers holding the blower motor to the frame.

(5) Remove the blower.

c. REPLACEMENT. Reverse above procedure to replace the blower.

137. Meters (Keying Supply and Bias) 44 (1–2)

a. TOOLS REQUIRED. (1) Spintite wrench.

(2) Screw driver.

(3) Pliers.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

NOTE. Two operators are required for this operation.

(1) Remove the four meter resistors (multipliers).

(2) Loosen the bolts on the lower mounting terminals of the resistors.

(3) Remove and tag the leads.

(4) Remove the nuts and lockwashers from the meter terminals.

(5) Remove and tag the leads.

(6) Remove the bypass capacitors.

(7) Remove the mounting bolts, nuts, lockwashers, and spacers holding the meter panel to the front panel.

Caution: Be careful not to drop the spacers.

(8) Remove the meter panel.

NOTE. While one operator holds the meter panel, the other operator removes the mounting bolts on the meter panel.

(9) Remove the three mounting bolts, nuts, and lockwashers holding the meter to the meter panel.

(10) Remove the meter.

c. REPLACEMENT. Reverse above procedure to replace meter.

138. Relay (Time Delay) 45 (fig. 113)

a. TOOLS REQUIRED. (1) Spintite wrench.

(2) Screw driver.

(3) Pliers.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Remove the relay panel mounting screws.

Caution: When removing the last screw, take care not to drop the panel and injure the relays which are attached.

(2) Turn panel over and anchor it so that it will stay in an upright position.

(3) Remove relay cover.

(4) Remove the nuts and lockwashers holding the white, black, and yellow leads to the relay terminal.

(5) Remove and tag the leads.

(6) Remove the two mounting bolts, lockwashers, and nuts holding the relay mounting bracket to the relay panel.

(7) Remove the relay.

c. REPLACEMENT. Reverse above procedure to replace relay.

139. Switch (Selector) 50 (fig. 111)

a. TOOLS REQUIRED. (1) Small screw driver.

(2) Adjustable open-end wrench.

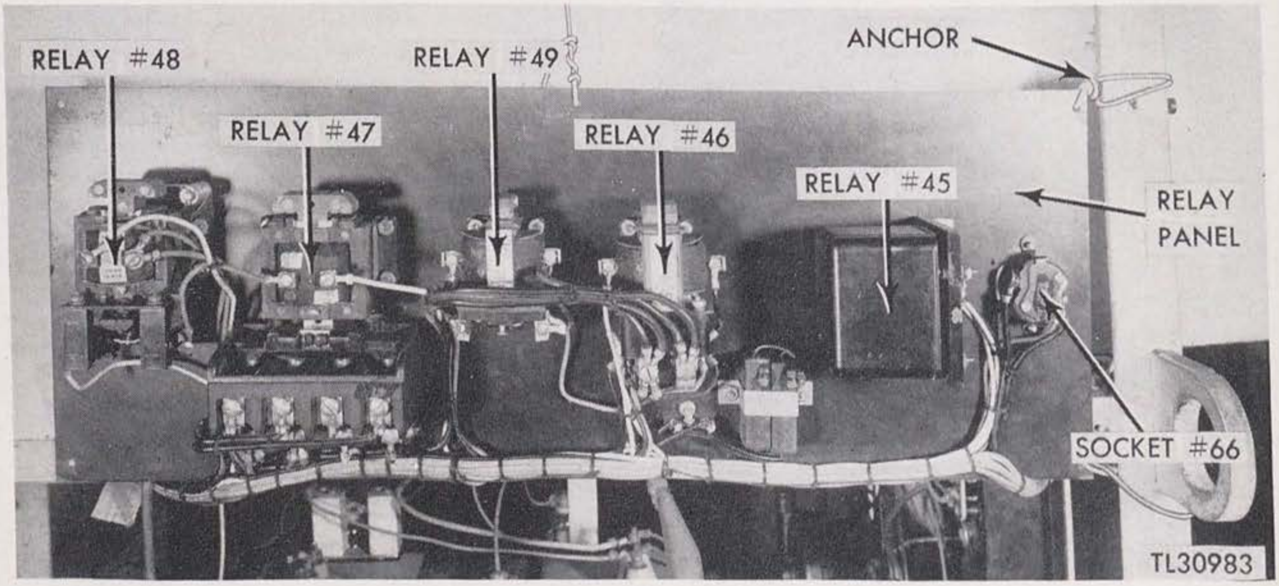


Figure 113. Keyer BC–758–A, showing location of relays 45 to 49 inclusive.

(3) Soldering iron.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Sketch a rough outline of each of the switch wafers.

(2) Label each sketch to correspond with the position of the switch wafer. For example, the sketch for the front wafer might be labeled *F*.

(3) Number the terminals on each sketch to correspond with the switch positions. For example, the terminals of the front wafer might be labeled F1, F2, etc.

(4) Label each lead to correspond with the terminal number on the corresponding sketch.

(5) Remove the leads from the contact terminals.

(6) Loosen the setscrews holding the coupling to the switch shaft.

(7) Remove the nut and washer holding the switch to the mounting bracket.

(8) Remove the switch.

c. REPLACEMENT. (1) Place the switch in the proper position.

(2) Replace the nut and washer holding the switch to the mounting bracket.

(3) Tighten the setscrews holding the coupling to the switch shaft.

(4) Connect the leads to the contact terminals in the order shown by the corresponding sketches made in the removal process.

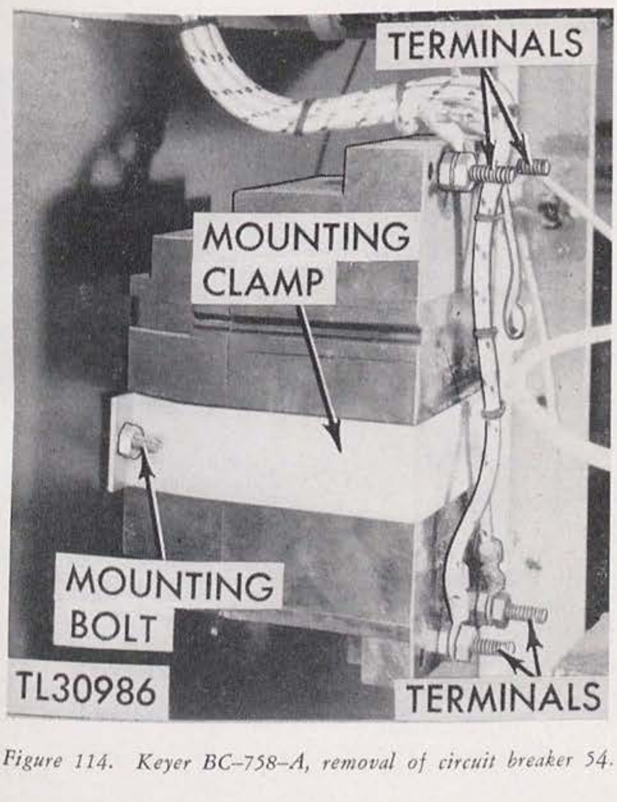


Figure 114. Keyer BC–758–A, removal of circuit breaker 54.

140. Circuit Breaker 54 (fig. 114)

a. TOOLS REQUIRED. (1) Screw driver.

(2) Spintite wrench.

b. REMOVAL.

Caution: All voltages to keyer must be removed at the distribution panel or power panel before attempting to work on the circuit breaker.

NOTE. Two operators are required for this procedure.

(1) Remove the nuts holding the leads to the circuit breaker terminals.

(2) Remove and tag the leads.

(3) While one operator holds the circuit breaker and clamp, the other operator removes the bolts, lockwashers, and nuts from the mounting clamp.

NOTE. The face plate and bracket will come off at the same time.

(4) Remove the circuit breaker.

c. REPLACEMENT. Reverse above procedure to install a new circuit breaker.

141. Filament Transformer 58 (fig. 115)

a. TOOLS REQUIRED. (1) Open-end wrench.

(2) Screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Remove the first 450TH tube.

(2) Remove the nuts and lockwashers from the primary and secondary terminals.

(3) Remove and tag the leads.

(4) Remove the two mounting bolts on the transformer primary side.

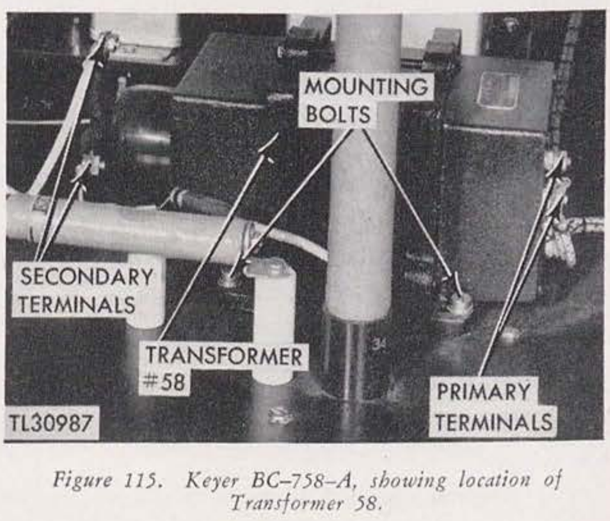


Figure 115. Keyer BC–758–A, showing location of Transformer 58.

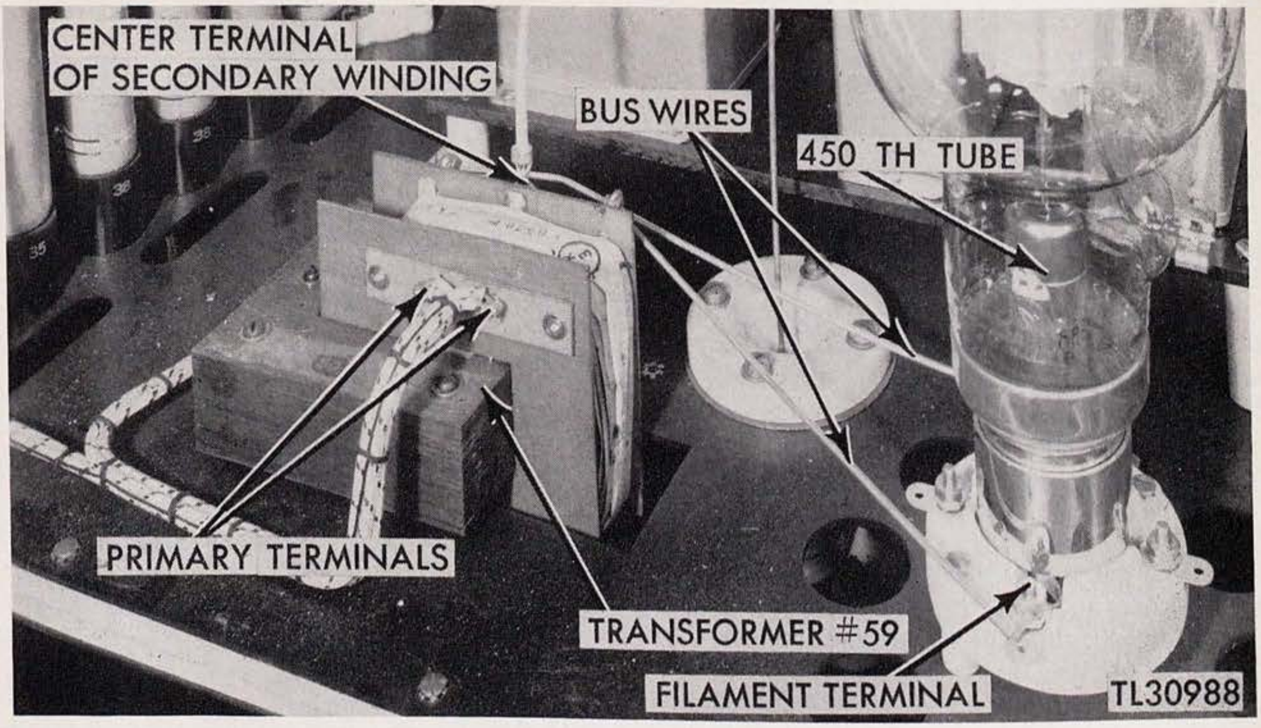


Figure 116. Keyer BC–758–A, showing location of Transformer 59.

(5) Loosen the two mounting bolts on the transformer secondary side.

(6) Slide the transformer out of the mounting.

c. REPLACEMENT. Reverse above procedure to install a new filament transformer.

142. Filament Transformer (Second 450th tube) 59 (fig. 116)

a. TOOLS REQUIRED. (1) Screw driver.

(2) Open-end wrench.

(3) Spintite wrench.

(4) Soldering iron.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Remove the second 450TH tube.

(2) Remove the nuts from the filament terminals on the 450TH tube socket.

(3) Remove the two bus wires.

(4) Remove the nut and lockwasher from the center terminal of the secondary winding.

(5) Remove and tag the lead.

(6) Remove and tag the four leads from the primary terminals.

(7) Remove the four mounting bolts holding the transformer to the chassis.

(8) Remove the transformer and the attached bus wires.

(9) Remove the bus wires.

c. REPLACEMENT. Reverse above procedure to install a new filament transformer.

143. Filament Transformers (866's) 60 (1–3)

a. TOOLS REQUIRED. (1) Screw driver.

(2) Open-end wrench.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Remove the four 866 tubes.

(2) Remove the nuts and lockwashers from the primary and secondary terminals (fig. 117).

(3) Remove and tag the leads.

(4) Remove the two mounting bolts from the secondary side.

(5) Loosen the two mounting bolts on the primary side.

(6) Slide the transformer forward and remove it from the unit.

c. REPLACEMENT. Reverse the procedure given above to install a new filament transformer.

144. Power Transformer (Low Voltage) 61

a. TOOLS REQUIRED. (1) Screw driver.

(2) Spintite wrench.

(3) Soldering iron.

(4) Wire cutters.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Remove the second 450TH tube. Follow the procedure outlined in paragraph 147.

(2) Cut each set of wires about 2 inches from the ends of the terminals.

NOTE. Cutting the leads in this manner will allow sufficient color coding for terminal identification when the transformer is being replaced.

(3) Remove the four mounting bolts, lockwashers, and nuts holding the transformer to the chassis.

(4) Remove the transformer.

c. REPLACEMENT. Reverse above procedure to replace the power transformer.

145. Plate Transformer (High-Voltage) 62 (fig. 117)

a. TOOLS REQUIRED. (1) Open-end wrench.

(2) Socket wrench.

(3) Spintite wrench.

(4) Offset wrench.

(5) Screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) Remove the four 866 rectifier tubes.

(2) Remove the nut and lockwashers from the rear terminal of the high-voltage capacitor 10.

(3) Remove and tag the lead.

(4) Remove the nuts and lockwashers from the primary and secondary terminals of the power transformer.

(5) Remove and tag the leads.

(6) Remove the bolts and lockwashers from the bottom of the three square porcelain insulators on the transformer mounting bracket.

(7) Remove and tag the insulators.

(8) Remove the four mounting bolts, lockwashers, and nuts.

(9) Remove the 866 tube sockets.

(10) Remove the heater socket.

(11) Cover the wires on the floor of the unit with a 1/4-inch board.

(12) Slide the transformer out through the left side of the keyer.

(13) Remove the bolts, lockwashers, and nuts holding the insulator brackets.

(14) Remove the brackets for replacement on the transformer.

c. REPLACEMENT. Reverse above procedure to replace plate transformer.

146. Autotransformer (Variable) 63 (fig. 118)

a. TOOLS REQUIRED. (1) Open-end wrench.

(2) Screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

NOTE. Two operators are required for this procedure.

(1) Loosen the setscrew holding the control knob to the shaft.

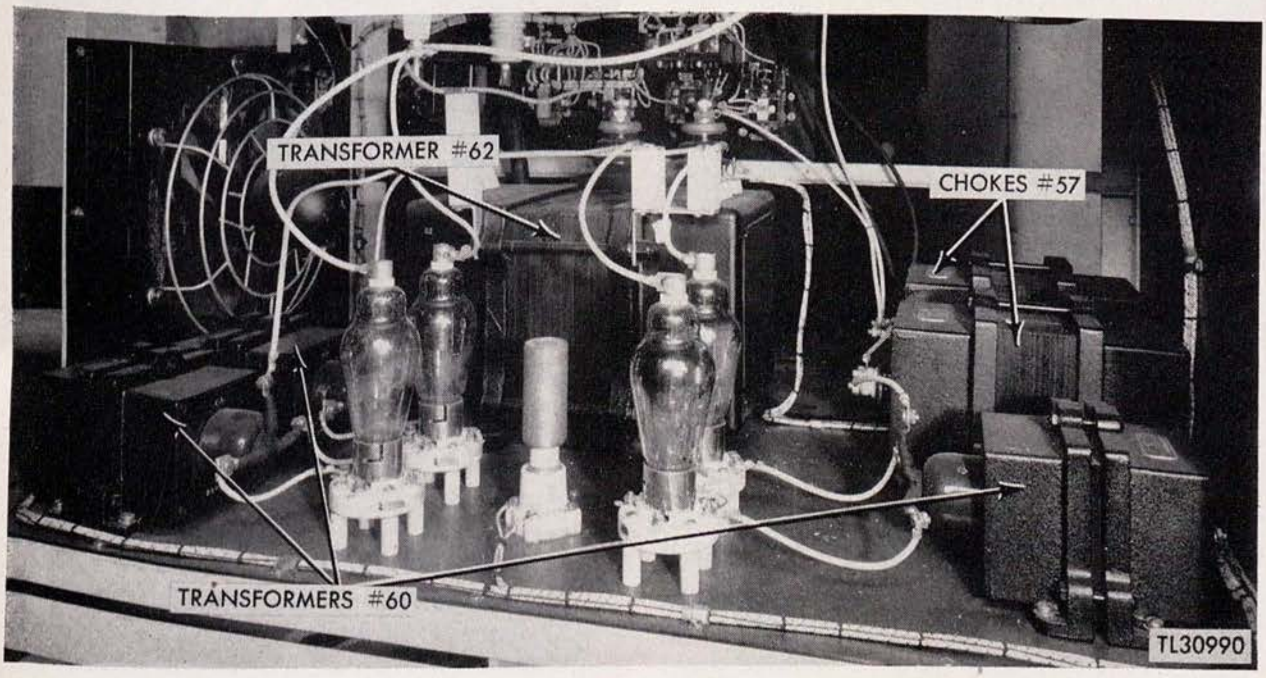


Figure 117. Keyer BC-758-A, showing location of Chokes 57 (1-2) and Transformers 60 (1-3), and 62.

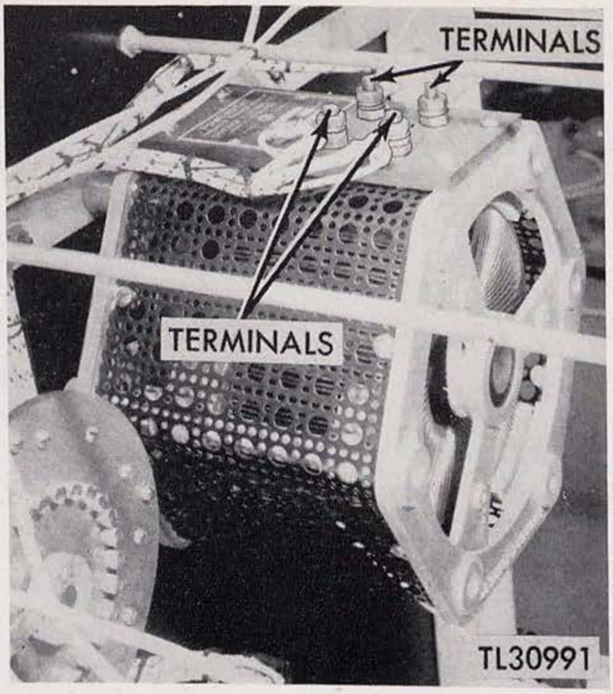


Figure 118. Keyer BC–758–A, showing connections to Autotransformer 63.

(2) Remove the control knob.

(3) Remove the three bolts, holding the face plate on the front panel and take off the plate.

(4) Remove the nuts and lockwashers from the transformer terminals.

(5) Remove and tag the leads.

(6) While one operator holds the transformer, the other operator removes the three mounting bolts and spacers from the front panel.

Caution: Take care not to drop the spacers.

(7) Remove the transformer.

c. REPLACEMENT. Reverse above procedure to install a new autotransformer.

147. 450th Tubes (fig. 119)

a. TOOLS REQUIRED. (1) Screw driver.

(2) Spintite wrench.

b. REMOVAL.

Caution: All voltages must be removed from the keyer.

(1) *Tube.* (*a*) Squeeze the plate clamp on the top cap of the tube and lift up.

(*b*) Squeeze the grid clamp on the grid terminal and remove from the cap.

(*c*) Grasp the base and bulb of the tube.

(*d*) Turn the tube in its base in a maximum counterclockwise position and lift it out of the socket.

(2) *Socket.* (*a*) Remove the nuts and lockwashers from the filament terminals of the tube socket.

(*b*) Remove the two bolts, lockwashers, and insulated washers holding the socket to the insulators.

(*c*) Remove the socket.

(3) *Insulator.* (*a*) Remove the bolt below the chassis holding the insulator.

(*b*) Remove the insulator.

c. REPLACEMENT. To replace insulator, socket assembly, and 450TH tube, reverse the above procedure.

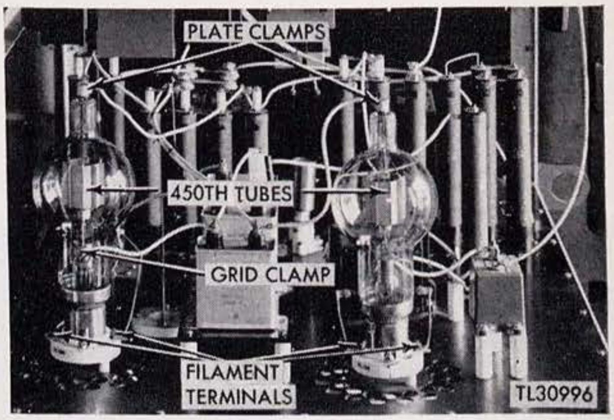


Figure 119. Keyer BC–758–A, showing location of 450th tubes.

Section IV. TRANSMITTER BC–785–A

148. Capacitor (Bypass) 2 (1–2) (fig. 120)

a. TOOLS REQUIRED. (1) Open-end wrench.

(2) Screw driver.

(3) Drop light.

b. REMOVAL.

Caution: All voltages must be removed from the transmitter.

(1) Remove the bolts, lockwashers, and nuts holding the bus wire to the filament transformer cable.

(2) Remove the nuts and washers from the capacitor terminals.

(3) Remove the bus wire from the capacitor terminal.

(4) Remove the connecting bus wire between

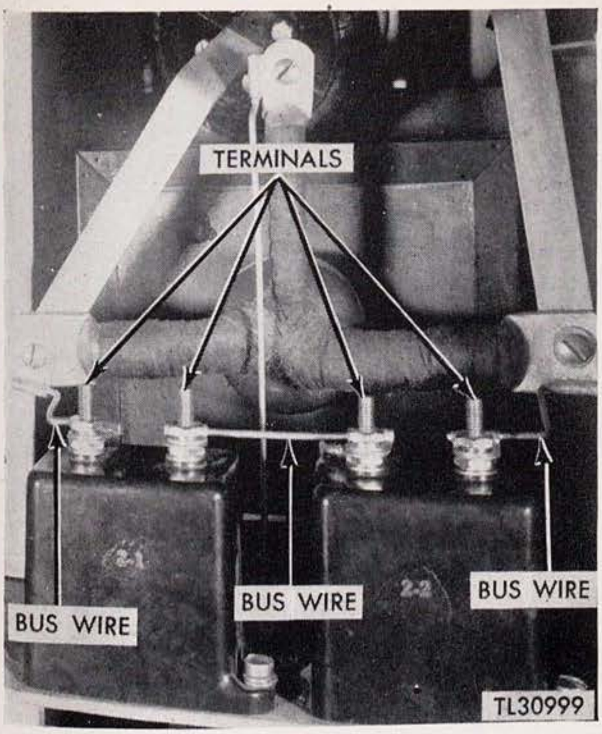


Figure 120. Transmitter BC–785–A, showing location of Capacitors 2 (1–2).

the capacitors.

(5) Remove the three capacitor mounting bolts and washers.

Caution: Take care not to damage the resistor insulator beneath the frame.

(6) Remove the capacitor.

c. Replacement. Reverse above procedure to replace capacitor.

149. Circuit Breaker 12 (fig. 121)

a. Tools Required. (1) Screw driver.

(2) Spintite wrench.

(3) Drop light.

b. Removal.

Caution: All voltages must be removed at the distribution board before attempting to work on the circuit breaker. The fuses must be removed from the board.

(1) While one operator holds the circuit breaker, the other removes the mounting bolts, lockwashers, and nuts holding the circuit breaker to the front panel.

(2) Pull the circuit breaker away from the panel sufficiently to turn over and expose the terminals.

(3) Remove the bolts and lockwashers from each terminal.. As each bolt is removed, remove the leads from that terminal and tag them.

(4) Remove the circuit breaker.

c. Replacement. Reverse above procedure to install a new circuit breaker.

150. Transformer (Filament) 16 (fig. 122)

a. Tools Required. (1) Screw driver.

(2) Open-end wrench.

(3) Drop light.

b. Removal.

Caution: All voltages must be removed from the transmitter. (Left, right, and bottom-rear panels must be removed for this operation.)

(1) Remove the bolts, nuts, and lockwashers from the three secondary terminals.

(2) Remove the nuts and lockwashers from the primary terminals 1 and 4.

(3) Remove and tag the leads.

(4) Remove the mounting bolts, lockwashers, and nuts from the primary side of the transformer.

(5) Loosen the bolts on the secondary side of the transformer.

(6) Move the transformer away from the mounting bolts and slide it through the rear of the transmitter.

c. Replacement. Reverse above procedure to replace the filament transformer.

151. Current Transformer 17 (fig. 122)

a. Tools Required. (1) Screw driver.

(2) Drop light.

b. Removal.

Caution: All voltages must be removed from the transmitter.

(1) Remove the bolts and lockwashers from the transformer terminal strip.

(2) Remove and tag the leads.

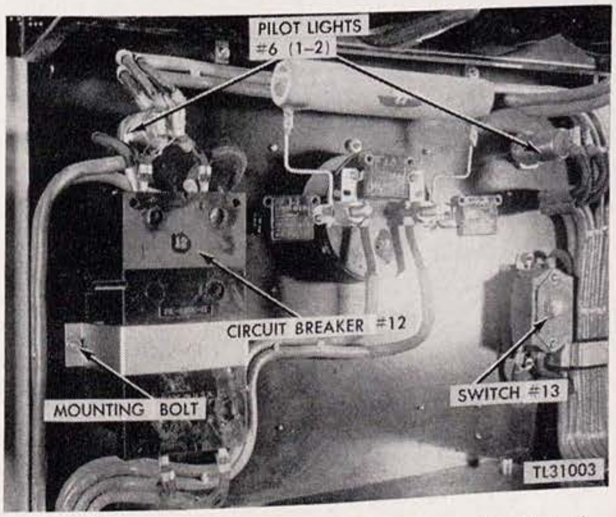


Figure 121. Transmitter BC–785–A, showing location of Circuit Breaker 12 and Switch 13.

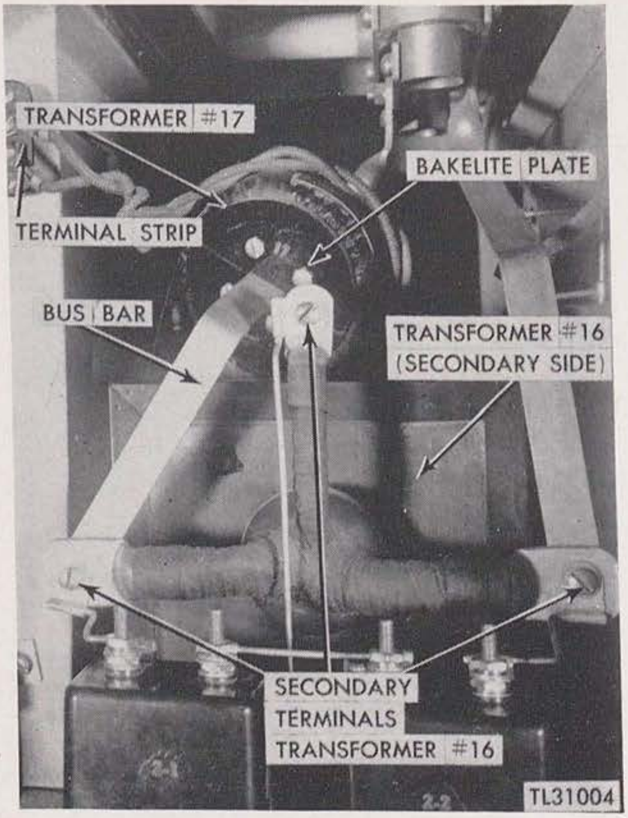


Figure 122. Transmitter BC-785-A, showing location of Transformers 16 and 17.

(3) Loosen (do not remove) the four bolts on the transformer bakelite plate.

(4) Remove the bolts, lockwashers, and nuts holding the bus bar to the filament-transformer secondary terminal.

(5) Loosen the bolt on the other side of the bus bar.

(6) Lift the bus bar.

(7) Remove the current transformer by sliding it off the bus bar.

c. Replacement. Reverse above procedure to install new current transformer.

152. Transtat 18 (fig. 123)

a. Tools Required. (1) Screw driver.

(2) Open-end wrench.

(3) Drop light.

b. Removal.

Caution: All voltages must be removed from the transmitter.

Note. Two operators are required for this procedure.

(1) Loosen the two setscrews on the control knob shaft.

(2) Remove the control knob.

(3) Remove the four mounting bolts, washers, and spacers holding the cover to the transtat.

(4) Remove the cover.

(5) Remove the four nuts and lockwashers from the transtat terminals. As each set is removed, the leads must be removed and tagged immediately.

(6) While one operator holds the transtat, the other removes the bolts, washers, and nuts from the transtat mounting.

(7) Remove the transtat.

c. Replacement. Reverse above procedure to replace the transtat.

153. Blower (Circulator) 19 (fig. 124)

a. Tools Required. (1) Offset screw driver.

(2) Screw driver.

(3) Open-end wrench.

(4) Drop light.

b. Removal.

Caution: All voltages must be removed from the transmitter. Be careful not to damage the transmitting tubes.

Note. Two operators are required for this procedure.

(1) Remove the bolts and lockwashers from the motor terminals.

(2) Remove and tag the leads.

(3) While one operator holds the blower unit, the other removes the three mounting bolts, lockwashers, and nuts.

(4) Remove the blower.

c. Replacement. Reverse above procedure to replace the blower.

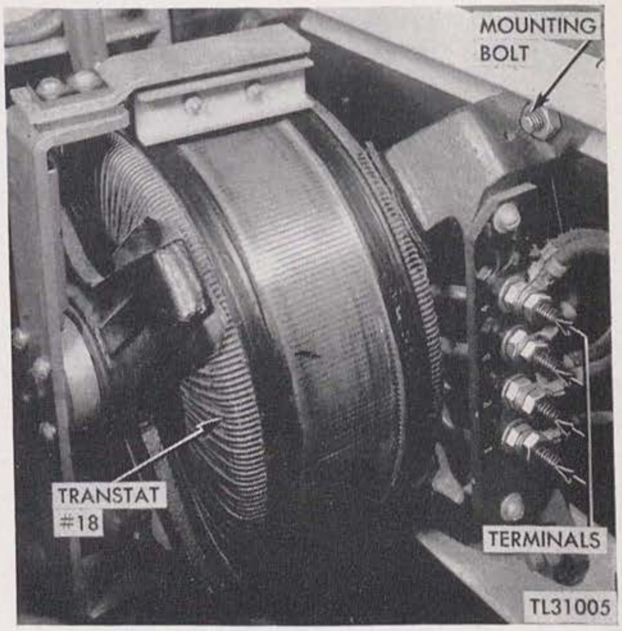


Figure 123. Transmitter BC-785-A, removal of transtat 18.

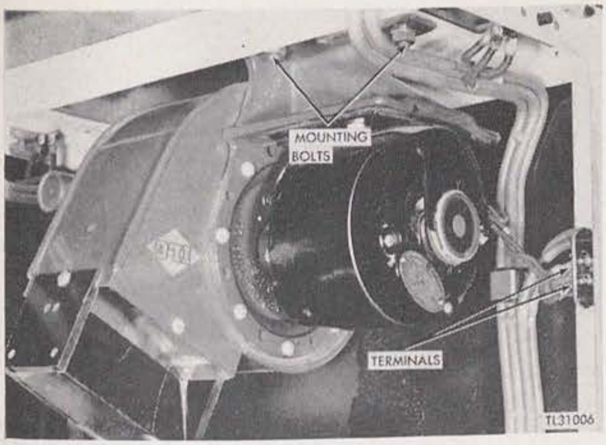


Figure 124. Transmitter BC–785–A, showing location of blower 19.

154. Blower (Intake) 20 (fig. 125)

a. Tools Required. (1) Screw driver.
(2) Open-end wrench.

b. Removal.

Caution: All voltages must be removed from the transmitter.

(1) Remove the bolts and lockwashers from the motor terminal strip.

(2) Remove and tag the leads.

(3) Remove the four mounting bolts, lockwashers, metal spacers, and nuts.

(4) Remove the blower.

c. Replacement. Reverse above procedure to replace the blower.

155. Exhaust Fan 21

a. Tools Required. (1) Screw driver.
(2) Open-end wrench.

b. Removal.

Caution: All voltages must be removed from the transmitter.

(1) Remove the rear bottom panel.

(2) Remove the bolts and lockwashers from the motor terminals.

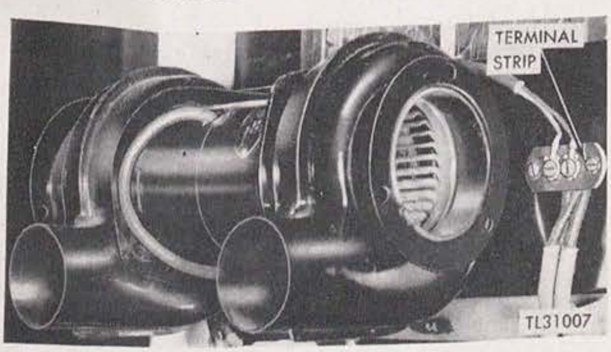


Figure 125. Transmitter BC–785–A, showing location of Blower 20.

(3) Remove and tag the leads.

(4) Remove the four mounting bolts.

(5) Remove the fan.

c. Replacement. Reverse above procedure to replace the exhaust fan.

156. WL–530 Tubes (fig. 126)

a. Tools Required. (1) Screw driver.
(2) Pliers.

b. Removal.

Caution: All voltages must be removed from the transmitter. Allow the tubes to cool sufficiently before handling.

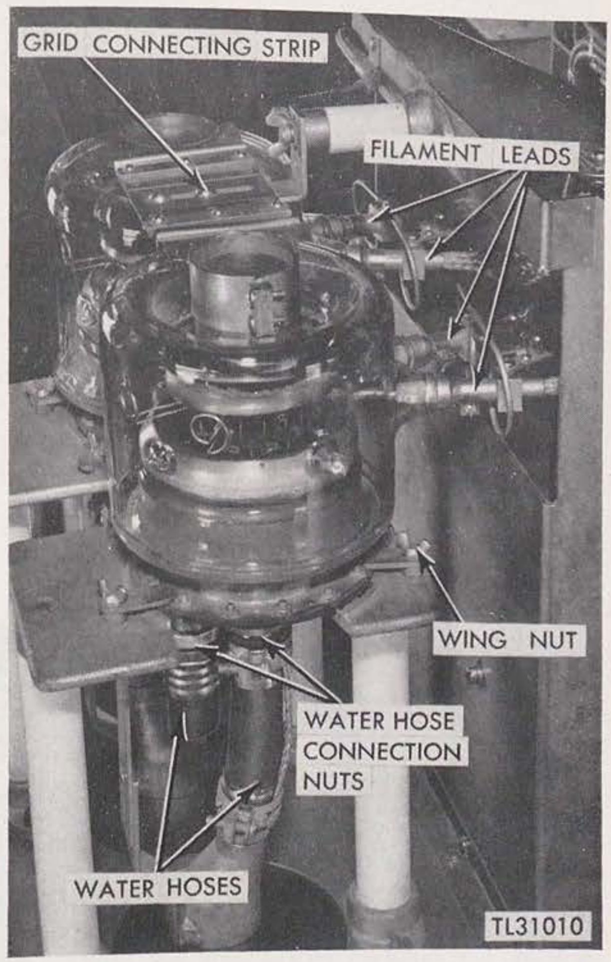


Figure 126. Transmitter BC–785–A, removal of WL–530 tubes.

(1) Remove the panels from the right and left sides of the transmitter.

(2) Turn off the valves on the water cooler.

(3) Place rags around the bottom of the WL–530 tubes to soak up the small amount of water remaining in the tube connections.

(4) Loosen the knurled cap nuts on the water hose connections.

(5) Remove the water hose connections.

(6) Remove the filament leads from filament terminals.

(7) Remove the grid lead from the upper grid terminal.

(8) Remove the grid-cap connection strip.

(9) Remove the wingnuts holding the tube to the tube mounting base.

(10) Remove the WL–530 tube.

c. REPLACEMENT. (1) Place the WL–530 tube in proper position.

(2) Replace the wingnuts holding the tube in the tube base.

(3) Replace the grid cap connecting strip.

(4) Replace the grid lead on the upper grid terminal.

(5) Replace the filament leads on the filament terminals.

(6) Place a new gasket in the water hose coupling, discarding the old gasket.

(7) Replace the water hose connections.

(8) Tighten the knurled cap nuts on the water hose connections.

(9) Open the water valves on the water cooler.

(10) Throw transmitter circuit breaker to ON position.

(11) Turn on the water cooler.

(12) Check for leaks at the WL–530 water hose connection.

Section V. WATER COOLER RU–4–A

157. Fan Motor 3 (fig. 127)

a. TOOLS REQUIRED. (1) Open-end wrench.

(2) Soldering iron.

(3) Screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the water cooler.

NOTE. Two men are preferred for this operation.

(1) Loosen the clamps holding the back cover of the fan motor.

(2) Remove the back cover.

(3) Untape the three leads.

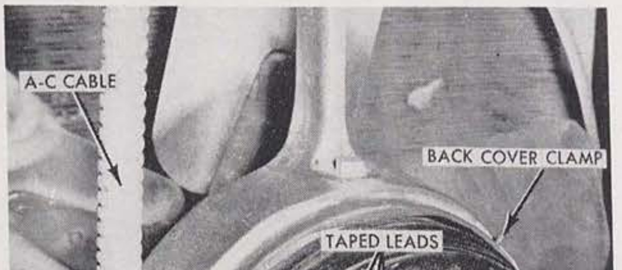


Figure 127. Water Cooler RU–4–A, showing connections to Fan Motor 3 (cover removed).

(4) Remove and tag the three leads.

(5) Loosen (do not remove) the two bolts on the clamps which hold the a-c supply cable.

(6) Remove the a-c supply cable from the fan motor.

(7) Remove the mounting nuts from the top of the assembly.

NOTE. It is advisable to use two men for this operation. One man should hold the assembly in place while the other removes the mounting nuts.

(8) Remove the mounting bolts from the bottom of the fan assembly.

(9) Remove the fan assembly.

(10) Remove the mounting bolts holding the assembly to the motor frame.

(11) Remove the assembly from the motor frame.

c. REPLACEMENT. Reverse above procedure to replace fan and assembly.

158. Pump and Motor 4 (fig. 128)

a. TOOLS REQUIRED. (1) Screw driver.

(2) Stilson wrench.

(3) Soldering iron.

(4) Open-end wrench.

b. REMOVAL.

Caution: All voltages must be removed from the water cooler.

(1) Remove the rear panel.

(2) Shut off all water valves leading to and from the pump.

(3) Open the petcock on the pump and drain excess water. Follow the procedure outlined in paragraph 89*d*(3).

(4) Remove all pipe connections from the pump.

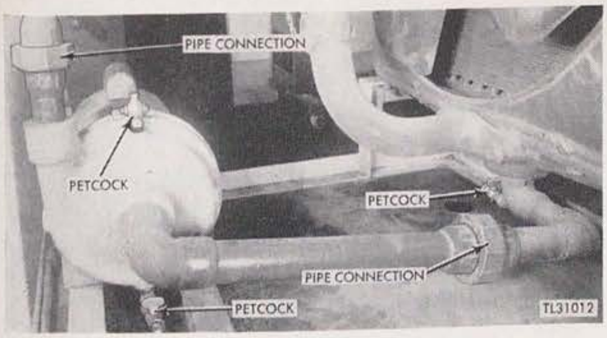


Figure 128. Water Cooler RU-4-A, showing connections to water pump.

(5) Remove the bolts holding the terminal box plate to the pump.

(6) Remove and tag the leads.

(7) Remove the six mounting nuts from the pump.

(8) Remove the pump.

c. Replacement. Reverse above procedure to replace pump and motor.

159. Low Cutout Switch 6, High Cutout Switch 7 (Pressuretrols)

a. Tools Required. (1) Soldering iron.

(2) Open-end wrench.

b. Removal.

Caution: Remove all voltages from the water cooler.

(1) Loosen the thumbscrew holding the case panel and remove the panel from the case (fig. 129).

(2) Loosen the terminal bolts holding the a-c input leads.

(3) Remove and tag the a-c input leads.

(4) Loosen the nut holding the case to the shaft and remove the case.

c. Replacement. Reverse above procedure to install new pressuretrol.

160. Converter 9

a. Tools Required. (1) Screw driver.

(2) Hammer.

(3) Spintite wrench.

b. Removal.

Caution: All voltages must be removed from the water cooler.

(1) Remove the top and rear panels.

(2) Remove the two bolts holding the cover to the converter box.

(3) Remove the cover.

(4) Loosen the three bolts holding the leads on the terminal block (fig. 130).

(5) Remove and tag the three leads.

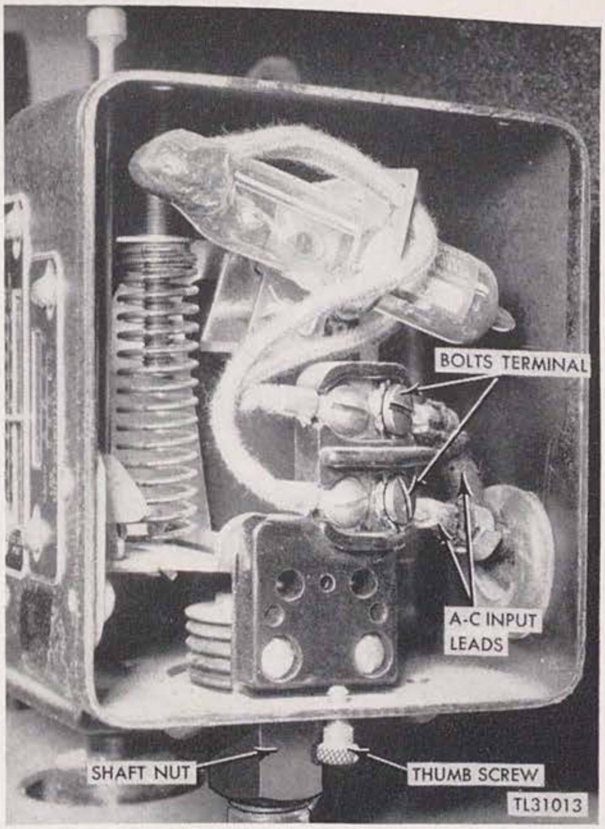


Figure 129. Water Coolers RU-4-A, showing low cutout Switch 6 (cover removed).

(6) Remove the nut which holds the phase converter cable to the converter box and pull out the phase converter cable.

(7) Remove the four mounting nuts which hold the converter box to the chassis.

(8) Remove the phase converter box.

c. Replacement. Reverse above procedure to replace phase converter.

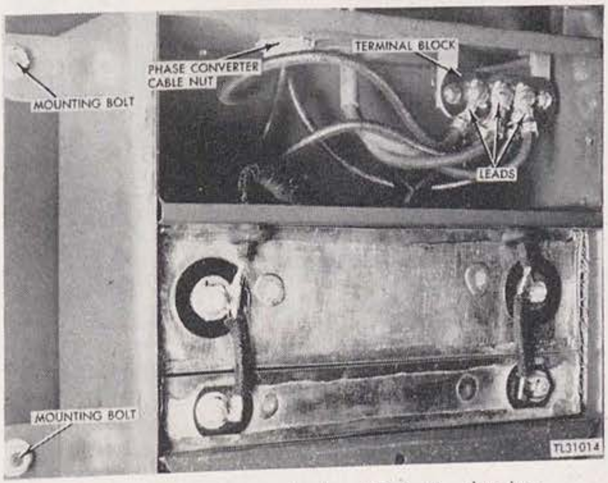


Figure 130. Water Cooler RU-4-A, showing connections to Phase Converter 9.

161. Potentiometers 50, 51, 52 (1–3)

a. Tools Required. (1) Screw driver.

(2) Soldering iron.

(3) Open-end wrench.

b. Removal.

Caution: All voltages must be removed from the oscilloscope.

(1) Remove and tag the leads from the terminals (fig. 131).

(2) Loosen the setscrews on the shaft coupling.

(3) Pull the control shaft through the front panel opening.

(4) Loosen the hex. nut which holds the potentiometer to the mounting panel.

(5) Remove the potentiometer.

(6) Slide off the coupling from the potentiometer.

c. Replacement. Reverse above procedure to replace potentiometer.

162. Inductance Coils 64 (1–4), 65–1

a. Tools Required. (1) Screw driver.

(2) Soldering iron.

b. Removal.

Caution: Remove all voltages from the oscilloscope.

(1) Place the oscilloscope on its side.

(2) Remove the cover from the oscillator compartment.

(3) Loosen the six screws which hold the oscillator compartment chassis to the chassis of the oscilloscope.

(4) Remove the oscillator chassis from the oscilloscope.

(5) Loosen the setscrews which hold the flexible coupler to the drive shaft of the phase control unit (fig. 132).

(6) Remove the four mounting screws that mount the phase control box to the supporting bracket.

(7) Remove the phase control box from the oscilloscope.

(8) Remove the screws that hold the cover on the phase control box.

(9) Remove the cover.

(10) Disconnect and tag the leads.

(11) Remove the mounting bolts.

(12) Remove the coil.

c. Replacement. Reverse above procedure to install a new coil.

163. Inductance Coil 66

a. Tools Required. (1) Open-end wrench.

(2) Soldering iron.

b. Removal.

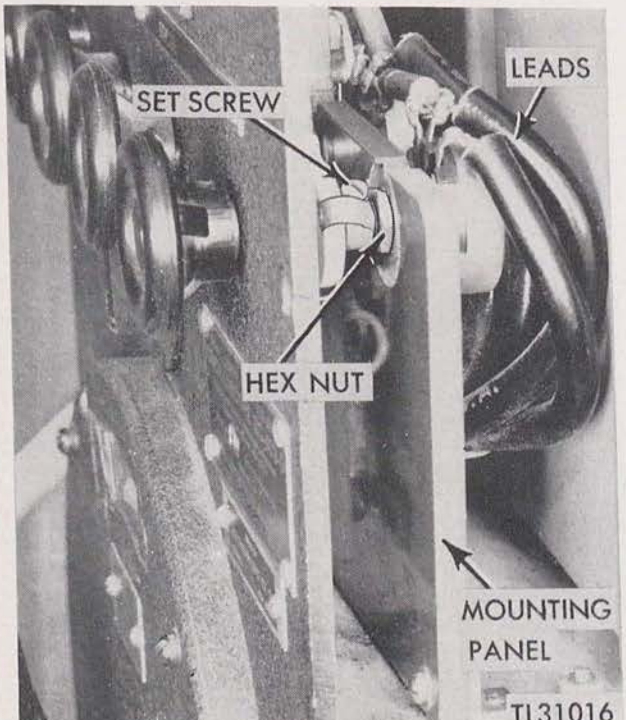


Figure 131. Oscilloscope BC–403–E, showing location of Potentiometers 50, 51, and 52 (1–2).

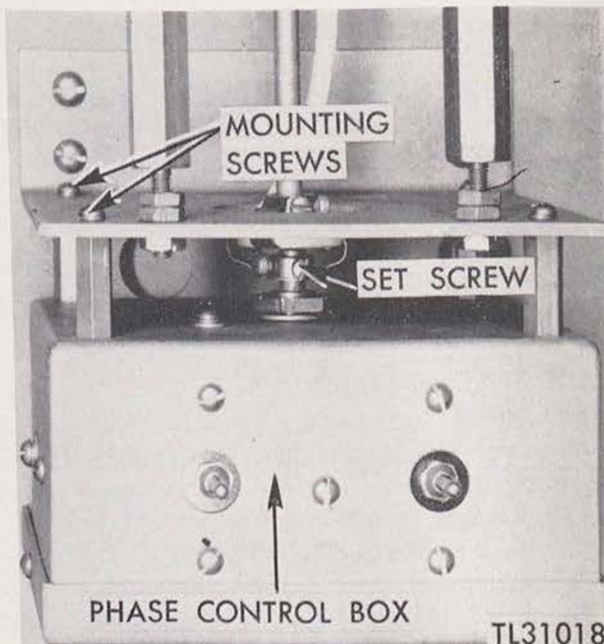


Figure 132. Oscilloscope BC–403–E, removal of phase control unit.

Caution: All voltages must be removed from the oscilloscope.

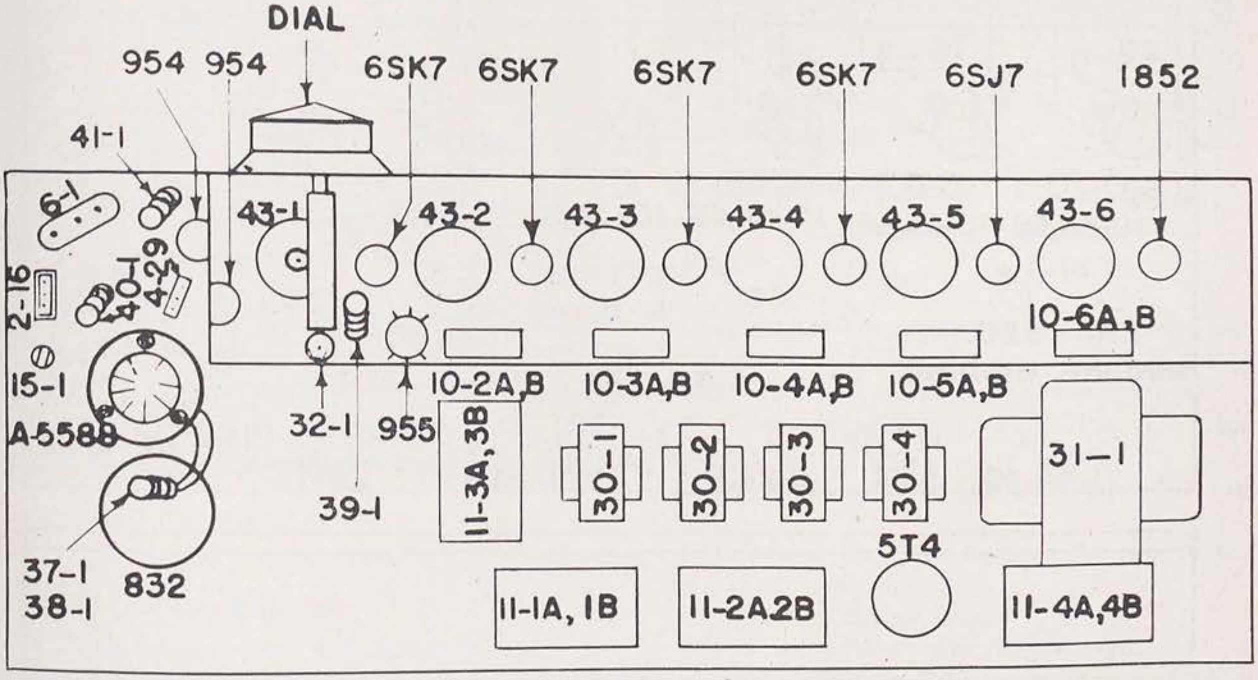
(1) Disconnect and tag the leads.

(2) Remove the knurled nuts from the top and bottom of the coil can.

(3) Remove the can and coil.

(4) Remove the coil from the can.

c. REPLACEMENT. Reverse above procedure to install a new coil.



SCHEMATIC PART NO.	DESCRIPTION.	SCHEMATIC PART NO.	DESCRIPTION.
2-16	CAPACITOR	30-3	CHOKE
4-29	CAPACITOR	30-4	CHOKE
6-1	CAPACITOR	31-1	POWER TRANS.
10-2A,2B	CAPACITOR	32-1	CAP. VARIABLE
10-3A,3B	CAPACITOR	37-1	R.F. PRI. COIL
10-4A,4B	CAPACITOR	38-1	R.F. SEC. COIL
10-5A,5B	CAPACITOR	39-1	OSC. COIL
10-6A,6B	CAPACITOR	40-1	SEC. R.F. COIL.
11-1A,1B	CAPACITOR	41-1	CONVERTER COIL
11-2A,2B	CAPACITOR	43-1	I.F. COIL
11-3A,3B	CAPACITOR	43-2	I.F. COIL
11-4A,4B	CAPACITOR	43-3	I.F. COIL
15-1	POTENTIOMETER	43-4	I.F. COIL
30-1	CHOKE	43-5	I.F. COIL
30-2	CHOKE	43-6	I.F. COIL

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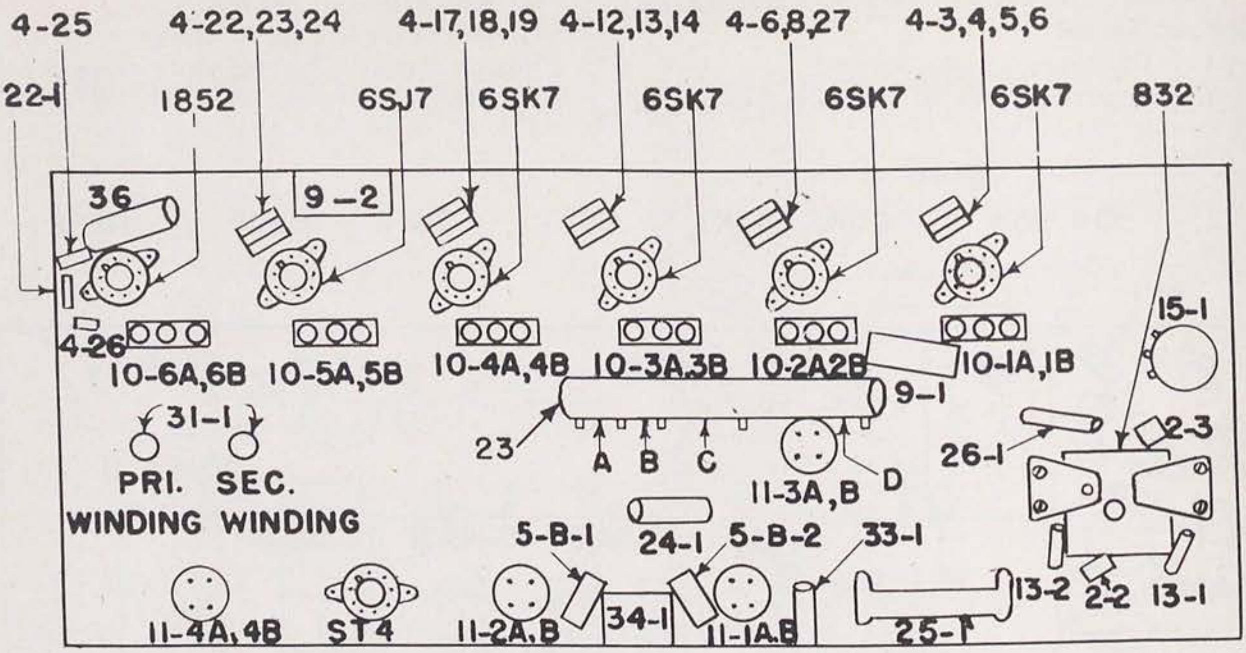
Figure 133. Receiver BC-404-C, diagram showing location of parts (top of chassis).



SCHEMATIC PART NO.	DESCRIPTION.	SCHEMATIC PART NO.	DESCRIPTION.
2-2	CAPACITOR	11-4A,4B	CAPACITOR
2-3	CAPACITOR	9-1	CAPACITOR
4-3,4,5,6	CAPACITOR	9-2	CAPACITOR
4-8,27,28	CAPACITOR	36	CAPACITOR
4-12,13,14	CAPACITOR	13-1	RESISTOR
4-22,23,24	CAPACITOR	13-2	RESISTOR
4-25	CAPACITOR	22-1	RESISTOR
4-26	CAPACITOR	24-1	RESISTOR
5-B-1	CAPACITOR	25-1	RESISTOR
5-B-2	CAPACITOR	15-1	POTENTIOMETER
10-1A,1B	CAPACITOR	26-1	RESISTOR
10-2A,2B	CAPACITOR	23-a,b,c,d	RESISTOR
10-3A,3B	CAPACITOR	33-1	FUSE
10-4A,4B	CAPACITOR	34-1	A.C. RECEPTACLE
10-5A,5B	CAPACITOR	31-1	POWER TRANSFORMER
10-6A,6B	CAPACITOR		
11-1A,1B	CAPACITOR		
11-2A,2B	CAPACITOR		
11-3A,3B	CAPACITOR		

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Figure 134. Receiver BC-404-C, diagram showing location of parts (bottom of chassis).

Figure 135. Receiver BC-404-B, r-f section.

164. Capacitors 2 (6-14)

a. TOOLS REQUIRED. (1) Screw driver.

(2) Soldering iron.

b. REMOVAL.

Caution: Remove all voltages from the receiver.

(1) Remove the A5588A tube (fig. 135). Follow procedure outlined in paragraph 167.

(2) Disconnect the capacitor terminal from the spring contactor.

(3) Disconnect the other terminal of the capacitor.

(4) Remove the capacitor.

c. REPLACEMENT. Reverse above procedure to replace a capacitor.

165. R-F Primary Coil 37-1

a. TOOLS REQUIRED. (1) Soldering iron.

(2) Screw driver.

b. REMOVAL.

Caution: All voltages must be removed from the receiver.

(1) Remove one lead of the secondary coil.

(2) Remove the secondary coil from within the primary coil.

(3) Remove and tag the leads from the coil center.

(4) Loosen the bolts holding the coil to the mounting clamp.

(5) Remove the coil.

(6) Remove the clamps from the coil.

c. REPLACEMENT. Reverse above procedure to replace r-f primary coil.

166. I-F Coil 43

a. TOOLS REQUIRED. (1) Spintite wrench.

(2) Soldering iron.

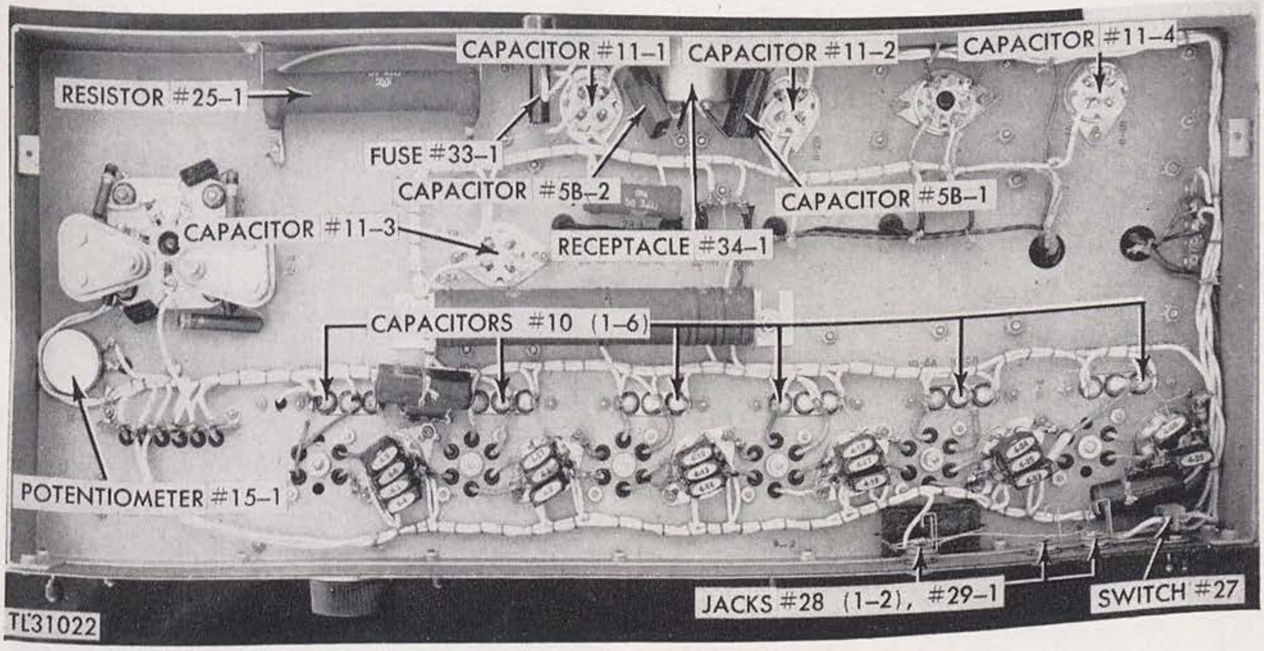

Figure 136. Receiver BC-404-C, bottom view.

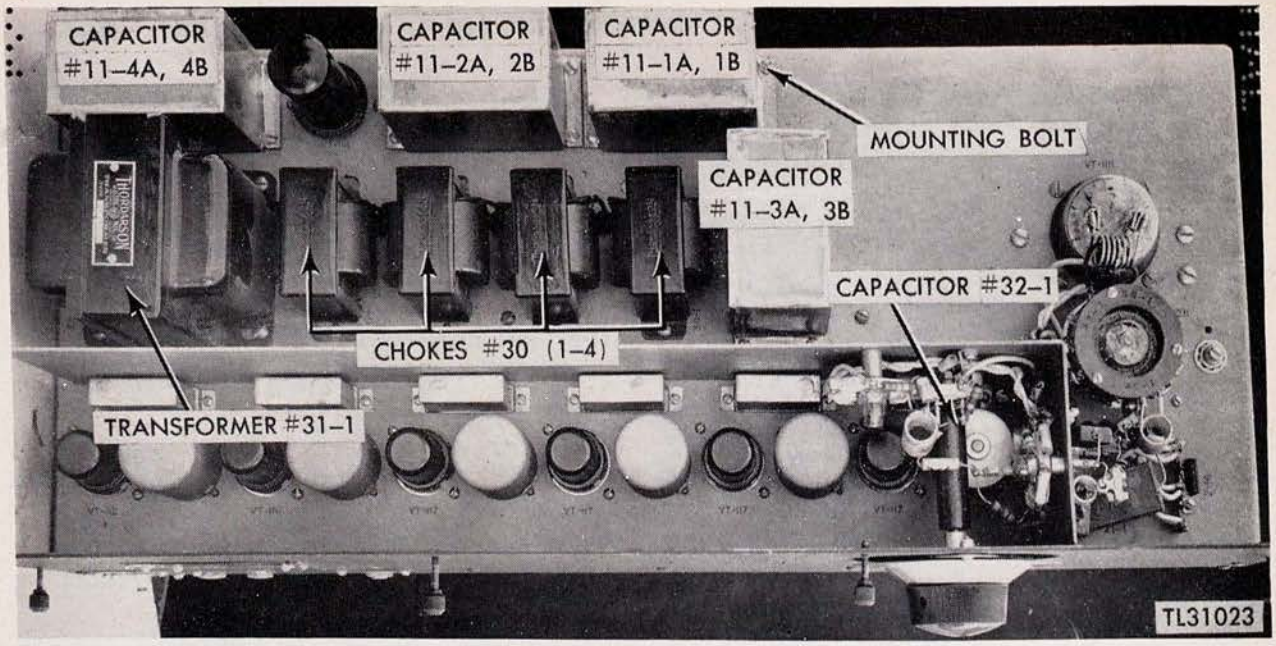

Figure 137. Receiver BC-404-C, top view.

b. REMOVAL.

Caution: All voltages must be removed from the receiver.

(1) Turn the receiver bottom side up.

(2) Remove the leads to the coil and tag the terminals.

(3) Remove the two mounting nuts.

(4) Remove the coil can.

(5) Remove the knurled nuts from the tuning shaft.

(6) Remove the coil.

c. REPLACEMENT. Reverse above procedure to replace i-f coil.

167. A5588A Tube (fig. 135)

a. TOOLS REQUIRED. (1) Screw driver.

(2) Soldering iron.

b. REMOVAL.

Caution: Remove all voltages from the receiver.

(1) *Tube.* (*a*) Remove the three bolts from the socket.

(*b*) Remove the upper section of the socket.

(*c*) Carefully remove the A5588A tube.

(2) *Spring contactor.* (*a*) Remove the lead from the spring contactor.

(*b*) Remove the bolt holding the spring contactor to the socket.

(*c*) Remove the spring contactor.

c. REPLACEMENT. Reverse above procedure to replace spring contactor and A5588A tube.

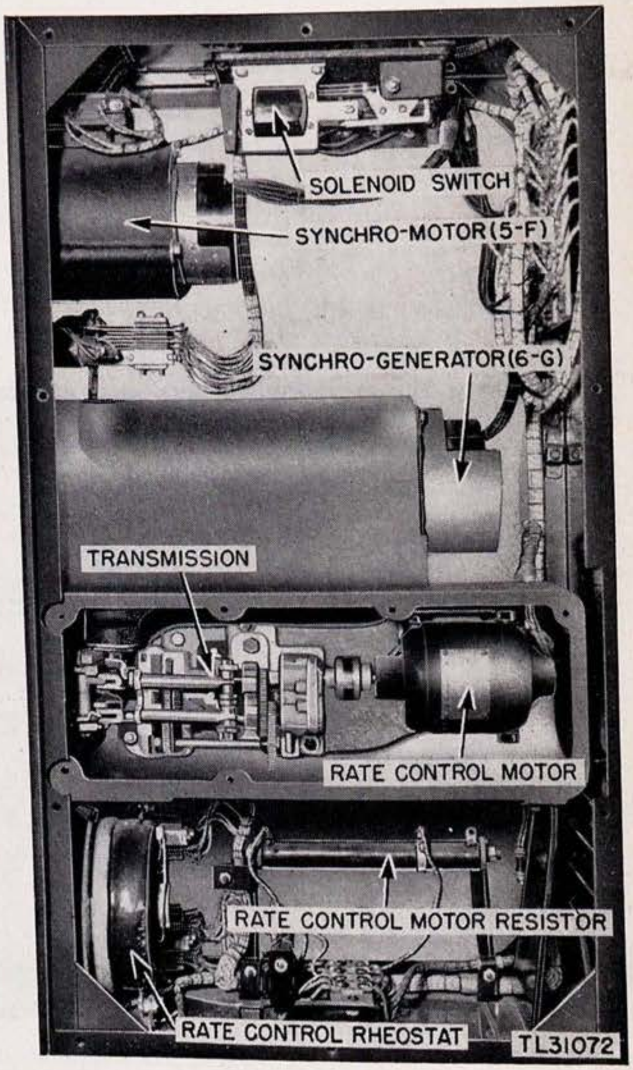

Figure 138. Control Unit BC-1011-A, side panel and access plate removed.

168. Rate Control Rheostat (fig. 138)

a. Tools Required. (1) Small screw driver.

(2) Large screw driver.

b. Removal.

Caution: Remove voltage from control unit.

(1) Loosen setscrew and remove rheostat knob.

(2) Remove nameplate and side panel.

(3) Remove two screws holding rheostat to control panel.

(4) Disconnect wiring and remove rheostat.

c. Replacement. Reverse above procedure to install new rheostat.

169. Rate Control Motor Switch

a. Tools Required. (1) Wrench, socket, ⅝-inch.

(2) Screw driver.

(3) Soldering iron.

b. Removal.

Caution: Remove voltage from control unit.

(1) Remove side panel.

(2) Remove and tag the leads.

(3) Remove locking nut from toggle switch and remove switch.

c. Replacement. Reverse above procedure to install new switch.

170. Rate Control Switch

a. Tools Required. (1) Soldering iron.

(2) Screw driver.

b. Removal.

Caution: Remove voltage from control unit.

(1) Remove nameplate and side panel.

(2) Remove and tag leads.

(3) Remove screws holding switch to control panel and remove switch.

c. Replacement. Reverse above procedure to install new switch.

171. Synchro-Motor (fig. 138)

a. Tools Required. (1) Wrench, Allen, 3/32-inch.

(2) Screw driver.

b. Removal.

Caution: Remove voltage from control unit.

(1) Remove side panel.

(2) Loosen setscrew on plug.

(3) Remove plug and unscrew the nut.

(4) Remove and tag leads.

(5) Remove the three screws holding the motor in the frame, and remove the motor.

c. Replacement. Reverse above procedure to install a new synchro-motor.

172. Rate Control Motor and Transmission (fig. 138)

a. Tools Required. (1) Screw driver.

(2) Wrench, socket, 7/16-inch.

(3) Long-nose pliers.

(4) Wrench, socket, ⅜-inch.

b. Removal.

Caution: Remove voltage from control unit.

(1) Remove side panel.

(2) Remove access plate.

(3) Remove tie-rod bolt.

(4) Remove the four bolts holding the motor base to remove assembly.

(5) Loosen setscrew on the coupling.

(6) Remove and tag the leads.

(7) Remove the four bolts holding the motor to the base and remove the motor.

c. Replacement. Reverse above procedure to install a new motor or transmission being careful to align taper pins on motor base with holes in housing.

Note. Tighten tie-rod bolt and back off ½ turn to free. Adjust tie-rods so that there will be equal clearance at each end of throw to avoid binding.

173. Rate Control Motor Armature Resistor

a. Tools Required. (1) Screw driver.

(2) Wrench, open-end, 7/16-inch.

b. Removal.

Caution: Remove voltage from control unit.

(1) Remove side panel.

(2) Remove and tag the leads.

(3) Remove nut on centering bolt of resistor.

(4) Spring bolt upward through slotted bracket and pull resistor from bolt.

c. Replacement. Reverse above procedure to install a new resistor.

174. Rate Control Motor Shunt Field Resistor

a. Tools Required. (1) Screw driver.

(2) Wrench, open-end, 11/32-inch.

b. Procedure. Follow procedure given in paragraph 173.

175. Solenoid Switch (fig. 138)

a. Tools Required. (1) Screw driver.

(2) Soldering iron.

b. Removal.

Caution: Remove voltage from control unit.

(1) Remove side panel.

(2) Remove and tag the leads.
(3) Remove switch.
c. REPLACEMENT. Reverse above procedure to install a new switch.

176. Synchro-Generator (fig. 138)

a. TOOLS REQUIRED. (1) Small screw driver.
(2) Large screw driver.
(3) Wrench, socket, 3/8-inch.
(4) Wrench, Allen, 3/32-inch.
(5) Wrench, 3/16-inch.
b. REMOVAL.
Caution: Remove voltage from control unit.
(1) Remove side panel.
(2) Remove hand wheel assembly.
(3) Remove locknut and washer.
(4) Remove four screws holding dial to spider.
(5) Remove screws on front of panel supporting synchro-generator and transmission housing.
(6) Free housing from support stand, and turn housing so that the generator can be removed without interference from the panel.
(7) Remove access plate on side of housing.
(8) Loosen setscrew on flexible coupling.
(9) Remove retaining screws and washers.
(10) Remove and tag the leads.
(11) Pull generator from the housing.
c. REPLACEMENT. Reverse above procedure to replace synchro-generator.

177. Silverstat Assembly (fig. 139)

a. TOOLS REQUIRED. (1) Wrench, socket, 3/8-inch.
(2) Wrench, 7/16-inch.
b. REMOVAL.
Caution: Remove voltage from the unit.
(1) Remove top cover plate which gives direct access to the Silverstat plate.
(2) Remove the Silverstat plate.
(3) Remove and tag leads.
c. REPLACEMENT. Reverse above procedure to install the assembly.

178. Variable Resistors

a. TOOLS REQUIRED. (1) Wrench, socket, 3/8-inch.
(2) Wrench, 7/16-inch.
(3) Wrench, 3/8-inch.
(4) Screw driver.
b. REMOVAL.
Caution: Remove voltage from the unit.
(1) Remove Silverstat plate. Follow procedure given in paragraph 177.

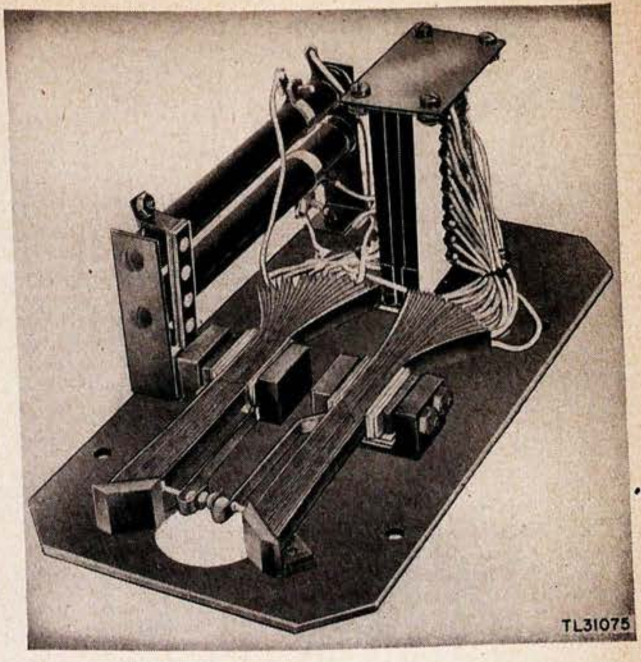

Figure 139. Gyrostat MC–392, silverstat assembly.

(2) Remove the long bolt centering the resistor.
(3) Remove the spacer bar.
(4) Remove and tag the leads.
(5) Lift the resistor from the mounting bracket.
c. REPLACEMENT. Reverse above procedure to install a new resistor.

NOTE. Be sure to install the insulated washers between the ends of the resistors and the mounting bracket.

179. Transformer (fig. 140)

a. TOOLS REQUIRED. (1) Wrench, socket, 3/8-inch.
(2) Wrench, 7/16-inch.
(3) Screw driver.
b. REMOVAL.
Caution: Remove voltage from the unit.
(1) Remove Silverstat plate. Follow procedure given in paragraph 177.
(2) Remove the two screws holding the transformer mounting to the housing.
(3) Remove and tag the leads.
(4) Lift out transformer.
c. REPLACEMENT. Reverse above procedure to install a new transformer.

180. Gyromotor (fig. 141)

a. TOOLS REQUIRED. (1) Wrench, socket, 3/8-inch.
(2) Long-nose pliers.
(3) Key, Unbrako, 5/64-inch.

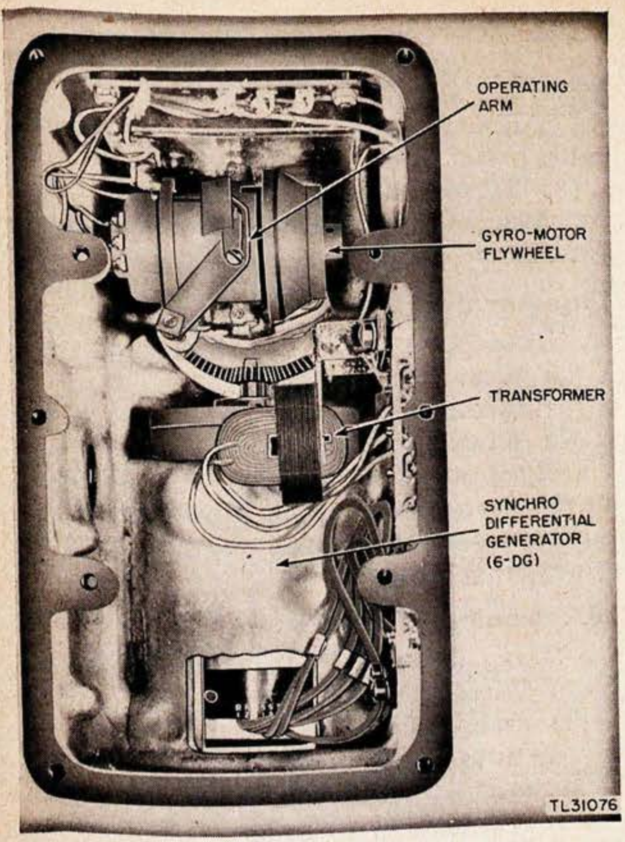

Figure 140. Gyrostat MC-392, silverstat assembly removed.

(4) Screw driver.

b. Removal.

Caution: Remove voltage from the unit.

(1) Remove the top cover and Silverstat plate (par. 177).

(2) Remove the side access plates.

(3) Remove the side cover to gain access to the friction shoes and damping springs.

(4) Release the damping springs.

(5) Loosen the pivot-pin clamping screws and remove the pivot pins.

(6) Remove the stop bar.

(7) Remove and tag the leads.

(8) Remove the gyromotor.

c. Replacement. (1) Place the gyromotor in the proper position.

(2) Connect the motor leads to the proper terminals.

(3) Install the pivot pins.

Note. These should be a push fit and should not be forced.

(4) Tighten the setscrews.

(5) Install the stop bar and damping springs.

(6) Back off the friction shoe adjusting screws until the shoes can be slipped on.

(7) Tighten the screws until there is no side motion.

Note. Be sure that the shoes do not bind the friction plate. Also check to see that the gyromotor is so placed that there will be no contacts closed in the neutral position.

(8) Install the side cover.

(9) Replace the side access plates.

(10) Install the Silverstat plate and replace the top cover.

181. Damping Springs

a. Tools Required. (1) Wrench, socket, 3/8-inch.

(2) Long-nose pliers.

b. Removal.

Caution: Remove voltage to the unit.

(1) Remove the access plate.

(2) Remove the damping springs.

c. Replacement. Reverse the above procedure to install the new damping springs.

Note. Adjust the spring tension so that there will be an equal pull on both sides of the gyromotor.

182. Friction Shoes

a. Tools Required. (1) Wrench, socket, 3/8-inch.

(2) Small screw driver.

(3) Long-nose pliers.

b. Removal.

Caution: Remove voltage to the unit.

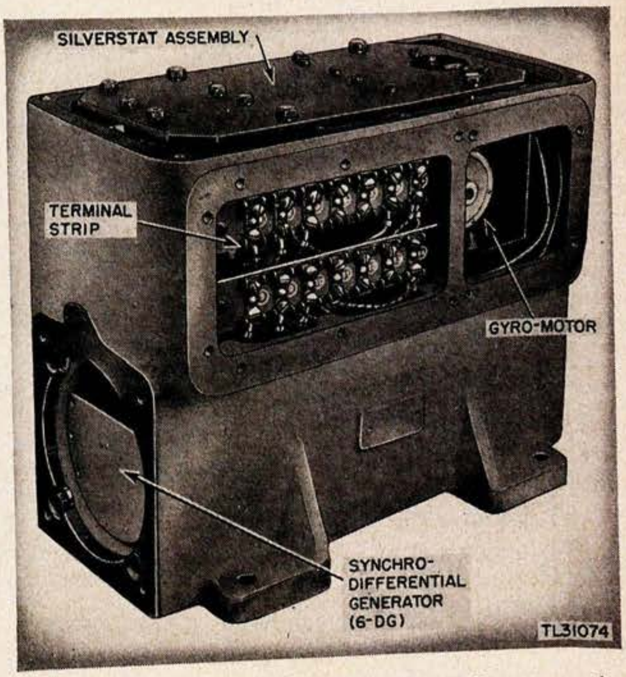

Figure 141. Gyrostat MC-392, side access plates removed.

(1) Remove the access plate.

(2) Back off the adjusting screws for the friction shoes.

(3) Remove the friction shoes.

c. REPLACEMENT. Reverse the above procedure to install new shoes.

183. Synchro-Generator GN–47

a. TOOLS REQUIRED. (1) Wrench, socket, 7/16-inch.

(2) Wrench, Allen, 1/8-inch.

(3) Long-nose pliers.

(4) Screw driver.

b. REMOVAL.

Caution: Remove voltage to the unit.

(1) Remove the side access cover.

(2) Loosen the setscrew on the flexible coupling.

(3) Remove cap.

(4) Remove retaining bolts and washers.

(5) Pull out clamping ring.

(6) Remove and tag the leads.

(7) Remove generator from the housing.

c. REPLACEMENT. Reverse above procedure to install a new generator.

184. Antenna Drive Motor MO–30

a. TOOL REQUIRED. 7/16-inch socket wrench.

b. REMOVAL.

Caution: Remove voltage from the unit.

(1) Remove the complete gear case from the motor frame.

(2) Remove the mounting bolts.

(3) Remove and tag the leads.

(4) Remove the motor.

c. REPLACEMENT. Reverse above procedure to install a new motor.

185. Disassembly of Drive Motor

a. TOOLS REQUIRED. (1) Screw driver.

(2) Wrench, box, 9/16-inch.

(3) Bearing puller.

(4) Wrench, socket, 9/16-inch.

b. REMOVAL. (Par. 184). (1) Remove brush covers.

(2) Disconnect the brush and field leads with a screw driver and pull the brushes from the brush holders.

(3) Remove the brush and bracket.

(4) Remove the six bolts in the rear end bracket.

(5) Pull the bracket from the shaft and pull the shaft from the motor frame. Tap flange gently while pulling on the bracket.

(6) Remove the bearings from the shaft.

NOTE. Care should be used so that no pressure is applied to the outer race of the bearing. Wrap the bearings in wax paper to keep them free from dirt.

(7) Remove the bolts holding the field coils to the frame.

(8) Remove the field coils and shoes.

c. REPLACEMENT. Reverse above procedure to assemble the motor.

186. Armature

a. TOOLS REQUIRED. (1) Screw driver.

(2) Wrench, box, 9/16-inch.

(3) Bearing puller.

(4) Wrench, socket, 9/16-inch.

b. REMOVAL. See paragraph 185. Disassemble motor in accordance with above instructions.

c. REPLACEMENT. Install the new armature and assemble the motor.

187. Bearings

a. TOOLS REQUIRED. (1) Screw driver.

(2) Wrench, box, 9/16-inch.

(3) Bearing puller.

b. REMOVAL. See paragraph 185. Disassemble motor in accordance with above instructions.

NOTE. Care should be exercised so that no pressure is applied to the outer race of the bearing.

c. REPLACEMENT. Install the new bearings taking care not to damage them, and assemble the motor.

188. Brush Holders

a. TOOLS REQUIRED. (1) Screw driver.

(2) Wrench, box, 9/16-inch.

b. REMOVAL. See paragraph 185.

(1) Remove the brush-end bracket as described in above instructions.

(2) Remove the brush holders and insulation.

c. REPLACEMENT. Install the new brush holders and assemble the motor.

189. Commutating or Main Field Coils

a. TOOLS REQUIRED. (1) Screw driver.

(2) Wrench, box, 9/16-inch.

(3) Bearing puller.

(4) Wrench, socket, 9/16-inch.

b. REMOVAL. See paragraph 185. Disassemble the motor as described above.

c. REPLACEMENT. Install the new coils and assemble the motor.

190. Motor-Generator MG–21 (fig. 142)

a. TOOLS REQUIRED. (1) Large screw driver.

(2) Small screw driver.

(3) Mallet.
(4) Wrench, open-end, 5/8-inch.
(5) Wrench, 1-inch box.
(6) Pliers.
(7) Bearing puller.

b. Removal and Disassembly.

Caution: Remove voltage to the unit.

(1) Remove and tag all leads.

(2) Remove bolts holding assembly to frame.

(3) Disconnect the field and brush leads from the brush terminals.

(4) Remove the brushes from the brush-holders.

(5) Remove the bolts on the brush-end bracket and tap gently on the flange with the mallet until the bracket is loose and can be pulled off.

(6) Remove the four bolts holding the exciter field frame to the motor frame and remove the exciter unit by tapping gently with the mallet.

(7) Remove the shaft nut.

(8) Remove the expansion lockwasher.

(9) Pull the armature and commutator from the shaft.

(10) Remove the nuts holding the bearing support bracket to the motor frame.

(11) Tap the bearing support bracket gently with a mallet until it is free from the motor frame.

(12) Pull the frame from the shaft.

(13) Remove the bearing.

Caution: Care should be used in removing the bearings so that no pressure is applied to the outside race. Wrap the bearing in wax paper to protect it from dirt.

(14) Disassemble the other end of the unit following the instructions given above.

(15) Pull the shaft from the motor frame.

c. Reassembly and Replacement. Reverse above procedure to assemble and install the motor generator set.

191. Brush-Holder Springs

a. Tools Required. (1) Screw driver.
(2) Mallet.
(3) Wrench, open-end, 5/8-inch.
(4) Long-nose pliers.

b. Removal. See paragraph 190*b* for instructions on removal and disassembly of motor generator set.

Caution: Remove voltage to the unit.

(1) Remove end bracket.

(2) Remove cotter key and spring.

c. Replacement. Reverse above procedure to install new brush-holder springs.

Note. To increase the compression of the spring, move the free end to another notch on the spring clip.

192. Exciter Field Resistor

a. Tools Required. (1) Large screw driver.
(2) Small screw driver.

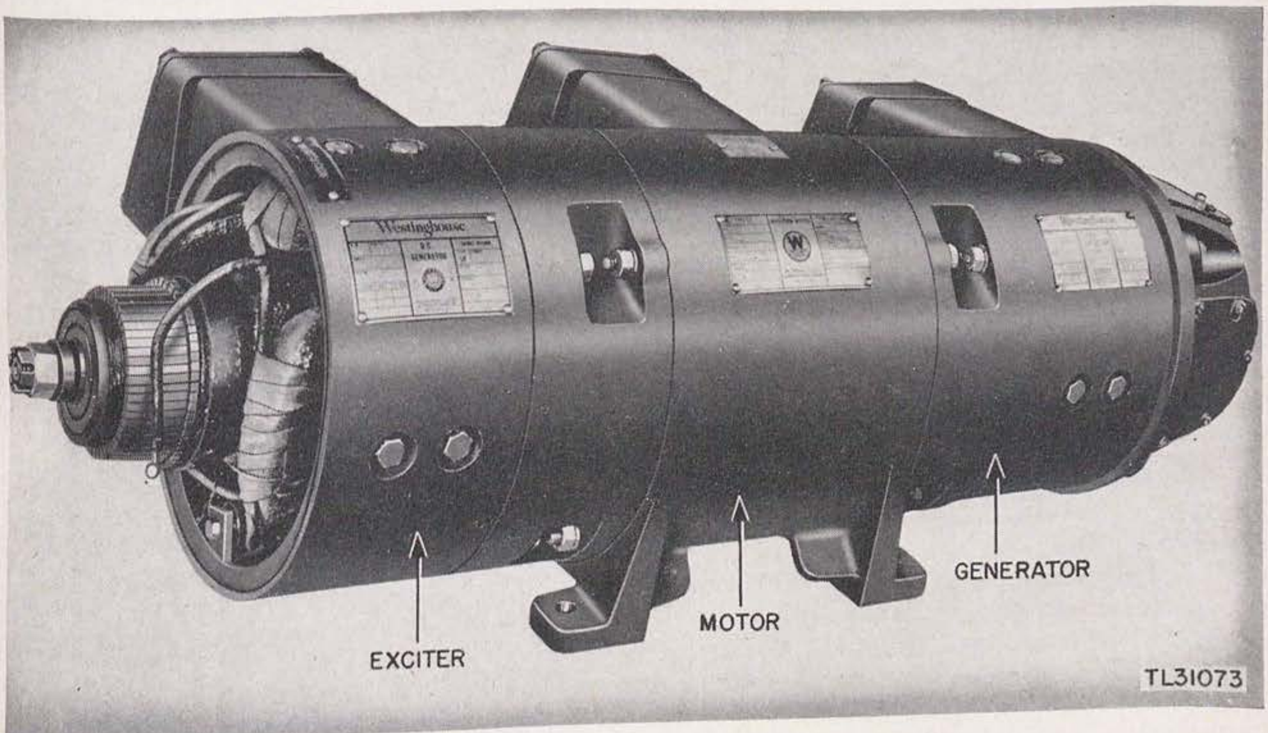

Figure 142. Motor-generator MG–21, end housing removed.

(3) Mallet.
(4) Wrench, open-end, $\frac{5}{8}$-inch.
(5) Wrench, box, 1-inch.
(6) Pliers.
(7) Soldering iron.
(8) Bearing puller.

b. REMOVAL. See paragraph 190*b* for instructions on removal and disassembly of motor generator set.

Caution: Remove voltage to the unit.

(1) Disassemble the unit as described.

(2) Remove screws holding resistor to the frame.

(3) Remove and tag the leads.

c. REPLACEMENT. Reverse procedure to install a new resistor.

NOTE. Be sure to test new resistor before assembling the unit.

CHAPTER 6

EMERGENCY REPAIRS

193. Introduction

a. An emergency repair is simply a repair which will keep the station operating after a failure has occurred. Although chapter 5 states that in replacing a defective part, a new part should be used, occasionally these are not available. The lack of a new part need not keep the station off the air, for there is usually a way of repairing or clearing the defect. It is the purpose of this section to describe steps which can be taken in emergencies to repair certain parts temporarily. These, of course, must be replaced as soon as a new part is received.

b. The number and methods of emergency repair are too numerous for complete coverage in this book. However, the suggestions included cover a variety of parts and should be sufficient for a clever repairman. By reading through the methods, examining the circuits and parts, and tying in the function of the part, a decision can be made as to whether the equipment can operate without the part or whether some procedure can be applied to repair it.

c. A repairman's ingenuity is the only limiting factor controlling the number of emergency repairs. Simply because a container is sealed does not mean that a repair is impossible. If no replacement is available and if the container content can be repaired, open it in any practical way and repair the unit. Should it be impossible to use the container again, find a way of replacing that too. Keep in mind that the equipment must be in operating condition at all times and if part failure means shut-down because of lack of replacements. try anything within reason to repair it.

d. Neatness and practicality are as important in making these temporary repairs as in permanent repairs. Neatness applies not only in the physical sense, but also electrically. Properly placing a part may mean perfect operation, while simply throwing it into place may have as bad an effect as a defective part.

e. Before attempting an emergency repair, the repairman must know that what he is doing will not affect any other parts in the set and will not be harmful to station personnel. Be sure that all power has been removed from the component and that all capacitors within the component have been discharged before attempting a repair. The cautions listed in the introduction of chapter 5 should be reviewed. Failure to follow these cautions may result in serious injury or loss of life.

Caution: Approval of the person in charge must be obtained before any emergency repairs involving circuit changes are attempted.

194. Filter Capacitors

a. A considerable amount of freedom is found in the selection of a rectifier filter capacitor. Certain limitations must be observed. When replacing a filter capacitor with another of the same type, it is best to choose a replacement having a value as close as possible to the original. In choosing the value, it is best to use one having a higher rather than a lower capacity. With a replacement having a lower capacity, regulation may become poor and the a-c ripple will increase. A capacitor that is much too large will also affect circuit operation and will be unsatisfactory.

b. Be extremely careful of the voltage ratings of capacitors in filter circuits. Usually, a capacitor is labeled with two voltage ratings, the working voltage and the peak-surge voltage. A capacitor having a working voltage approximately 30 percent above the voltage measured in the circuit and a peak-surge voltage approximately 50 percent above the working voltage of the circuit, should be used.

c. If it is impossible to provide a repair or any form of replacement for a filter capacitor, it may be possible to operate without it. Remove the defective capacitor, check all other parts in the supply and points being fed, apply power and make checks for ripple voltage and circuit operation. It is natural that the ripple voltage should increase, but if circuit operation is not affected to any great degree, operate without the capacitor. Always check the other capacitors in the filter circuit a few hours after operating in this way to see that they are not hot and are carrying the load satisfactorily. If circuit operation is affected, it may be possible to borrow a capacitor from one of the other power supplies where a-c ripple will not affect operation. As soon as a replacement part is received, replace the capacitor.

195. Bypass and Blocking Capacitors

a. Careful thought must be applied to the choice of capacitors being used for replacement since apparent replacements can have totally different properties. Not only the working voltage and value, but the type and construction must be compared to the defective part being replaced.

b. An examination of the different types of capacitors will indicate the properties of each. The construction of each is totally different and if each were to be substituted in a circuit, the results would be different even though the values and ratings were the same.

(1) An air capacitor is the simplest type, for it consists of metal plates suspended in air. The capacity is determined by the number and size of plates and the air space between them. Since the capacity obtained in this manner is low, it is rarely used for a fixed capacitor. The greatest use is in the form of a variable capacitor for tuning purposes or for setting desired capacity values.

(2) A mica capacitor consists of plates of metal separated by thin sheets of mica with the whole covered by insulating material. This type is an approach to a pure capacitor with very small leakage. It is extremely useful as a fixed compact capacitor with low capacity values and fairly high working voltages.

(3) A paper capacitor is made of two sheets of thin metal foil separated by waxed paper. These can be packed in any suitable way, the roll being used for the smaller sizes. This type is no longer a pure capacitor, for the leakage has been increased by the use of waxed paper and the roll creates inductance. Although the inductance is small, it is sufficient to distort waveshapes and create other electrical effects. By special winding, the inductance can be down to a fairly small value. Capacitors of this type have "noninductive" written on the label.

(4) An oil-filled capacitor is made in the same way as the paper capacitor except that the unit is placed within a container filled with oil. This provides low leakage and high working voltage. This type is usually used in filter circuits of high voltage rectifiers.

(5) An electrolytic capacitor can take two forms, a wet or dry electrolytic. One manner of construction is a metal rod covered by a can filled with a paste or solution. The other type is a construction similar to the paper capacitor, except that the paper is impregnated with the electrolyte. The first of these types is usually used for the wet electrolytics containing a solution; the other is used for dry electrolytics containing a paste. The materials used in this type of capacitor cause a high resistance and capacity to be created when one polarity is applied and a very low resistance with practically no capacity on reversal. It is this property that makes an electrolytic totally different from the other two types; it cannot be used for ac, but can be used in circuits having dc or pulsating dc.

c. For emergencies, it may be possible to construct the following capacitors with any materials available. The capacity will be determined by the type of dielectric (materials between plates), the size, and number of plates. An air capacitor can be made by supporting two metal plates on insulators with a small gap between the plates. This is an air capacitor and will have a very small value of capacity.

d. Another form of small capacitor is two lengths of insulated wire twisted together. If the capacity is too high, wire cutters can be used to clip off some of the length. Be sure no voltages are present when cutting.

Caution: The insulation on the wire must be able to withstand the peak voltage of the circuit.

e. When connecting coupling capacitors into circuits, avoid long leads. The best connection is one having leads no longer than the original leads. Extra long leads tend to affect the signal properties and can become a source of extraneous signals.

f. There is no rule of thumb that can apply to the choice of capacitors for use in signal circuits. Since the signals used consist of sharp pulses, the harmonic content is very high. By improper choice of capacitor values, normal input pulses can be distorted into broad, flat pulses or high, narrow pulses. If these types of pulses are used in place of the normal pulse in the keyer or oscilloscope, improper operation will take place.

g. Not only the coupling capacitors, but also the bypass capacitors affect the waveforms in signal stages. Extreme caution need not be exercised for the total effect is not as great as that in the grid-coupling circuit, yet a certain amount of care is necessary. When a replacement using a different value or type of capacitor has been made, make a careful test of the stage waveforms to be certain that the waveforms are not being distorted.

h. A simple method of obtaining a desired capacity value is to combine a number of capacitors in series, parallel, or a combination of both. In some cases, this may become undesirable because of bulk and circuit influence. If several capacitors are combined, the outside area of the whole increases and an additional capacity is added by the proximity of the combination to the chassis with a resultant upset of circuit conditions.

i. Whenever capacitors are to be combined, choose the values carefully and be positive the method of combining them will use the least number and will make the most efficient replacement. Place the combination in the chassis so that it can be moved easily. In this way, the temporary connection can be used while the circuit operation is being checked. If the set operates properly, the connections can be made permanent. If the operation is incorrect, then the combination can be disconnected and modified or moved. In r-f circuits, even the location of the capacitor is very important.

196. Chokes

a. Low-voltage rectifier chokes can be eliminated by connecting a resistor in place of the choke. It may be necessary to experiment with resistor values before the correct one is found. From the trouble charts, find the voltage output of the rectifier under normal operating conditions. Next, determine the amount of current drawn from the rectifier. The trouble charts will give the voltage at the input to the choke. Subtract the voltage output from the voltage input to the choke to find the amount of voltage dropped at the choke. Apply Ohm's law to find the value of resistance needed to create the same drop when placed in the choke position $\left(R = \frac{E}{I}\right)$. Using the voltage drop in volts and current flow through the resistor in amperes, take the product to find the amount of power dissipated $(P = EI)$. This is now multiplied by $1\frac{1}{4}$ to find the power rating needed for a resistor in that circuit.

b. High-voltage chokes cannot be eliminated. If one should break down and no replacement is available, it will be necessary to dismantle the choke and find the burned-out section. This must then be rewound.

Caution: Do not attempt to operate without a choke in the high-voltage rectifier.

197. Bleeder Resistors

a. Since a bleeder resistor forms a protective device, it must be maintained in the circuit. A burned-out resistor must be replaced with another having the same ratings. If such a unit cannot be obtained, it can be made by combining a number of resistors in series, parallel, or series-parallel.

b. When selecting the resistors to be combined, remember that the total amount of power that can be dissipated in the combination is the sum of the power ratings of all resistors. If a resistor having a power rating of 100 watts and a resistance of 1,000 ohms is to be replaced by two resistors having 500 ohms each, then the power rating for each resistor need be only 50 watts.

c. The bleeder resistors in the high-voltage rectifier would be rather difficult to replace by combining a series of smaller resistors. If one should burn out, remove the defective unit, solder a heavy piece of copper wire between the terminals, and replace the unit in the rack. When this is done, it is essential that the rectifier be operated at a lower output voltage.

198. Resistors

a. Resistor values in signal circuits are as important as capacitors, for they also affect circuit operation. If a resistor with a value higher or lower than the original part is substituted, the formulas contained in paragraph 5 can be used to find the value needed in the circuit.

b. The bias resistors in the cathode circuits or in the power supplies must be replaced by resistors having values within 10 percent of the value of the originals. It is the voltage developed across these resistors that controls the tube and circuit operation. The plate and screen resistors, however, do not require the exact considerations necessary for cathode resistors, but should not vary more than 20 percent from the original values.

199. Tubes

a. If the filament of one tube in the high-voltage rectifier should fail, or some other condition prevents the use of a tube, half-wave operation *at reduced voltage* is suggested. Remove the defective tube, following the procedure outlined in paragraph 132, WL–531 Tubes; then apply the power. Watch the currents carefully so as not to overload the remaining tube.

b. Operation of the keyer rectifier can be continued if one or more of the mercury-vapor rectifier tubes should fail. If only one should fail, continue with voltage available, but be sure to reduce the high-voltage rectifier output. The correct high voltage can be ascertained by watching the meters on the units closely while the voltage is raised. If two of the rectifier tubes should fail, a voltage output may or may not be available. If there is a voltage output, operate as stated for a one-tube failure. However, if no output voltage is available, it may be necessary to change the positions of the good tubes until the proper positions are found for voltage output. The defective tubes must be taken out of the circuit. Continue operation with the voltage output available and reduce the high voltage accordingly. *Be positive that all voltages have been removed and all capacitors discharged before attempting any changes.* Serious injury or death can result from contact with high voltages present.

c. Full-wave rectifiers contained in one tube such as the low-voltage power supplies must be replaced when they fail. If no duplicate replacements are available, the only procedure possible would be to replace the defective tube by another type with similar power handling capacity.

d. The full-wave Rectifier Tube 5T4 used in the low-voltage supplies can be replaced with any of the tubes listed in the following table, provided that the changes in socket connections are accomplished.

Replacement	Change socket connection	
	From	To
5U4-G....................	None	None
5X5-G....................	2	7
	4	3
	6	5
5Z3-G*....................	2*	1
	8*	4
	4*	2
	6*	3

*The type 5Z3-G tube uses a four-prong socket. The changes specified refer to the change in lead connections from the eight-prong socket to the four-prong socket.

e. If no replacements for a tube are available, it may be possible to bypass that stage. Never make any circuit changes without knowing exactly what effect the change will have on circuit operation. This applies specifically to stage bypassing. If a tube burns out and an attempt to bypass that stage is made, the station may become totally inoperative. It is highly essential that the oscillators and pulse forming circuits are not changed in any way. Amplifiers can be bypassed provided the signal level is high enough for circuit operation without that tube. The simplest method of bypassing a stage is to remove the tube, disconnect the plate-load and grid-load resistors and the grid-coupling capacitor to the preceding stage. Next, connect a lead between the plate of the stage preceding the defective stage and the grid of the stage following. The lead must follow the same path of the original connections.

f. The tubes used in the signal stages can be replaced with the following tubes plus a few changes in socket connections.

Tube	Replacement	Change socket lead	
		From	To
6SJ7............	6J7............	1	1
		2	2
		3	5
		4	Cap
		5	8
		6	4
		7	7
		8	3
6SJ7............	6C6*............	1*	Gnd
		2*	1
		3*	4
		4*	Cap
		5	5
		6*	3
		7*	6
		8*	2
6F6............	42*............	1*	Gnd
		2*	1
		3*	2
		4*	3
		5*	4
		6*	(Insulated Support)
		7*	6
		8*	5
6C5............	6J5............	No	changes required.
6SK7............	6K7............	1	1
		2	2
		3	5
		4	Cap
		5	8
		6	4
		7	7
		8	3
6K7............	6SK7............	1	1
		2	2
		3	8
		4	6
		5	3
		6	(Insulated Support)
		7	7
		8	5
		Cap	4

Tube	Replacement	Change socket lead	
		From	To
6C5	6J7[a]	1	1
		2	2
		3	3
		4	(Insulated Support)
		5	Cap
		6	(Insulated Support)
		7	7
		8	8
6C5	6SJ7[b]	1	1
		2	2
		3	8
		4	(Insulated Support)
		5	4
		6	(Insulated Support)
		7	7
		8	5
6C5	6C6[c]	1*	Ground
		2*	1
		3*	2
		4*	(Insulated Support)
		5*	Cap
		6*	(Insulated Support)
		7*	6
		8*	5
6C5	77[d]	1*	Ground
		2*	1
		3*	2
		4*	(Insulated Support)
		5*	Cap
		6*	(Insulated Support)
		7*	6
		8*	5
6SJ7	6K7	1	1
		2	2
		3	5
		4	Cap
		5	8
		6	4
		7	7
		8	3
6SJ7	6SK7	None	

* For these replacements, a socket change from an octal to a 6-prong socket is necessary.

a The replacement tube is a pentode, while the 6C5 is a triode. This necessitates a connecting link on Terminals 3, 4, and 5 for the pentode to operate as a triode.

b The replacement tube is a pentode, while the 6C5 is a triode. This necessitates a connecting link between Terminals 3, 6, and 8 to convert the pentode to triode operation.

c The replacement tube is a pentode while the 6C5 is a triode. This necessitates a connecting link between Terminals 2, 3, and 4 to convert the pentode to triode operation.

d The replacement tube is a pentode while the 6C5 is a triode. This necessitates a connecting link between Terminals 2, 3, and 4 to convert the pentode to triode operation.

g. In general, low cut-off tubes can be replaced by sharp cut-off tubes. This will apply reasonably well in certain circuits, but circuit control may become quite critical and minute adjustments will be necessary. Because of the tube characteristics, signal distortion will take place on high-level signals. This can be remedied only by circuit changes to establish new operating conditions. In some cases, this can be prevented by replacing the defective tube with a substitute from a low signal stage, and replacing the low signal stage tube with the sharp cut-off tube.

200. Power Transformers

If a power transformer in a rectifier circuit should fail, it will be necessary to dismantle the transformer, find the break or defect, and rewind it. Power transformer leads may be repaired if the leads are damaged on the outside of the transformer. These leads often short to the chassis or between one another. This is caused by the insulation of the leads cracking or deterioration. An object of this kind may be repaired by cutting out the defective section of the lead and replacing the section with a new lead. A transformer having its winding shorted to the core, may in some cases be made to operate temporarily. This is done by insulating the transformer mounting to the chassis, i. e., the case of the transformer is mounted above ground.

201. I–F Coupling Units

The coils found in the i–f stage can be replaced by emergency units wound in the field. It may be necessary to experiment with different coils before the correct inductance is found. It would be best to duplicate the winding found on the present units as closely as possible. If a coil cannot be wound properly, substitute a resistor of approximately 6,000 ohms. Difficulties may arise with this type of repair, but it may be possible to find a resistor having a very low capacity effect. The last solution is to bypass the stage completely. In each of these repairs, a decrease in signal strength will be noticed.

202. Meters

A meter is a delicate instrument and never should be taken apart. If a meter should fail, it is best, if it is at all possible, to get along without it rather than to open it. The most insignificant slip in meter repairing may mean a total loss, for the experienced workers will not be able to repair it when it is sent to them. Operation without meters can be continued in most cases. These are listed in the following paragraphs with the means of operation.

a. A-C LINE VOLTMETER. If the a-c line voltmeter on the generator power panel should fail, operation can be continued by checking the rectifier line voltmeter. This meter should indicate 118 volts, ± 2 volts. Although this checks the voltage of one phase only, safe operation can be maintained if an ordinary test voltmeter is connected in place of the a-c line voltmeter at least once a day to see that the phases are properly balanced. If one or two positions of the a-c line-voltmeter selector switch do not supply a meter indication, the remaining positions will be a sufficient check. It is best to apply a test voltmeter to the phase on which the meter does not read to check the balance.

b. A-C LINE AMMETER. A burned-out a-c line ammeter can be supplemented by the log readings obtained for the other current meters. If all other meters read correctly and the a-c line voltage at the generator power panel is correct, it can be assumed that correct operation is taking place.

c. FREQUENCY METER. The frequency of the a-c voltage can be checked on the water cooler if the frequency meter should fail. Check the readings of the water pressure meter on the log sheets over a period of time having the water valves set at the present position. These must not be changed. Note how the water pressure ties in with the frequency generated. By watching the water pressure meter carefully, the frequency can be maintained fairly constant.

d. RECTIFIER LINE VOLTAGE METER. The rectifier line voltage can be checked by reading phase one on the a-c line voltage meter of the generator power panel. Check the readings of the other rectifier meters with those recorded on the log sheets.

e. RECTIFIER LINE CURRENT METER. Read the phase one current of the a-c line current meter of the generator power panel. This phase feeds the rectifier and will provide a check on the rectifier line current. Also check the other meters on the rectifier panel.

f. RECTIFIER FILAMENT HOUR METER. If this meter should fail, it will be necessary to time the period in which the rectifier is operating by means of the station clock.

g. RECTIFIER FILAMENT VOLTAGE. Check the line voltage before attempting this procedure. The FILAMENT VOLTAGE CONTROL is first set at approximately two-thirds full rotation. Next, the high voltage is applied and the rest of the start procedure is followed. When the transmitter is operating properly, carefully decrease the rectifier filament voltage while watching the OUTPUT VOLTAGE meter. The correct setting for the control is the point slightly above where the output voltage begins falling.

h. RECTIFIER OUTPUT VOLTAGE. The OUTPUT CURRENT meter on the rectifier or the PLATE CURRENT meter on the transmitter can be used to set the high voltage. The starting procedure must be followed to the point where the high voltage is to be adjusted. The meter indications on *all* station components are then checked against those entered in the log sheets. If any meters do not indicate the same values as those recorded, they must be compensated. Once all the meters are set at the correct values, the high voltage can be applied. At this time, watch the OUTPUT CURRENT and PLATE CURRENT meters closely. As soon as the indications are the same as those recorded in the log, the high voltage is at approximately the correct value and station operation can continue.

i. RECTIFIER OUTPUT CURRENT. The PLATE CURRENT meter of the transmitter will read the same value without the additional leakage current as the OUTPUT CURRENT meter on the rectifier.

j. KEYING SUPPLY VOLTAGE. This voltage can be set by means of the BIAS VOLTAGE meter. Be sure the BIAS VOLTAGE CONTROL is set completely clockwise before applying the supply voltage. As the KEYING SUPPLY VOLTAGE CONTROL is turned clockwise, the BIAS VOLTAGE meter will indicate the proper voltage. If both meters have failed, the KEYING SUPPLY VOLTAGE CONTROL can be set at the correct division from the log records. If the meter has failed, the grid bias voltage can be set by reading the PLATE CURRENT meter on the transmitter. With all other meters indicating the value previously recorded in the log, the BIAS VOLTAGE CONTROL can be turned counterclockwise until the PLATE CURRENT meter indicates the same value as that recorded in the log.

k. TRANSMITTER FILAMENT CURRENT. The filament current can be set at approximately the correct value by the a-c line current meter. As the transmitter filament current control is adjusted, phase three on the a-c line current meter is carefully watched. The final setting of the control is established by the recorded readings for that meter on the log. An additional indication is the click of the keyer relay when the transmitter filament current is approximately 150 amperes.

l. TRANSMITTER PLATE CURRENT. The OUT-

PUT CURRENT meter on the rectifier can be used to serve as a plate current meter. These meters will indicate practically the same values. The log should be checked to see that there is not a too marked difference.

203. Transtats and Rheostats

Both parts are repaired in practically the same manner. If one section should be open, a heavy shorting link is connected across the burned or broken section to complete the circuit. After this link is added, the transtat can be returned to circuit operation. Care must be exercised when making this repair, for if too many defective sections have been shorted, the unit will not operate. After the link is added to the rheostat, an additional external resistor having approximately the same resistance as the burned-out section must be connected in series. This resistor must have the correct power handling capacity. If this cannot be determined easily, the current flowing through the circuit can be used to find the amount of power that will be dissipated in the resistor. The power is the product of the current squared and the resistance ($P = I^2R$). This must have a 25-percent safety factor added to it.

204. Alignment of Receiver Without Test Equipment

a. Remove the receiver from its case, return to operating position supporting the receiver on blocks 2 by 4 inches. The receiver should be raised high enough to allow access to the i-f transformers.

b. Connect the receiver in the conventional manner to the antenna with the spark gap in its normal operating position.

c. Place the complete radar station on the air.

d. Tune the receiver and the receiver shorting bar for maximum echo.

e. Tune the plate coil (37–1) of the first r-f stage for maximum echo, by squeezing or spreading the coil turns with two insulating sticks. This can be done if the operator is careful not to come in contact with the live potentials (230 volts to ground). Retune the receiver for maximum echo (oscillator variable capacitor).

f. Move the position of the second r-f grid coil for maximum echo. This is a very delicate operation and a slight difference in the position of this coil has a very great effect upon the sensitivity of the receiver. Retune the receiver for maximum echo (oscillator variable capacitor).

g. Tune the second r-f plate coil (40–1) for maximum echo, by squeezing or spreading the coil with two insulating sticks. This coil is 350 volts to ground. Tune the oscillator variable capacitor for maximum echo.

h. Adjust the outside focusing-cylinder potentiometer for maximum echo.

i. Move the position of the converter coil (41–1) for maximum echo. The relative position of this coil to the second r-f plate coil, has quite an effect on the echo. Compressing or lengthening the coil will give a sizeable increase in echo gain. Very minute movements of this coil have great effect on the echoes.

j. Tune the i-f section for maximum echo beginning with the first and tuning towards the last. It is not necessary to retouch them after they have once been peaked; no marked advantage can be gained by doing so in respect to the maximum echo.

k. If unsatisfactory results are obtained, and the receiver cannot be aligned or made to show gain, check the following:

(1) Resistance of resistors 13–1 and 13–2. If less than 100,000 ohms each, sensitivity will be low.

(2) Disassemble input capacitors 12–1 and 12–2. See whether they have arced over; if so, replace the mica sheets and reassemble.

(3) Electrical connections at ends of all r-f coils.

(4) Check the first and second r-f tubes.

CHAPTER 7

MAINTENANCE PARTS LIST

205. Index to Major Components

Major Component	Symbol
Antenna AN–118	AN
Antenna AN–140	AN
Antenna Mount Trailer K–64–A	K64
Control MC–298–( )	C
Cords	CO
Frequency Meter BC–439	FM
Interference Reducer BC–736–A	IR
Keying Unit BC–758–A	KU
Keying Unit BC–402–B	KU
Modulator BC–424–A (Tweeter)	TW
Operating Truck K–30	K30
Operating Truck K–62–A	K62
Oscilloscope BC–403–( )	OS
Power Panel BD–99–A	BD99
Power Panel BC–111–A	BD111
Power Truck K–31–( )	K31
Pulse Indicator BC–780–A	PI
Receiver BC–404–( )	R
Rectifier RA–60–A	Rect
Rectifier RA–39	Rect
Trailer K–22–B (Antenna Mount)	K22
Transmitter BC–785–A	T
Transmitter BC–405–( )	T
Water Cooler RU–4–A	WC
Water Cooler RU–3–B	WC

In the parts list, an asterisk (*) denotes the availability of the part in the echelon under which it appears.

206. Maintenance Parts List for Radio Sets SCR–270–( ) and SCR–271–( )

Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock: 1st ech	Organization stock: 2d ech	3d ech	4th ech	Depot stock
	1F681.1	T	BRAID: cable shielding; 3/8" ID; Beldon Braid Co.	7	...	...	...	*	*
	3E3139-492	CO	CABLE: 1-conductor; bare; #4 stranded	160	...	...	...	...	*
	1B808.2	CO	CABLE: 1-conductor; #8 stranded; S. B. R. C.; 600 v.	100	...	...	...	...	*
	1B808.5	CO	CABLE: 3-conductor; #8 stranded; S. B. R. C.; 600 v.	100	...	...	...	...	*
	1B810.3	CO	CABLE: 1-conductor; #10 copper stranded; S. B. R. C.; 600 v.	110	...	...	...	...	*
	1B7810-3	CO	CABLE: 3-conductor; #10 stranded; R. C.; 600 v.	100	...	...	...	...	*
	1B812.1	CO	CABLE: 1-conductor; #12 stranded; S. B. R. C.; 600 v.	200	...	...	...	...	*
	1B812.11	CO	CABLE: 2-conductor; #12 stranded; R. C.; 600 v.	150	...	...	...	...	*
	3E3141.4-1368	CO	CABLE: 1-conductor; #14 stranded; S. B. R. C.; 600 v.	250	...	...	...	...	*
	1B7814-3	CO	CABLE: 3-conductor; #14 stranded; R. C.; 600 v.	175	...	...	...	...	*
	2C6382.B/C2	T	CABLE: lead covered	275	...	...	...	...	*
	1B3341	T	CABLE: ignition cable #341–D; Packard #500 as made by Packard Elec. Division of GMC.	15	...	...	...	...	*
	1B7814-7	CO	CABLE: 7-conductor; #14 stranded; R. C.; 600 v	100	...	...	...	...	*
	1B7814-2	CO	CABLE: 2-conductor; #14 stranded; 600 v.	250	...	...	...	...	*
	3E4163-1	CO	CABLE: 2-conductor; #16 stranded	30	...	...	...	...	*
	1B818.22	CO	CABLE: 1-conductor; #18 stranded; shielded; R. C.; 600 v.	50	...	...	...	...	*
	1A804.2	CO	WIRE: bare; #4; solid copper; hard drawn	100	...	...	...	...	*
	1B131	KU	WIRE W–131	150	...	...	...	...	*
	1B814.31	....	WIRE: 2-conductor; #14; switchboard	150	...	...	...	*	*
	1B818.4	KU	WIRE: single-conductor; #18 stranded; red	50	...	...	...	*	*
	1B818.5	KU	WIRE: single-conductor; #18 stranded; white	50	...	...	...	*	*
	1B818.16	KU	WIRE: single-conductor; #18 solid; black	15	...	...	...	*	*
	1B818.17	KU	WIRE: single-conductor; #18 solid; yellow	5	...	...	...	...	*
	1B818.18	KU	WIRE: single-conductor; #18 solid; green	5	...	...	...	...	*

Note.—Order maintenance parts by stock number, name, and description. Only maintenance parts can be requisitioned.

Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock 1st ech	Organization stock 2d ech	3d ech	4th ech	Depot stock
	1B818.19	KU	WIRE: single-conductor; #18 solid; blue	5	...	...	...	...	*
	1B818.20	KU	WIRE: single-conductor; #18 solid; red	5	...	...	...	...	*
	1B818.21	KU	WIRE: single-conductor; #18 stranded; black	150	...	...	...	*	*
	2C2263B/W2	KU	WIRE: #14; tinned copper; #2003-2 WEMCO	5	...	...	...	...	*
	1B818.23	CO	WIRE: 2-conductor; #18; switchboard; lamp cord; reinforced; R. C.; black.	100	...	...	...	...	*
	2C2263B/W3	KU	WIRE: #18; tinned copper; No. 2003-3	5	...	...	...	...	*
	1A810.2	AN	WIRE: transmission line antenna; stranded; phosphor bronze.	66	...	...	...	...	*
	1A8109	AN	WIRE: steel; 3/32" diam	275	...	...	...	...	*
	1B814.21	KU	WIRE: #14; solid; 5,000 v test; black	50	...	...	...	...	*
	1B814.20	KU	WIRE: single-conductor; #14; stranded; 5,000 v test; white.	50	...	...	...	...	*
2	3D9005-9	FM	CAPACITOR: variable; air dielectric; 5 mmfd	1	...	...	...	...	*
8	3D9015-18	FM	CAPACITOR: 15 mmfd; 600 v; silver mica	1	*	...	*	*	*
1	3D9025-13	FM	CAPACITOR: variable; air dielectric; 25 mmfd; 4 rotor; 3 stator plates.	1	...	...	...	...	*
3-1, 3-2	3D9050-66	FM	CAPACITOR: 50 mmfd; 1,000 v; mica	2	...	...	*	*	*
70	3D9100-9	KU	CAPACITOR: variable; air dielectric; 100 mmfd.	1	...	...	...	...	*
1	3D9200-5	KU	CAPACITOR: 200 mmfd; 500 v; mica; ±5%	1	*	...	*	*	*
1-1 through 1-7	3D9250-11	T	CAPACITOR: 250 mmfd; 2,500 v; mica	7	*	...	*	*	*
3, 2-1	3D9350	T, KU	CAPACITOR: 350 mmfd; 500 v; mica	2	*	...	*	*	*
4	3D9400-18	FM	CAPACITOR: 400 mmfd; 500 v; mica	1	...	...	*	*	*
3-1 through 3-10	3K3010211	KU	CAPACITOR: 1,000 mmfd; 500 vdc; mica	10	*	...	*	*	*
5-1, 5-2, 5-3, 5-4	3DA2-70	FM	CAPACITOR: 2,000 mmfd; 1,000 v; ±10%; mica.	4	*	...	*	*	*
2-1, 2-2	3DA10-32	T	CAPACITOR: 10,000 mmfd; 5,000 v; ±5%; mica (oil).	2	*	...	*	*	*
1-1	3DA10-31	Rect	CAPACITOR: 10,000 mmfd; 1,000 vdc; mica	1	*	...	*	*	*
4	3DA10-38	Rect	CAPACITOR: 10,000 mmfd; 1,200 v working; 2,500 v test; mica.	1	*	...	*	*	*
4-1	3DA10-56.1	KU	CAPACITOR: 10,000 mmfd; 600 v; paper	1	*	...	*	*	*
8-1	3DA10-36	KU	CAPACITOR: 10,000 mmfd; 8,000 v; mica	1	*	...	*	*	*
5-1	3DA30-4	KU	CAPACITOR: 30,000 mmfd; 600 vdc; ±2%; mica.	1	*	...	*	*	*
7	3DA100-33	KU	CAPACITOR: 100,000 mmfd; +10% −5%; 1,600 v (oil).	1	*	...	*	*	*
6-1, 6-2	3DA100-90	FM	CAPACITOR: 100,000 mmfd; paper; 600 v (oil).	2	*	...	*	*	*
6-1	3DA100-32	KU	CAPACITOR: 100,000 mmfd; 600 v; paper; ±5%.	1	*	...	*	*	*
2-1	3H4679/C6	Rect	CAPACITOR: 500,000 mmfd; 25,000 v	1	...	...	*	*	*
11-1	3DB1.5	KU	CAPACITOR: 1 mfd; 6,000 vdc; dual (oil)	1	*	...	*	*	*
10-1	3DB1.4	KU	CAPACITOR: 1 mfd; 10,000 vdc (oil)	1	*	...	*	*	*
71-1	3DB1.15	KU	CAPACITOR: 1 mfd; 5,000 vdc (oil)	1	*	...	*	*	*
9-1	3DB1.10	KU	CAPACITOR: 1 mfd; 3,000 vdc (oil)	1	*	...	*	*	*
3-1	3DB6-1	Rect	CAPACITOR: 6 mfd; 330 vdc; 50-60 cycle (oil).	1	...	...	*	*	*
7-1, 7-2	3DB8-21	FM	CAPACITOR: 8-8 mfd; 450 v; elect	2	*	...	*	*	*
12-1 through 12-3.	3DB8-10	KU	CAPACITOR: 8-8 mfd; 600 vdc; paper	3	...	...			*
	2C6382B/C5	T	COIL: ceramic cooling	1	...	...	...	...	*
22-1, 22-2	2C1538/C1	FM	COIL: reactor	2	...	...	...	...	*
29	3H4679/R3	Rect	COIL: reactor	1	...	...	...	...	*
9	2C1539/C10	FM	COIL: oscillator inductance	1	*	...	*	*	*
10	3C326-100	FM	COIL: choke; RF	1	...	...	...	...	*
57-1, 57-2	2C2263B/C3	KU	COIL: choke; main rectifier	2	...	...	...	...	*
56	2C2270/C1	KU	COIL: choke; small; rectifier	1	...	...	...	...	*
55	2C2263B/C5	KU	COIL: oscillator	1	...	...	...	...	*
	2C1538/J1	FM	JACK: #402; Insuline Corp. of America	1	*	...	...	...	*
	2C4404A/J1	KU	JACK: open circuit; side panel	5	...	...	...	...	*
	2Z5574.1	T	JACK: #247J; General Radio	2	...	...	...	...	*
	2C1538/P1	FM	PLUG: 2-pole; male	1	...	...	...	...	*
	6Z1727	KU	PLUG: armored cord grip	1	*	...	*	*	*
	2Z7227-4	T	PLUG: banana; #274-P; General Radio	2	...	...	...	...	*
	2Z7111.24	T	PLUG: brass; 1½" OD x ⅝" x ⅛" thk; 1.015" OD bub part of filament line.	2	...	...	...	...	*
	2Z7112.10	CO	PLUG: Cat. No. 3710; Russell & Stoll	2	...	...	...	...	*
	2Z7114.8	CO	PLUG: Cat. No. 3730; Russell & Stoll	2	...	...	...	...	*
	2Z7117.12	CO	PLUG: Cat. No. 3880; Russell & Stoll	2	...	...	...	...	

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Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock 1st ech	Organization stock 2d ech	3d ech	4th ech	Depot stock
	2Z7155	CO	PLUG: PL-55	6	*	...	...	...	*
	2Z7231	CO	PLUG: 10-amp, 250 v; 15-amp, 125 v; No. 7187; Harvey Hubbell.	4	*	...	...	*	*
	2Z7232	CO	PLUG: Cat. No. 9940; Harvey Hubbell	4	*	...	...	...	*
	6Z7565F	CO	PLUG: Cat. No. 8098; Russell & Stoll	4	*	...	...	...	*
	2Z5988	T, KU, WC	RECEPTACLE: pilot light, for S6 lamp #9387	9	...	...	...	...	*
	6Z7812	WC	RECEPTACLE: control panel, candelabra base	2	...	...	...	...	*
	6Z7811	KU	RECEPTACLE: convenience outlet	1	...	...	...	...	*
	6Z7811	KU	RECEPTACLE: convenience outlet type 7723; A-H&H.	1	...	...	...	...	*
25	3Z1926	FM	FUSE: 1-amp; 250 v; 3AG	1	*	...	*	*	*
11-1, 11-2, 11-3	3Z2610.9	Rect	FUSE: 10-amp; 250 v; cartridge; renewable	3	*	...	*	*	*
12	3Z750-3	Rect	FUSE: 150-amp; 250 v; cartridge; renewable	1	*	...	*	*	*
11-1, 11-2, 11-3	3Z3010	Rect	LINK: fuse; 10-amp; for renewable cartridge fuse	3	*	...	*	*	*
12	3Z3150.1	Rect	LINK: fuse; 150-amp; for renewable cartridge fuse	1	*	...	*	*	*
	3G112-80F	Rect	BUSHING: insulator; ceramic; female; 1¼" lg	21	*	...	...	*	*
	3G112-137M	Rect	BUSHING: insulator; ceramic; male; 2 9/32" lg	21	*	...	...	*	*
	3G1837-12	Rect	BUSHING: insulator; micarta; ⅜" lg, ⅞" OD, 0.206" ID.	2	...	...	...	...	*
	2C6382B/G6	T	GROMMET: 4½" x 3" x ¼" x ¾" hole	1	...	...	...	...	*
	2C6382B/G5	T, Rect	GROMMET: rubber; 8¼" x 3" x ¼"	2	...	...	...	...	*
	2C6382B/G7	T	GROMMET: rubber; keyer; cable; 4½" x 3" x ¼"	1	...	...	...	...	*
	6Z4920-8	T	GROMMET: rubber; 8¼" x 3" x ½"	1	...	...	...	...	*
	3G1350-50	Rect	INSULATOR: feed-through; ceramic	2	...	...	...	...	*
	3G1250-80	Rect	INSULATOR: ceramic; round; 5" lg, 1" diam; no base; ¼-20 tapped hole; type 348L5.	2	...	...	...	...	*
	3G1300-80.2	Rect	INSULATOR: stand-off; ceramic with fittings; 5" lg, 1" diam; type 411-B5; metal base; metal cap with 1 tapped hole in top.	2	...	...	...	...	*
	3G1300-80.1	Rect	INSULATOR: stand-off; ceramic; 1" diam x 5" lg; type 411C5; metal base; metal cap with 2 tapped holes in top.	2	*	...	...	...	*
	3G1838-98	AN	INSULATOR: spacer; polystyrene	6	*	...	...	*	*
	3G1839	Rect	INSULATOR: bracket; for resistor ¼" thk; 2½" sq x 8¼" lg.	1	...	...	...	...	*
	3G1000-9	Rect	INSULATOR: feed-through; porcelain; for pri of h-v transf.	2	...	...	...	...	*
	3G1350-51	Rect	INSULATOR: h-v; feed-through; ceramic; for filter choke.	2	...	...	...	...	*
	3G1300-80	T	INSULATOR: ceramic; round; 5" lg	2	*	...	...	...	*
	3G1300-160.1	T	INSULATOR: ceramic; round; 10" lg	2	*	...	...	...	*
	2Z6966	T	INSULATOR: panel (2 5/16" x 1½" x 3/16"; 4 holes)	1	...	...	...	...	*
	3G1838-73	T	INSULATOR PLATE: (4 9/16" x 9/16" x ¼")	1	...	...	...	...	*
	3G1838-43	T	INSULATOR PLATE: (2 11/16" x 2⅝" x ¼")	1	...	...	...	...	*
	2C6382B/S8	T	INSULATOR SPACER: terminal board	8	...	...	...	...	*
	3G1837-16.1	T	INSULATOR SPACER: pf fil line (1.753" OD x ½").	2	...	...	...	...	*
	3G1839-11	T	INSULATOR: 3¼" diam x ¼" (support pr transf).	2	...	...	...	...	*
	3G1839-10	T	INSULATOR: 3¼" diam x ⅛" (support pr transf).	2	...	...	...	...	*
	3G1839-1	Rect	INSULATOR: angle (1 11/16" x 1 11/16" x 9" lg)	1	...	...	...	...	*
	3G1839-3	T	INSULATOR: cap (2" OD x 1.2465" ID x 1")	2	*	...	...	...	*
	3G1250-48	T	INSULATOR: ceramic; round; 3" lg (fil line support).	4	*	...	...	...	*
	3G1250-40	T	INSULATOR: ceramic; round; 2½" lg (fil line support).	4	*	...	...	...	*
	3G1300-48	T	INSULATOR: ceramic; round; (3" lg; 1" diam).	1	...	...	...	...	*
	2C2263B/S3.2	KU	INSULATOR SPACER: (⅜" diam x 1/16" lg).	24	*	...	...	*	*
	2C2263B/55.1	KU	INSULATOR SPACER: (⅜" OD x 0.154" ID x ½" lg).	2	...	...	...	...	*
	2C2263B/S5	KU	INSULATOR SPACER: (⅜" OD x 0.180" ID x ½" lg).	2	...	...	...	...	*
	2C2263B/S3	KU	INSULATOR SPACER: (⅜" diam x ¾" lg).	6	...	...	...	...	*
	2C2263B/S3.1	KU	INSULATOR SPACER: (9/16" diam x ½" lg).	3	...	...	...	...	*
	2C2263B/S6	KU	INSULATOR SPACER: (1¼" diam x ¼" lg).	15	...	...	...	...	*
	2C2263B/S7	KU	INSULATOR SPACER: (1¼" diam x 1⅝" lg).	15	...	...	...	...	*
	2Z7093	KU	INSULATOR SUPPORT: (¼" x 2⅞" x 3⅛").	1	...	...	...	...	*

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	2S271A/B1	KU	INSULATOR: bushing; micarta; (3/4" diam x 7/16").	4	...	...	...	...	*
	2C2263B/B8	KU	INSULATOR: bushing for middle shelf (1" diam x 1 1/8").	3	...	...	...	*	*
	3G1250-16.3	KU	INSULATOR: ceramic; round; (1/2" diam x 1" lg).	24	...	...	...	...	*
	3G1250-8	KU	INSULATOR: ceramic; round; (1/2" diam x 1/2" lg).	4	...	...	...	...	*
	3G1250-32.2	KU	INSULATOR: ceramic; round; (3/4" diam x 2" lg).	19	...	...	...	...	*
	2C2263B/J2	KU	INSULATOR: isolantite; round; (1/2" diam x 1/2" lg).	8	...	...	...	...	*
	2C2263B/B3	KU	INSULATOR: binding post for h-v output to keyer; 4" high.	1	*	...	...	*	*
	2C2263B/S4.1	KU	INSULATOR SPACER: (1/4" OD x 0.154" ID x 1/4").	2	...	...	...	...	*
	2C2263B/S4	KU	INSULATOR SPACER: (3/8" OD x 0.180" ID x 1/16").	2	...	...	...	...	*
	2C1538/B1	FM	INSULATOR: antenna bushing; lucite; 1" diam, 1" lg x 1/4".	1	...	...	...	...	*
	3G1838-32.4	FM	INSULATOR: plate; (2" x 3/4" x 1/8")	1	...	...	...	...	*
	3G1837-88	FM	INSULATOR: antenna support; (5/8" x 2 3/4" lg).	1	...	...	...	*	*
	2C2263B/J1	KU	INSULATOR: osc; (5/16" x 1 9/16")	1	...	...	...	...	*
	2S271A/P1	KU	INSULATOR: panel; (1/4" x 7" x 19 1/2")	1	...	...	...	...	*
	3G1838-240	KU	INSULATOR: panel; (15 1/4" x 5 7/16" x 1/4")	1	...	...	...	...	*
	3G1000-3.1	KU	INSULATOR: ceramic; (1 1/2" diam x 3")	1	*	...	...	*	*
	3G1450-32	KU	INSULATOR: ceramic; sq post (1" sq, 2" lg)	1	*	...	...	*	*
	3G1450-64	KU	INSULATOR: ceramic; sq post (1" sq, 4" lg)	1	*	...	...	*	*
	3G1838-264	Rect	INSULATOR: panel (16 1/2" x 9 3/4" x 1/2")	1	...	...	...	...	*
	3G1838-96	Rect	INSULATOR: panel (6" x 3" x 1/2")	1	...	...	...	...	*
	3G1838-48	WC	INSULATOR: phenolic; (3" x 7/8" x 1/4")	1	...	...	...	...	*
	3G1838-48.1	WC	INSULATOR: phenolic; (3" x 7/8" x 1/4")	1	...	...	...	...	*
	2C2263B/R5	KU	RESISTOR BOARD: 1/8" x 3 1/2" x 4 1/4"	1	...	...	...	...	*
14, 15, 16, 17	2Z5935	Rect	LAMP: indicator; 55 v; Pushin type	4	*	...	...	...	*
14	2Z5891-1	Rect	LAMP: indicator; neon; 110 v; candelabra base	1	*	...	...	...	*
13-1 through 13-2	6Z6815-9	Rect	LAMP: panel; 110 v; 25 w	3	*	...	...	...	*
15	2Z5989	Rect	LAMP ASSEMBLY; 110 v; 60 cycle; comp of bulb, red lens, light, and resistor.	1	...	...	...	...	*
16	2Z5989-1	Rect	LAMP ASSEMBLY: 110 v; 60 cycle; comp of bulb, amber lens, light, and resistor.	1	...	...	...	...	*
17	2Z5989-2	Rect	LAMP ASSEMBLY: 110 v; 60 cycle; comp of bulb, green lens, light, and resistor.	1	...	...	...	...	*
24	2Z5925-1	FM	LAMP: 6-8 v; 0.25 amp; 1.5 w; bayonet	1	*	...	...	...	*
43-1 through 43-5, 6-1, 6-2, 5-1, 5-2	2Z5941.1	KU, T, WC	LAMP: pilot; 125 v; 6 w; candelabra base; clear	9	*	...	...	...	*
43-2, 6-1, 6-2, 1, 2	2Z5988	KU, T, WC	LAMP ASSEMBLY: red; 1" diam	5	...	...	...	...	*
43-5	2Z5988-1 -2	KU	LAMP ASSEMBLY: blue; 1" diam	1	...	...	...	...	*
43-4	2Z5988-2 -1	KU	LAMP ASSEMBLY: white; 1" diam	1	...	...	...	...	*
43-3	2Z5988-3	KU	LAMP ASSEMBLY: amber; 1" diam	1	...	...	...	...	*
43-1	2Z5988-4 -9	KU	LAMP ASSEMBLY: green; 1" diam	1	...	...	...	...	*
44-1, 44-2	3F31600	KU	METER: 0-1 ma; d-c; graduated 0-6 kv; 3 1/2 flush type.	2	...	...	...	...	*
22	3F1200-1	T	METER: 0-5 amp; a-c; graduated 0-200 amp.	1	...	...	...	...	*
23	3F980-1.1	T	METER: milliameter; 0-400 ma; d-c; 5" square bakelite case.	1	...	...	...	...	*
35	3F1150-2	Rect	METER: 0-150 amp; a-c	1	...	...	...	...	*
31	3F980-2	Rect	METER: 0-800 ma; d-c	1	...	...	...	...	*
34	3F3355	Rect	METER: total hour	1	...	...	...	...	*
32	3H4679/V2	Rect	METER: voltmeter; a-c; 150 v	1	...	...	...	...	*
30	3H679/V1	Rect	METER: voltmeter; d-c; 0-20,000 v	1	...	...	...	...	*
33	3H4679/V3	Rect	METER: voltmeter; 0-150 v; a-c	1	...	...	...	...	*
	3ZA10038/M1	WC	METER: pressure; 0-20 lb sq in	1	...	...	...	...	*
	6Z8644	WC	METER: thermometer; 50° to 260° F	1	...	...	...	...	*

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46	2Z3204	KU	CONTACTOR: 2-pole; 25-amp; 110 v; 60 cycles; AB-A209 (filament power).	1	*	...	...	...	*
49	2Z3203	KU	CONTACTOR: heater control; AB-A216 (2 normally closed contacts; 110 v; 5-amp; 60 cycles).	1	*	...	...	...	*
47	2Z3200-1	KU	CONTACTOR: 3-pole; 24-amp; 110 v; 60 cycles; AB-#1 (plate power control).	1	*	...	...	...	*
48	2Z3201	KU	CONTACTOR: 1-pole; 110 v; 60 cycles; AB-B107.	1	*	...	...	...	*
9	2Z3202-1	T	CONTACTOR: 110 v; 60 cycles; AB type; B-300.	1	*	...	...	...	*
8	2Z3202	T	CONTACTOR: 110 v; 60 cycles; AB type; B-400.	1	*	...	...	...	*
36	2Z3206	Rect	CONTACTOR: main 105 amp cont. duty; 115 v; 60 cycles; single-pole; normally open.	1	...	...	*	...	*
46	2Z3204/1	KU	CONTACTS: set; for contactor 2Z3204	1	...	...	*	*	*
9	2Z3202-1/1	T	CONTACTS: set; for contactor 2Z3202-1	1	...	...	*	*	*
47	2Z3200/1	KU	CONTACTS: set; for contactor 2Z3200-1 3 front stationary contacts. 3 rear stationary contacts. 3 moving contacts S#Z35163. 3 moving contacts S#Z33552. 3 springs.	1	...	...	*	*	*
8	2Z3202/1	T	CONTACTS: set; for contactor 2Z3202	1	...	...	*	*	*
48	2Z3201/1	KU	CONTACTS: set; for contactor 2Z3201	1	...	...	*	*	*
49	2Z3202/1	KU	CONTACTS: set; for contactor 2Z3202	1	...	...	*	*	*
36	2Z3206/1	Rect	CONTACTS: set; for contactor 2Z3206	1	...	...	*	*	*
38	3H915AB/C1	Rect	CONTACTS: set; for circuit breaker 3H915AB	1	...	...	*	*	*
7	2ZA1003B/C1	WC	CONTROL: pressure control	1	*	...	...	...	*
	2ZA1003B/C2	WC	CONTROL: pressure control w/motor starting button on top.	1	*	...	...	...	*
45	2Z7663	KU	RELAY: thermal time delay 30 sec timing (plate power) 110 v; 60 cycles.	1	*	...	...	...	*
7	2Z7662-1	T	RELAY: Struthers Dunn type CBTX-1 (110 v; 60 cycles; heater control).	1	*	...	...	...	*
10	2Z7690A1	T	RELAY: 55-125 v; 60 cycles; type SV	1	*	...	...	...	*
37	3H4679/R5	Rect	RELAY: tripping current range; 175 to 700 milliampere dc; Westinghouse type SC-1.	1	*	...	...	...	*
19	3Z9822-1	Rect	SWITCH: panel light; SPST	2	*	...	...	...	*
23	3Z9823	Rect	SWITCH: panel interlock	2	*	...	...	...	*
21	3H4679/S10	Rect	SWITCH: SPST; local-remote control	1	*	...	...	...	*
18	3H4690( )/S1	Rect	SWITCH: key operated	1	*	...	...	...	*
22	3Z9824-271	Rect	SWITCH: start-stop for remote control	1	*	...	...	...	*
20	3H4679/S11	Rect	SWITCH: stop, emergency	1	...	...	...	...	*
	3Z9824-341	Rect	SWITCH: push button; start-stop; 600 v w/red indicating light for 125 v circuit.	1	*	...	...	...	*
14	3Z9560	T	SWITCH: interlock C-H 8410	10	*	...	*	...	*
	3Z9822-1	T	SWITCH: part of panel ass'y	1	*	...	...	...	*
13, 51	3Z9829-2	T, KU	SWITCH: start-stop; flush type	3	*	...	...	...	*
11	3Z9857.4	T	SWITCH: toggle; SPST; slotted base; Hubbel 9072; 6-amp; 125 v.	1	*	...	...	...	*
12	3Z9542D	T	SWITCH: control type Re-cirk-it time delay	1	*	...	...	...	*
24	3H4679/S8	Rect	SWITCH: door interlock	2	*	...	...	...	*
54	3H900-20-1	KU	SWITCH: circuit breaker; main power; one 5-amp coil, and one 20-amp coil; time delay curve "D".	1	*	...	...	...	*
23	3Z8105	FM	SWITCH SW-105: toggle; SPST; 3 amp; 250 v	3	*	...	...	...	*
50	3Z8314	KU	SWITCH: nonshorting; 3 circuits per section; two sections.	1	*	...	...	...	*
52	3Z8142.1	KU	SWITCH: toggle; DPST; blower control; 3 amp; 250 v.	1	*	...	...	...	*
53	2C2263B/S10	KU	SWITCH: oscillator frequency control	1	...	...	...	...	*
38	3H915AB	Rect	CIRCUIT BREAKER: de-ion type AB	1	...	...	...	...	*
39	2C2263S/100M	KU	POTENTIOMETER: 100,000 ohms	1	*	...	*	*	*
40	2Z296-250M	KU	POTENTIOMETER: 250,000 ohms	1	...	...	...	*	*
8	3H4679/R6	Rect	RHEOSTAT: 5 ohms	1	...	...	...	*	*
4-1	3Z6001-7	T	RESISTOR: fixed; 10 ohms; 100 W; type HA	1	*	...	...	*	*
9-1	3Z6001E6	Rect	RESISTOR: fixed; 15 ohms; 100 W; wirewound	1	*	...	...	*	*
10-1	3Z6015-7	Rect	RESISTOR: fixed; 150 ohms; 100 W	1	*	...	...	*	*

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23-1, 23-2	3Z6020-10	KU	RESISTOR: fixed; 200 ohms ±5%; 2 W; wirewound.	3	*	...	*	*	*
31-1	3Z6050-11	KU	RESISTOR: fixed; 500 ohms; 50 W; wirewound	1	*	...	...	*	*
30	3Z6100-23	KU	RESISTOR: fixed; 1,000 ohms ±5%; 20 W; power; wirewound; 2 terminals; IRC type DG.	1	*	...	*	*	*
11-1	3Z4526	FM	RESISTOR: fixed; 2,000 ohms ±10%; ½ W; carbon.	1	*	...	*	*	*
19-1, 19-2	3Z6200-12	KU	RESISTOR: fixed; 2,000 ohms ±5%; 1 W; carbon.	2	*	...	*	*	*
27-1	3Z6250-10	KU	RESISTOR: fixed; 2,500 ohms ±5%; 10 W; wirewound.	1	*	...	*	*	*
13	3Z6500-10	KU	RESISTOR: fixed; 5,000 ohms ±5%; ½ W; carbon.	1	...	...	...	*	*
28-1	3Z6500-16	KU	RESISTOR: fixed; 5,000 ohms ±5%; 10 W; wirewound.	1	*	...	*	*	*
39	3Z6500-93	KU	RESISTOR: fixed; 5,000 ohms ±5%; 20 W; wirewound.	2	*	...	*	*	*
35-1, 35-2	3Z6500-24	KU	RESISTOR: fixed; 5,000 ohms; 60 W; wirewound; No. 3 terminals.	2	*	...	...	*	*
38	3Z6575-18	KU	RESISTOR: fixed; 7,500 ohms; 100 W	1	*	...	...	*	*
14-1	3Z6610-7	KU	RESISTOR: fixed; 10,000 ohms ±5%; ½ W; carbon.	1	*	...	*	*	*
16-1	3Z6610-11	FM	RESISTOR: fixed; 10,000 ohms ±10%; 1 W; carbon.	1	*	...	*	*	*
39	3Z6610-83	KU	RESISTOR: fixed; 10,000 ohms ±5%; 20 W; wirewound.	9	*	...	*	*	*
33-1	3Z6610-14	KU	RESISTOR: fixed; 10,000 ohms; 100 W; wirewound.	3	*	...	*	*	*
6-1 through 6-20	3Z6610-22	Rect.	RESISTOR: fixed; 10,000 ohms; 200 W; wirewound.	20	*	...	...	*	*
15	3Z6615-1	KU	RESISTOR: fixed; 15,000 ohms ±5%; ½ W; carbon.	1	*	...	*	*	*
17-1, 20-1	3Z6620-11	FM, KU	RESISTOR: fixed; 20,000 ohms ±5%; 1 W; carbon.	2	*	...	*	*	*
24-1	3Z6620-14	KU	RESISTOR: fixed; 20,000 ohms ±5%; 2 W; carbon.	2	*	...	*	*	*
29-1	3Z6620-15	KU	RESISTOR: fixed; 20,000 ohms; 20 W; power; wirewound; IRC type DG.	1	*	...	*	*	*
36-1, 36-2, 36-3, 36-4	3Z6625-12	KU	RESISTOR: fixed; 25,000 ohms; 60 W; wirewound.	4	*	...	...	*	*
16	3Z6630-9	KU	RESISTOR: fixed; 30,000 ohms ±5%; ½ W; carbon.	1	*	...	*	*	*
19-1	3Z6640-6	FM	RESISTOR: fixed; 40,000 ohms; 5 W	1	*	...	*	*	*
12	3Z4531	FM	RESISTOR: fixed; 50,000 ohms ±10%; ½ W; carbon.	1	*	...	*	*	*
18-1, 21-1	3RC31BE5135	FM, KU	RESISTOR: fixed; 50,000 ohms ±5%; 1 W; carbon.	2	*	...	*	*	*
25-1	3Z6650-14	KU	RESISTOR: fixed; 50,000 ohms ±5%; 2 W; carbon.	1	*	...	*	*	*
17-1 through 17-6	3Z6700-6	KU	RESISTOR: fixed; 100,000 ohms ±5%; ½ W; carbon.	6	*	...	*	*	*
26-1	3Z6700-12	KU	RESISTOR: fixed; 100,000 ohms ±5%; 2 W; carbon.	1	*	...	*	*	*
34-1	3Z6700-24	KU	RESISTOR: fixed; 100,000 ohms; 60 W; wirewound.	1	*	...	...	*	*
17-1, 17-6	3RC21BE2045	KU	RESISTOR: fixed; 200,000 ohms ±5%; ½ W; carbon.	6	*	...	*	*	*
15	3Z4533	FM	RESISTOR: fixed; 500,000 ohms; ½ W; carbon	1	*	...	*	*	*
22-1, 22-2	3Z6803-1	KU	RESISTOR: fixed; 3 megohms; 5 W; voltmeter; multiplier; special.	2	...	...	...	...	*
5	3F3466	Rect.	RESISTOR: fixed; 20 megohms; voltmeter; multiplier; special.	1	...	...	...	...	*
5-1, 5-2, 7-1, 7-2, 7-3, 7-4	3Z5015-2	T, Rect.	RESISTOR: heater; cartridge type; screw base; 150 W; 115 v.	7	*	...	...	*	*
32-1, 32-2	2Z5015-3	KU	RESISTOR: heater; cartridge type; screw base; 110 v.	2	*	...	...	*	*
24	2C1538/L1	FM	SOCKET: dial light	1	...	...	...	...	*
	2Z8795.1	FM, KU	SOCKET: octal tube	13	*	...	*	*	*

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Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock 1st ech	Organization stock 2d ech	3d ech	4th ech	Depot stock
32-1, 32-2	6Z7806	KU	SOCKET: resistor; A-H&H; Cat. No. 50715	2	*	...	*	*	*
	2Z8762.1	KU	SOCKET: tube filter; standard 4 prong	5	*	...	*	*	*
	2Z8759.4-1	KU	SOCKET: main rectifier	4	...	...	...	...	*
	2Z8783	KU	SOCKET: for 450TH	2	...	...	...	...	*
	6Z7803-1	T	SOCKET: Edison base	2	...	...	...	...	*
	6Z8357.1	Rect	SOCKET: med. screw base	5	...	...	...	...	*
	6Z8368-7	Rect	SOCKET: panel light	2	...	...	...	...	*
17	2C6382B/T6	T	TRANSFORMER: current; 200/5 ratio; Weston No. 604.	1	...	...	...	...	*
16	2C6382B/T5	T	TRANSFORMER: filament; 220/110 v; 60 cycles; Kenyon S-9527.	1	...	...	...	...	*
25	3H4679/T4	Rect	TRANSFORMER: power; 115/11.5 v; 40 amp.	1	...	...	...	...	*
28	2Z9933-1911	Rect	TRANSFORMER: line current; 150/5 ratio; WEMCO W1.	1	...	...	...	...	*
25	3H4679/T3	Rect	TRANSFORMER: main plate; special; WEMCO R-1160-B.	1	...	...	...	...	*
27	2Z9957	Rect	TRANSFORMER: variable; 11.5 kva; 0-115 v.	1	...	...	...	...	*
18	2Z9957-4	T	TRANSFORMER: variable; 0-130 v	1	...	...	...	...	*
21	2Z9613.5	FM	TRANSFORMER: power; two 6.3 fil and 1 plate winding.	1	...	...	...	...	*
20	2Z9954	FM	TRANSFORMER: output; Gen Trans; type TR-6212.	1	*	...	...	...	*
63	2C2263B/T8	KU	TRANSFORMER: power; Amertron No. 26579.	1	...	...	...	...	*
64	2C2263B/T4	KU	TRANSFORMER: output; Kenyon No. T-104	1	*	...	...	...	*
58	2C2263B/T6	KU	TRANSFORMER: fil; 110/7-½ v; Kenyon	1	*	...	...	...	*
60-1, 60-2, 60-3	2C2263B/T7	KU	TRANSFORMER: fil; 110/2.5 v; center tap	3	*	...	...	...	*
59	2C2263B/T5	KU	TRANSFORMER: fil; for final 450TH tube	1	*	...	...	...	*
63	2C2263B/T9	KU	TRANSFORMER: variable; 2 kva; 0-135 v	1	...	...	...	...	*
61	2Z9717-45556	KU	TRANSFORMER: power; Thordarson T-92-R-21.	1	...	...	...	...	*
	2J6C5	KU	TUBE: JAN-6C5 (VT-65)	1	*	...	...	...	*
	2J6F6	KU	TUBE: JAN-6F6 (VT-66)	4	*	...	...	...	*
	2J6K7	KU	TUBE: JAN- 6K7 (VT-86)	1	*	...	...	...	*
	2J6K7GT	FM	TUBE: JAN-6K7GT (VT-86-B)	1	*	...	...	...	*
	2J6J5GT	FM	TUBE: JAN-6J5GT (VT-94-D)	1	*	...	...	...	*
	2J6V6GT	FM	TUBE: JAN-6V6GT (VT-107-A)	1	*	...	...	...	*
	2J450TH	KU	TUBE: JAN-450TH (VT-108-A)	2	*	...	...	...	*
SC	2J5T4	KU	TUBE: JAN-5T4 (VT-114)	1	*	...	...	...	*
	2J6L6	KU	TUBE: JAN-6L6 (VT-115)	1	*	...	...	...	*
	2J6SJ7	KU	TUBE: JAN-6SJ7 (VT-116)	1	*	...	...	...	*
	2JWL530	T	TUBE: JAN-WL530 (VT-122)	2	*	...	...	...	*
	2J6X5GT	FM	TUBE: JAN-6X5GT (VT-126-B)	1	*	...	...	...	*
	2JWL531	Rect	TUBE: JAN-WL531 (VT-144)	2	*	...	...	...	*
	2J6A8GT	FM	TUBE: JAN-6A8GT (VT-151-B)	1	*	...	...	...	*
	2J866A	KU	TUBE: JAN-866A (VT-46-A)	2	*	...	...	...	*
	2Z2702	KU	TERMINAL: grid clip No. 2	2	...	...	...	...	*
	2Z2708	KU	TERMINAL: grid clip No. 8	1	...	...	...	...	*
	2Z2712	KU	TERMINAL: grid clip No. 12	6	...	...	...	...	*
	3Z12072-5	KU	TERMINAL: 0.032″ thk with 0.136″ hole	13	...	...	...	...	*
	3Z3915-10A	KU	TERMINAL: Cinch No. 1510A	1	...	...	...	...	*
	2Z9403.19	KU	TERMINAL: Cinch No. 1530	1	...	...	...	...	*
	2Z9463.1	KU	TERMINAL BOARD: type 2-50	1	...	...	...	...	*
	3Z3915-14	KU	TERMINAL STRIP: Cinch Type 1514	6	...	...	...	...	*
	3Z12513-50	WC	TERMINAL BOARD: Jones No. 3-50	1	...	...	...	...	*
	3Z12048-3	KU	TERMINAL: F. W. Morse No. 2028	2	...	...	...	...	*
	...	KU	TERMINAL: Special; WEMCO S #47268	2	...	...	...	...	*
	3Z12048-19	Rect	TERMINAL: WEMCO S #867478	130	...	...	...	...	*
	3Z12048-13	Rect	TERMINAL: WEMCO S #269917	12	...	...	...	...	*
	3Z12048-8	Rect	TERMINAL: WEMCO S #229113	8	...	...	...	...	*
	3Z12048-20	Rect	TERMINAL: F. W. Morse No. 1963	11	...	...	...	...	*
	3Z12048-9	Rect	TERMINAL: WEMCO S #229114	3	...	...	...	...	*
	3Z9402.32	KU	TERMINAL: Cinch No. 1510	3	...	...	...	...	*
	3Z3915-12	KU	TERMINAL: Cinch No. 1512	2	...	...	...	...	*
	2Z9402.37	KU	TERMINAL: Cinch No. 1520	2	...	...	...	...	*
	2Z9315	KU	TERMINAL: phenolic block; WEMCO S #542247.	1	...	...	...	...	*
	2Z9408.3	Rect	TERMINAL BLOCK: WEMCO S #1225375	1	...	...	...	...	*
	2Z9412.3	Rect	TERMINAL BLOCK: WEMCO S #1225376	1	...	...	...	...	*
	2Z2708.9	T	TERMINAL ASSEMBLY: grid clip	1	...	...	...	...	*

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	3Z12031-7	T	TERMINAL: Stewart, Stamping 919	2	...	...	...	...	*
	3Z133	T	TERMINAL: WEMCO S #147242	2	...	...	...	...	*
	3Z12048-22	T	TERMINAL LUG: Sherman No. 175	1	...	...	...	...	*
	3Z11085	CO	TERMINAL LUG: GE No. 2269	20	...	...	...	...	*
	3Z11085-2	CO	TERMINAL LUG: GE No. 2271	20	...	...	...	...	*
	2ZA1003B/T1	WC	TERMINAL BLOCK	1	...	...	...	...	*
	3Z12522	T	TERMINAL BOARD: WEMCO No. 805456	1	...	...	...	...	*
	3Z11085-5	CO	TERMINAL LUG: GE No. 2272	20	...	...	...	...	*
	3Z12048-16	CO	TERMINAL LUG: WEMCO S #867295A	15	...	...	...	...	*
	3Z12048-11.1	CO	TERMINAL: WEMCO S #233155	18	...	...	...	...	*
	3Z12048-18	CO	TERMINAL: WEMCO S #867476A	18	...	...	...	...	*
	3Z12048-21	CO	TERMINAL: WEMCO S #147242A	10	...	...	...	...	*
	....	CO	TERMINAL: WEMCO S #867508	5	...	...	...	...	*
	2ZA1003B/T2	WC	TERMINAL BLOCK	1	...	...	...	...	*
	3H4679/A1	Rect	ANGLE: micarta; 1/4" thk x 35" lg x 2 3/4" sq; root angle; 11 holes of 7/16" diam.	1	...	...	...	...	*
	3G1839-2	Rect	ANGLE: micarta; 1/4" thk x 35" lg x 2 3/4" sq; root angle; 10 holes of 7/16" diam.	1	...	...	...	...	*
	2A272-7	FM	ANTENNA: telescopic; 20" extended	1	...	...	...	...	*
	2A275-118/1	AN	BAR: shorting; 1/8" thk x 3/8" w x 3 1/2" lg	8	...	...	...	...	*
	6L946-16-3	AN	BOLT: "U"; steel; 3/8-16; 3 1/2" w x 3 1/2" lg	42	...	...	...	...	*
	2Z1245-2	KU	BRACKET: for 20-W resistor	4	...	...	...	...	*
	2Z1406-3	KU	BUSHING AND NUT: type UB-241	3	...	...	...	...	*
	2Z1384-3	T	BUSHING: brass; 0.42" diam x 7/8" lg; 1/4" lh thd; part of connector for fil line.	1	...	...	...	...	*
	2Z1384	T	BUSHING: brass; 1/2" dia x 1" lg; 1/4" lh thd; part of connector for fil line.	1	...	...	...	...	*
	6Z1663-4	WC	BUSHING: face; brass; 2 1/2" x 1 1/2" thd	1	...	...	...	...	*
	6Z1663-3	WC	BUSHING: face; brass; 2 1/2" x 1" thd	1	...	...	...	...	*
	6Z1728	WC	CAP: std flat top screw type for automobile radiator with vent hole.	1	...	...	...	...	*
	2C1538/C2	FM	CLAMP: crystal	1	...	...	...	...	*
	6Z1925	T	CLAMP: for hose plate line connection; galvanized steel; 1 1/8" ID.	2	*	...	*	*	*
	2Z2642.34	CO	CLAMP: Sherman No. 2	3	*	...	*	*	*
	2Z2727-7	FM	CLIP: antenna mounting; phosphor bronze; 0.020" thk x 1/2" x 5/16" x 1 1/16".	1	...	...	...	...	*
	2Z2727-6	KU, Rect.	CLIP: 1 1/2" x 11/16" x 15/32"	8, 40	...	...	...	...	*
	3Z1100-1	Rect	CLIP: resistor; part of resistor board ass'y	2	...	...	...	*	*
	3Z1100	Rect	CLIP: resistor; type 781380 altered	3	*	...	*	*	*
	6Z2253-2	WC	CONDUIT: flexible steel; 1/2"	2	...	...	...	...	*
	3Z1016-4	Rect	CLIP: fuse; S #K77397 WEMCO	1	...	...	*	*	*
	2C6382B/C10	T	CONNECTOR: ceramic coil; neoprene	2	*	...	*	*	*
	2C6382B/C11	T	CONNECTOR: plate line; neoprene	2	*	...	*	*	*
	2C6382B/C12	T	CONNECTOR: water jacket; neoprene	2	*	...	*	*	*
	6Z3176-8	WC	CONNECTOR: 90° angle; BX type; visible; type #AC912. 1/2" size.	2	...	...	...	...	*
	2Z3017.3	T	CONNECTOR: brass; Z-shaped, 1/8" thk; 3/4" x 7 7/8" x 10 3/4".	1	...	...	...	...	*
	2Z3017.6	T	CONNECTOR: brass; Z-shaped, 1/8" thk; 3/4" x 8 1/4" x 12".	1	...	...	...	...	*
	2Z3017.4	T	CONNECTOR: brass; 1 1/4" OD; 3/4" ID; 1 3/8" lg.	2	...	...	...	...	*
	2Z3017.14	T	CONNECTOR: brass tubing; 0.875" OD; 3/4" ID; 1 3/4" lg.	2	...	...	...	...	*
	2Z3017.5	T	CONNECTOR: brass; angle shaped; 1/8" thk x 1" x 1 3/16" x 2 1/4".	2	...	...	...	...	*
	2Z3017.7	T	CONNECTOR: brass; 1/8" x 3/4" x 5 3/4"	3	...	...	...	...	*
	2Z3017.4	T	CONNECTOR: brass; 1 1/4" diam; 1 3/8" lg	2	...	...	...	...	*
	2C6382B/S5	T	CONNECTOR ASSEMBLY	1	...	...	...	...	*
	4G1668B/C8	KU	COUPLING: flexible	2	*	...	*	*	*
	6Z3430-7	WC	COUPLING: Cat. No. A-1552; Mueller Brass	1	...	...	...	...	*
	6Z3430-10	WC	COUPLING: Cat. No. A-1624; Mueller Brass	1	...	...	...	...	*
	6Z3430-6	WC	COUPLING: Cat. No. A-2569; Mueller Brass	1	...	...	...	...	*
	6Z3430-8	WC	COUPLING: Cat. No. A-3719; Mueller Brass	1	...	...	...	...	*
	6Z3430-9	WC	COUPLING: Cat. No. A-4218; Mueller Brass	4	...	...	...	...	*
	2C1538/C3	FM	CRYSTAL: 4,100 kc	1	...	...	...	...	*
	2C1538/D1	FM	DIAL: velvet vernier; 4"	1	...	...	...	...	*

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	2A275–118/10	AN	DIPOLE: steel plate; steel spacer; steel tubing; steel gusset and brass support; over-all dimen 2″ d; 28¼″ w; 38″ lg.	32	...	...	...	...	*
	6Z949	WC	ELBOW: 90°, 1″ size; Cat. No. A–3114; altered.	2	...	...	...	...	*
	6Z950	WC	ELBOW: 180°; Cat. No. A–3128	1	...	...	...	...	*
	6Z3862–1	T	ELBOW: cast copper; streamlined; 1½″ x ¾″ x 90°.	2	...	...	...	...	*
	6Z3682–2	T	ELBOW: wrought copper; streamlined; 1½″ x 1½″ x 90°.	2	...	...	...	...	*
	6Z3670	WC	ELBOW: street brass; ¼″ x 45°	1	...	...	...	...	*
	6Z3671	WC	ELBOW: street brass; ¼″ x 90°	1	...	...	...	...	*
	6Z3682–4	WC	ELBOW: Cat. No. A–1558; Mueller Brass	1	...	...	...	...	*
	6Z3664	WC	ELBOW: Cat. No. A–1629; Mueller Brass	1	...	...	...	...	*
	6Z3862–6	WC	ELBOW: Cat. No. A–1631; Mueller Brass	1	...	...	...	...	*
	6Z3682–7	WC	ELBOW: street; Cat. No. A–2680; Mueller Brass.	1	...	...	...	...	*
	6Z3682–8	WC	ELBOW: Cat. No. A–6107; Mueller Brass	1	...	...	...	...	*
	6Z3682–3	WC	ELBOW: street; Cat. No. A-6160; Mueller Brass.	1	...	...	...	...	*
	2Z8799G6A6A	AN	ELECTRODE: tungsten; used with spark gap on ass'y; type GA–6–A.	4	*	...	*	*	*
	2C2263B/F1	KU	FILTER: air; "Dustop"; 12″ x 12″ x 2″	1	*	...	*	*	*
	6Z3856–10	T	FILTER: air; "Dustop"; No. 2; 10″ x 10″ x 2″	1	*	...	*	*	*
	2Z4310	FM	FOOT: rubber; type 970; Canfield Rubber Co.	4	...	...	...	...	*
	2A1168	AN	FRAME: antenna ass'y; frames No. 1 and No. 8; 4 ft 7⅞″ w x 18 ft 10½″ lg.	2	...	...	...	...	*
	2A1169	AN	FRAME: antenna ass'y; frames Nos. 2, 3, 6, 7; 4 ft 7½″ w x 18 ft 10½″ lg.	4	...	...	...	...	*
	2A1170	AN	FRAME: antenna ass'y; frames Nos. 4 and 5; 4 ft 7⅞″ w x 18 ft 10½″ lg.	2	...	...	...	...	*
	3Z2831–2	Rect	FUSE BLOCK	1	...	...	...	...	*
	3Z1927.1	FM	FUSE POST	1	...	...	...	...	*
	2S271A/G2	KU	GASKET: treated fabric; 0.036″ x 7/32″ x 3 7/16″	1	*	...	*	*	*
	2S271A/G4	KU	GASKET: treated fabric; 0.036″ thk x 3⅞″ x 11⅞″.	1	*	...	*	*	*
	2S271A/G3	KU	GASKET: treated fabric; 0.036″ x 7/32″ x 11⅞″	1	*	...	*	*	*
	2C2263B/G1	KU	GASKET: h-v binding post	2	*	...	*	*	*
	2S271A/G1	KU	GASKET: cork; 1/16″ x 1 15/16″ x 1 15/16″	2	*	...	*	*	*
	2C6382B/G1	T	GASKET: connector; tube water connection; vellumoid; 1 1/16″ OD x ¾″ ID x 1/32″ thk.	2	*	...	*	*	*
	3H4679/G2	Rect	GASKET: for cover of h-v rectifier transf	1	...	...	*	*	*
	3H4679/G1	Rect	GASKET: cork; for feed-through insulator h-v rectifier.	2	...	...	*	*	*
	2C6382B/H4	T	HOSE ASSEMBLY: trans to water cooler; brass; flexible; 1″ ID; 48″ lg with pipe union at each end.	2	...	...	*	...	*
	2ZA1003B/H3	T, WC	HOSE DRAIN ASSEMBLY: consists of hose nipple and rubber tubing.	2	...	...	...	...	*
	2ZA1003B/J1	WC	INDICATOR: flow; bull's eye 1″	1	...	...	...	...	*
	6Z8576	AN	INSULATOR ASSEMBLY: over-all dimen 4″ d, 4¾″ w, 27¾″ lg.	2	...	...	...	...	*
	2C2263B/K2	KU	KNOB AND POINTER	1	...	...	...	...	*
	2Z5819	KU	KNOB: switch; bakelite bar	1	...	...	...	...	*
	2C6382B/K2	T	KNOB AND POINTER ASSEMBLY: fil control.	1	...	...	...	...	*
	2C6382B/K1	T	KNOB: plate line tuning	1	...	...	...	...	*
	2Z5749.2	Rect	KNOB: molded bakelite	1	...	...	...	...	*
	2C6382B/N1	T	NIPPLE; brass; trans	2	...	...	...	...	*
	6Z7246–7	WC	NIPPLE: Cat. No. A–1555; Mueller Brass	1	...	...	...	...	*
	6Z7246–5	WC	NIPPLE: lg 1¼″–2″	2	...	...	...	...	*
	6L3404–20K	...	NUT: knurled; ½″ OD x ¼″–20 tap x ¼″ lg.	......	...	...	...	*	*
	6L3406–24K	...	NUT: knurled; brass; ½″ OD x 5/16″ lg; tapped ⅜″–24 thd.	......	...	...	...	*	*
	6L3504–20K	...	NUT: knurled; brass; ¾″ OD x ⅝″ lg.	......	...	...	...	*	*
	6L3674–20	...	NUT: lock; brass; ¾″ OD x ¼″ lg; sides cut; tapped ¼″–20.	......	...	...	...	*	*
	2C6382B/P1	T, WC	PETCOCK: male and female ends	4	...	...	...	...	*
	6Z7557–1.1	WC	PIPE: copper; hard 1″ diam	3	...	...	...	...	*
	6Z7557–8.2	WC	PIPE: copper; 1½″ diam	3	...	...	...	...	*
	6Z1663–5	T	REDUCER: brass; ¾″ x 1″	2	...	...	...	...	*
	6L6440–32.1	...	SCREW: mach; RH; No. 4–40; 2″ lg	......	...	...	...	*	*

Note.—Order maintenance parts by stock number, name, and description. Only maintenance parts can be requisitioned.

Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock 1st ech	Organization stock 2d ech	3d ech	4th ech	Depot stock
	6L6832-32.1		SCREW: mach; RH; No. 8-32; 2″ lg					*	*
	6L7032-32.1		SCREW: mach; RH; No. 10-32; 2″ lg					*	*
	6L7920-32.1		SCREW: mach; RH; No. ⅜-20; 2″ lg; brass					*	*
	6L7920-6-32.1		SCREW: mach; RH; No. ⅜-20; 2″ lg; brass					*	*
	6L4908-32.1		SCREW: hex; HM; No. ½-13; 2″ lg; steel					*	*
	2C6382B/S6	T	SHAFT: insulating; 1½″ diam x 7″ lg	1				*	*
	2C2263B/S1	KU	SHIELD: h-v	1					*
	2C2263B/S2	KU	SHIELD: terminal	1					*
	2Z8551	T	SLEEVE: brass; 1 1/16″ diam x ⅝″ lg	1				*	*
	6Z8161	T	SLEEVE: brass; 1 1/16″ diam x 1″ lg	1				*	*
	2S270B/S4	AN	SPARK GAP: (air) with adjustable tungsten elements; type GA-6-A; used in transmission lines.	2	*			*	*
	2Z8878-7	KU	SPRING: steel; 3 29/32″ lg x 0.060″ diam	7					*
	2Z8876-6	KU	SPRING: steel; 4 9/32″ lg x 0.060″ diam	4					*
	2C2263B/S9	KU	SPRING: middle shelf bushing; 0.064″ diam x 2⅞″ lg.	3					*
	2C6382B/S9	T	SPRING: brass tubing; ½″ OD x 3″ lg; 110″ of 0.040″ diam wire.	2					*
	2Z8872-2	T	SPRING: phosphor bronze; 3 1/16″ x 1¼″ x 1/32″ thk.	1					*
	2Z8878-4	T	SPRING: steel wire; 15/32″ OD x ½″ lg of 0.06″ diam wire.	2					*
	2A275-118/11	AN	STUB: antenna; ½″ d x 3″ w x 17 7/16″ lg	1					*
	6L31267	KU	STUD: brass; 5⅛″ lg x 6-32	1					*
	6L31233	KU	STUD: brass; 2¾″ x 8-32	2					*
	6L2123L-2	KU	STUD: brass; 8⅞″ lg x 8-32	4					*
	6L31307	KU	STUD: brass; 10⅞″ lg x 8-32	11					*
	6L31214-1	KU	STUD: brass; 1½″ lg x 10-32	1					*
	6L31260	KU	STUD: brass; 4⅜″ x ¼″-20 thd; for h-v insulator.	1					*
	6L31209	T	STUD: brass; ¼-20 x 9/16″ lg	1					*
	6L31228	T	STUD: ground; brass; ¾″ hex x 2¼″ lg	1					*
	6L31215	Rect	STUD: brass; ¼-20 x 1⅝″ lg	1					*
	6L31226	Rect	STUD: brass; ¼-20 x 2⅛″ lg	1					*
	6L31225	Rect	STUD: brass; No. 10-32 x 2″ lg	1					*
	6L31238	Rect	STUD: brass; No. 10-32 x 3¼″ lg	1					*
	6L31242	Rect	STUD: brass; No. 10-32 x 3⅝″ lg	1					*
	6L31230-1	Rect	STUD: brass; 5/16″-13 x 2½″ lg	1					*
	6L31214	Rect	STUD: brass; ⅜-16 x 1½″ lg	1					*
	6Z8577	AN	SUPPORT: inner; horizontal transmission line; ½″ d, 3″ w, 27 7/32″ lg.	2					*
	6Z8577-1	AN	SUPPORT: outer; horizontal transmission line; 1″ d, 4″ h, 30⅛″ lg.	2					*
	6Z8577-2	AN	SUPPORT: vertical transmission line; ½″ OD, 0.032″ wall, 29″ lg.	2					*
	6Z8635-9	WC	TEE: Cat. No. A-1564; Mueller Brass	1					*
	6Z8635-10	WC	TEE: Cat. No. A-1565; Mueller Brass	1					*
	6Z8635-11	WC	TEE: Cat. No. A-1566; Mueller Brass	1					*
	6Z8635-8	WC	TEE: Cat. No. A-4204; Mueller Brass	2					*
	3Z12513-50	WC	TERMINAL BOARD: 3 terminal; phase converter.	1					*
	6Z7812A	AN	TRANSMISSION LINE: horizontal	2					*
	6Z8712-1	AN	TRANSMISSION LINE: vertical; sec No. 2; 1⅞″ w, 29″ h, 8 ft 7¼″ lg.	1					*
	6Z8712-2	AN	TRANSMISSION LINE: vertical; sect No. 3; 1⅞″ w, 29″ h, 9 ft 10¾″ lg.	1					*
	2Z8304.3	Rect	TUBE SUPPORT	2					*
	6Z8724-3	T	TUBING: inner; yellow brass tubing	2					*
	6Z8724-9	T	TUBING: copper; 1½″ diam x 11 13/16″ lg	1					*
	6Z8724-8	T	TUBING: copper; 1½″ diam x 13 5/16″ lg	1					*
	6Z8724-7	T	TUBING: copper; 1½″ diam x 34¾″ lg	1					*
	6Z8724-2	T	TUBING: outer; copper tubing 2″ OD x 26″ x ⅛″ thk.	2					*
	6Z3320-3.1	AN	TUBING: soft copper; ⅜″ OD x 19 ft 8″ lg	1					*
	6Z1243.2	AN	TUBING: vertical transmission line; sect No. 1; ⅜″ OD x 0.042″ wall x 35-⅜″ lg.	1					*
	6Z8850-2	T	UNION: brass; ¾″						*
	6Z8853	WC	UNION: Cat. No. A-11204; Mueller Brass						*

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Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock: 1st ech	Organization stock: 2d ech	3d ech	4th ech	Depot stock
	6Z8855.1	WC	UNION: Cat. No. A–11206; Mueller Brass	...	...	...	...	...	*
	2ZA1003B/V1	WC	VALVE GATE: brass; nonrising; stem; streamline type.	...	...	...	...	...	*
	4G1668C/W2	...	WASHER: ceramic; steatite; ⅝″ OD x $\frac{3}{16}$″ ID	...	...	...	...	*	*
	4G1668C/W3	...	WASHER: vellutex; fabric; ⅝″ OD x ⅜″ ID x $\frac{1}{32}$″ thk.	...	...	...	...	*	*
	4G1668C/W5	...	WASHER: fibre; ½″ OD; $\frac{3}{16}$″ ID; $\frac{1}{32}$″ thk.	...	...	...	...	*	*
	6L72924C	...	WASHER: lock; bronze; type BZ No. 1924	...	...	...	...	*	*
	6L50502–5	...	WASHER: vellutex; ⅜″ OD x 0.1495″ ID x $\frac{1}{32}$″ thk.	...	...	...	...	*	*
	3G1625–9	...	WASHER: vellutex; $\frac{9}{16}$″ OD x 0.261″ ID x $\frac{1}{32}$″ thk.	...	...	...	...	*	*
	6Z989	T	BLOWER: 115 v; 60 cycles; twin	1	...	...	...	...	*
	6Z982	T	BLOWER: 115 v; 60 cycles	1	...	...	...	...	*
	3H399	Rect	BLOWER: 115 v; 60 cycles; single phase; 1,725 rpm.	1	...	...	...	...	*
	6Z3802	T	FAN: 115 v; 60 cycles	1	...	...	...	...	*
	3H399/S1	T, Rect.	FAN ASSEMBLY: for blower 3H399	1	...	...	...	...	*
	6Z3804	KU	FAN UNIT: 110 v; 60 cycles; with 10″ blades	1	...	...	...	...	*
	2ZA1003B/P2	WC	PUMP ASSEMBLY: complete with ¼-hp motor.	1	...	...	...	...	*
	2ZA1003B/R1	WC	RADIATOR ASSEMBLY: complete with motor; 115 v; 60 cycles; single phase.	1	...	...	...	...	*
	2A275–118	AN	ANTENNA AN–118	1	...	...	...	...	*
	2C1539	FM	FREQUENCY METER BC–439	1	...	...	...	...	*
	2C2263B, 2C2288A	KU	KEYING UNIT BC–402–B or BC–758–A	1	...	...	...	...	*
	3H4679	Rect	RECTIFIER RA–60–A or RA–39	1	...	...	...	...	*
	2C6596/785A	T	TRANSMITTER BC–405–( ) or BC–785–A	1	...	...	...	...	*
	2ZA1004	WC	WATER COOLER RU–3–B or RU–4–A	1	...	...	...	...	*
32	3D9003	R	CAPACITOR: variable; 2½–10 mmfd	2	...	...	...	...	*
8–1	3D9030V–5	R	CAPACITOR: variable; air dielectric; 3–30, mmfd.	2	...	...	...	...	*
12–2	3D9025–3.1	R	CAPACITOR: 25 mmfd at 5,000 v; lh	2	...	...	...	*	*
12–1	3D9025–3.1	R	CAPACITOR: 25 mmfd at 5,000 v; rh	2	...	...	...	*	*
6–1	3D9027–4	R	CAPACITOR: 27 mmfd; 500 v; ceramicon	2	*	...	*	*	*
1–1 through 1–6.	3D9047–5	R	CAPACITOR: 47 mmfd (50); 500 v; ±5%; ceramic	12	*	...	*	*	*
1–1, 1–2	3D9056–1	OS	CAPACITOR: 56 mmfd (50); 500 v; mica	4	*	...	*	*	*
3–1 through 3–12.	3D9100–23	R	CAPACITOR: 100 mmfd; 500 v; ceramicon	24	*	...	*	*	*
7–1	3D9330–2.1	OS	CAPACITOR: 330 mmfd; 500 v; mica	2	*	...	*	*	*
2–1 through 2–16.	3D9500–22	R	CAPACITOR: 500 mmfd; 500 v; mica	32	*	...	*	*	*
3–1 through 3–9.	3K3010211	OS	CAPACITOR: 1,000 mmfd; 500 v; dc; mica	18	*	...	*	*	*
8–1	3DA1–23	OS	CAPACITOR: 1,000 mmfd; 2,500 v; mica	2	*	...	*	*	*
7–1	3DKA2–111	R	CAPACITOR: 2,000 mmfd; 500 v; mica	2	*	...	*	*	*
4–1 through 4–30.	3DA9	R	CAPACITOR: 9,000 mmfd; 500 v; mica; ±10%.	60	*	...	*	*	*
5A–1	3DA10–37.1	R	CAPACITOR: 10,000 mmfd; 600 v; mica	2	*	...	*	*	*
5B–1, 5B–2, 5–1 through 5–12.	3DA10–34	R, OS	CAPACITOR: 10,000 mmfd; 400 v; mica	28	*	...	*	*	*
4–1	3DA10–33	OS	CAPACITOR: 10,000 mmfd; 2,500 v; working	2	*	...	*	*	*
9–1	3DA50–9.1	OS	CAPACITOR: 35,000 mmfd; 300 v; silver mica; seven 5,000 mmfd capacitors totalling 35,000 mmfd; ±2%.	2	*	...	*	*	*
11–1	4G1668C/C1	OS	CAPACITOR ASSEMBLY: consists of two 36,500 mmfd, 250 v, capacitors in parallel to equal 73,000 mmfd; ±10%.	2	*	...	*	*	*
36–1, 6–1, 6–2, 6–3, 6–5, 6–7, 6–8, 6–10.	3DA100–26	R, OS	CAPACITOR: oil impregnated; 100,000 mmfd; 600 v; ±10%.	16	*	...	*	*	*
10–1A, 10–1B, 10–1C through 10–6A, 10–6B, 10–6C.	3DA100–36.1	R	CAPACITOR: 100,000 mmfd; 600 v; mica; triple; oil.	12	*	...	*	*	*
9–1, 9–2, 6–4, 6–9, 6–11, 6–12, 6–13.	3DA100–31	R, OS	CAPACITOR: 100,000 mmfd, ±5%; 400 v; bakelite.	14	*	...	*	*	*
2–1, 2–2	3DA200–1	OS	CAPACITOR ASSEMBLY: triple; 200,000 mmfd; 4,000 v dc.	2	*	...	*	*	*
13–1	3DA500–29	OS	CAPACITOR: 500,000 mmfd; 600 v	1	*	...	*	*	*
12–1	3DB2.6020–1	OS	CAPACITOR: 2 mfd; 600 v; oil	1	*	...	*	*	*
10–6, 10–7, 11–1 through 11–4.	3DB8–10	OS, R	CAPACITOR: 8–8 mfd; 600 v dc; paper	6	*	...	*	*	*
10–5, 10–8, 10–9.	3DB8–13	OS	CAPACITOR: 8–8 mfd; 600 v; paper	14	*	...	*	*	*
	3DB5–70	C	CAPACITOR: for gyro motor gyrostat; S#1231835.	1	...	...	*	...	*

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Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock 1st ech	Organization stock 2d ech	3d ech	4th ech	Depot stock
39–1	2C4404A/C9	R	COIL: oscillator	2	...	...	...	...	*
40–1	2C4404A/C10	R	COIL: 2d r-f	2	...	...	...	...	*
37–1	2C4404A/C15	R	COIL ASSEMBLY: 1st r-f	2	...	...	...	...	*
38–1	2C4404A/C12	R	COIL: secondary r-f	2	...	...	...	...	*
	3C1115–2	OS	COIL: relay #ASBX1	2	...	...	*	*	*
	3C1116	OS	COIL: relay #33L16	2	...	...	*	*	*
48–1, 48–2	4G1668C/R1	OS	COIL: reactor	4	...	...	...	...	*
65–1	3C1063	OS	COIL ASSEMBLY: part of phase-shifting unit	2	*	...	*	*	*
66–1	3C1081–2G	OS	COIL ASSEMBLY: oscillator	2	*	...	*	*	*
42–1	2C4404A/C5	R	COIL: buffer	2	...	...	...	...	...
30–1 through 30–4.	3C330	R	COIL: choke; filter	8	*	...	*	*	*
41–1	2C4404A/C7	R	COIL: converter or 1st det	2	...	...	...	...	*
67–1	3C1064	OS	COIL ASSEMBLY: pulse filter	2	*	...	*	*	*
64–1 through 64–4.	3C1065	OS	COIL ASSEMBLY: phase-shifting unit	8	...	...	...	...	*
	3H2421/C11	C	COIL: exciter field for motor generator S#1200927.	1	...	...	...	...	*
	3H3421/C10	C	COIL: generator field for motor generator S#1200927.	1	...	...	...	...	*
	3H8730/C5	C	COIL: field for motor S#1200926	1	...	...	...	...	*
	2Z7231	OS, R	CONNECTOR: #2187; Harvey-Hubbell, Inc	4	*	...	*	*	*
	2Z2736–6	R	CONNECTOR: grid and plate clip for acorn tube; Zenith Rad dwg #19G30 or Bell Laboratories dwg #ESO–690568.	6	*	...	...	*	*
	2C4404A/J1	R	JACK: open circuit side panel	2	...	...	...	...	*
	2Z5574.1	OS	JACK: #247J; General Radio	17	...	...	...	...	*
	2Z5540	OS, R	JACK: closed circuit midget; short jack	5	*	...	*	*	*
	6Z7565	OS	PLUG: 2-pole; male	1	...	...	...	...	*
	2Z7227–4	OS	PLUG: banana; #274–P; General Radio	17	*	...	...	*	*
	2Z5599	R	JACK: long frame; open circuit	1	...	...	...	...	*
	6Z7816	OS, R	RECEPTACLE: 2-pole; male; flush motor plug; 10-amp, 250 v; 15-amp, 125 v; type 4897.	2	...	...	...	...	*
33	3Z1935	R	FUSE: 5-amp	2	*	...	*	*	*
	4G1668C/C7	OS	CONTACT: phosphor bronze; 0.0159″ x $\frac{3}{16}$″ x $1\frac{29}{64}$″.	2	*	...	*	*	*
	2C4404B/16	R	CONTACT: brass (part of trombone support)	4	*	...	*	*	*
55	4G1668C/R2	OS	RELAY: 110 v; 60 cycles; Struthers-Dunn type 1AXX.	1	*	...	*	...	*
54	4G1668B/R5	OS	RELAY: time delay; 110 v; 60 cycles; WL	1	*	...	*	...	*
	2Z7591–14	C	RELAY: ratchet; for control unit S#1233380	...	...	...	...	...	...
	3H4995–1	C	SILVERSTAT ASSEMBLY: complete with mounting plate and resistors for gyrostat S#1231835.	1	*	...	...	...	*
	3Z9559–8.4	C	SWITCH: micro; S#1233756; for control unit S#1233380.	1	...	...	*	...	*
	3Z9859/22.8	C	SWITCH: toggle; rate on-off for control unit S#1233380.	1	...	...	*	...	*
59	3Z9848.1	OS	SWITCH SW–127: toggle; DPDT; 250 v, 1 amp; 125 v, 3 amp.	2	*	...	*	...	*
51, 60	4G1668C/S/10	OS	SWITCH: toggle; SPDT; potentiometer	2	*	...	*	...	*
27	3Z8106	R	SWITCH SW–106: 3-amp, 125 v; 2-circuit	2	*	...	*	...	*
56	3Z9899	OS	SWITCH: spring plunger; SPST; normally open; 110 v, 10 amp.	1	*	...	*	...	*
50	2Z7296–25M	OS	POTENTIOMETER: 25,000 ohms	2	*	...	*	*	*
	2Z7276.3	C	POTENTIOMETER: 60,000 ohms; series P–10W–60000; Clarostat Mfg. Co.	1	*	...	*	*	*
51	4G1668B/P5	OS	POTENTIOMETER: 75,000 ohms; in/toggle switch; SPST.	2	*	...	*	*	*
15–1	2Z7296–100M	R	POTENTIOMETER: 100,000 ohms	2	...	...	*	*	*
52–1, 52–2, 52–3.	2Z7271–73	OS	POTENTIOMETER: 200,000 ohms; type CP; taper A; not slotted; IRC.	6	*	...	*	*	*
70	2Z7298.3	OS	POTENTIOMETER: 1.5 megohm	2	*	...	*	*	*
	3Z7080	C	RHEOSTAT: for rate control unit S#1233380	...	...	...	...	...	*
	3Z4832A5	C	RESISTOR: 32.5 ohms; 200 W; wirewound	2	*	...	*	...	*
16–1, 16–2	3Z6004A7–2	OS	RESISTOR: fixed; 47 ohms ±5%; ½ W; wirewound.	4	*	...	*	*	*
33–1, 33–2	3Z6007E8.1	OS	RESISTOR: fixed; 75 ohms; 2 W; wirewound	4	*	...	*	*	*
23–1	3Z6015–29	OS	RESISTOR: fixed; 150 ohms; 1 W; wirewound	1	*	...	*	*	*
34	3Z6020–10	OS	RESISTOR: fixed; 200 ohms ±5%; 2 W; wirewound.	1	*	...	*	*	*

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206. Maintenance Parts List for Radio Sets SCR–270–( ) and SCR–271–( )—Continued

Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock 1st ech	Organization stock 2d ech	3d ech	4th ech	Depot stock
17–1	3Z6025–3	OS	RESISTOR: fixed; 250 ohms; ½ W; carbon	2	*	...	*	*	*
15–1	3Z6030–10	OS	RESISTOR: fixed; 300 ohms; 50 W; IRC type EP.	1	*	...	...	*	*
18–1, 18–2	3Z6033–3	OS	RESISTOR: fixed; 330 ohms ±10%; ½ W; carbon.	4	*	...	*	*	*
19–1, 19–2	3Z6047	R	RESISTOR: fixed; 470 ohms ±10%; ½ W; carbon.	4	*	...	*	*	*
35–1, 35–2	3Z6056–1	OS	RESISTOR: fixed; 560 ohms; 2 W; carbon	4	*	...	*	*	*
24–1	3Z6075–13	OS	RESISTOR: fixed; 750 ohms ±5%; 1 W; carbon.	2	*	...	*	*	*
26–1	3Z6075–7.1	R	RESISTOR: fixed; 750 ohms ±5%; 2 W; carbon.	2	*	...	*	*	*
24–1	3Z6075–6	R	RESISTOR: fixed; 750 ohms ±5%; 20 W	2	*	...	*	*	*
19–1, 19–2, 14–1	3Z6100–9	R, OS	RESISTOR: fixed; 1,000 ohms ±5%; ½ W; carbon.	10	*	...	*	*	*
19–3	3ZK6100–97	OS	RESISTOR: fixed; 1,000 ohms ±2%; 1 W; carbon; to consist of resistors in parallel, each 2,000 ohms, ½ W.	4	*	...	*	*	*
27–1, 27–2	3RC31BE102K	OS	RESISTOR: fixed; 1,000 ohms; 1 W; carbon	4	*	...	*	*	*
25–1	3Z6575–7	OS	RESISTOR: fixed; 7,500 ohms ±5%; 1 W; carbon.	2	*	...	*	*	*
41–1, 41–2	3Z6575–10	OS	RESISTOR: fixed; 7,500 ohms; 10 W	4	*	...	*	*	*
18–1	3Z6330	R	RESISTOR: fixed; 3,300 ohms ±5%; ½ W; carbon.	2	*	...	*	*	*
40–12	3Z6500–16	OS	RESISTOR: fixed; 5,000 ohms ±5%; 10 W; wirewound.	2	*	...	*	*	*
45–1, 21–1, through 21–6	3Z6501	OS	RESISTOR: fixed; 5,100 ohms ±5%; ½ W; carbon.	14	*	...	*	*	*
36–1	3Z6610–18	OS	RESISTOR: fixed; 10,000 ohms ±5%; 2 W; carbon.	2	*	...	*	*	*
42–1	3Z6610–21	OS	RESISTOR: fixed; 10,000 ohms ±5%; 10 W	2	*	...	*	*	*
44–1	3Z6610–19	OS	RESISTOR: fixed; 10,000 ohms; 20 W; type DG.	1	*	...	*	*	*
29–1	3Z6615–4	OS	RESISTOR: fixed; 15,000 ohms ±5%; 1 W; carbon.	2	*	...	*	*	*
43–1	3Z6615–9	OS	RESISTOR: fixed; 15,000 ohms; 10 W	2	*	...	*	*	*
37–1, 37–2	3Z6618–5	OS	RESISTOR: fixed; 18,000 ohms ±10%; 2 W; carbon.	4	*	...	*	*	*
14–1	3Z6618–12	OS	RESISTOR: fixed; 18,000 ohms; 4 W; carbon; composed of two resistors in parallel; one 33,000 ohms; the other 39,000 ohms; 2 W each; carbon.	2	*	...	*	*	*
16–1	3Z6622–2	R	RESISTOR: fixed; 22,000 ohms ±10%; ½ W; carbon.	2	*	...	*	*	*
28–1	3Z6666	OS	RESISTOR: fixed; 66,000 ohms; to consist of two resistors in parallel; 1–82,000, 1 W; and 1–330,000 ohm, ½ W; carbon.	2	*	...	*	*	*
17	3Z6682–1	R	RESISTOR: fixed; 82,000 ohms ±20%; ½ W; carbon.	2	*	...	*	*	*
30–1 through 30–4, 13–1, 15–2	3Z6700–23	OS R	RESISTOR: fixed; 100,000 ohms ±5%; 1 W; carbon.	12	*	...	*	*	*
20–1, 20–5, 22	3Z4550	OS R	RESISTOR: fixed; 100,000 ohms ±10%; ½ W; carbon.	12	...	...	...	*	*
38–1 through 38–4	3Z6727–3	OS	RESISTOR: fixed; 270,000 ohms ±10%; 2 W; carbon.	8	*	...	*	*	*
31–1	3Z6725–6	OS	RESISTOR: fixed; 270,000 ohms ±5%; 1 W; carbon.	2	*	...	*	*	*
39–1	3Z6750–8	OS	RESISTOR: fixed; 470,000 ohms; 5 W; carbon	2	*	...	*	*	*
21–1, 21–2	3RC21BE105J	OS	RESISTOR: fixed; 1 megohm ±5%; ½ W; carbon.	4	*	...	*	*	*
68	3Z6808	OS	RESISTOR: fixed; 8 megohms; 10,000 v; max d-c rating.	1	*	...	*	*	*
22–1	3RC21BE106K	OS	RESISTOR: fixed; 10 megohms; ½ W; carbon	1	*	...	*	*	*
32–1, 32–2	3Z6810–3	OS	RESISTOR: fixed; 10 megohms; 10 W	4	*	...	*	*	*
23	2C4404A/R5	R	RESISTOR: fixed; tapped at 2–23 ohms, 1 W; 1–7,500 ohms, 5 W; and 1–3,000 ohms, 25 W; type HA–IRC.	2	*	...	...	...	*
	3Z483235	C	RESISTOR: field exciter; for motor generator S#1200927.	......	...	...	*	...	*
	3Z6100–178	C	RESISTOR: for rate motor series field; control unit S#1233380.	......	...	...	*	...	*

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Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock 1st ech	Organization stock 2d ech	3d ech	4th ech	Depot stock
49-1, 49-2	4G1668B/T22	OS	TRANSFORMER: Thordarson type T-89-5-74.	4	*	...	*	...	*
31-1, 46-1, 46-2	2Z9717-70R62	R, OS	TRANSFORMER: Thordarson type 70R62	6	...	...	*	...	*
47-1	4G1668B/T21	OS	TRANSFORMER: Kenyon S-12366	1	...	...	...	...	*
	2C4404C/A3	R	TRANSFORMER: 6th i-f assembly	2	...	...	...	...	*
	2C4404C/A1	R	TRANSFORMER: i-f; 1st, 2d, 3d, 4th, and 5th.	5	...	...	...	...	*
	6J922B/T3	BD99, BD111	TRANSFORMER: for use with rectifier 6J922B/R2.	1	*	...	...	...	*
	2Z9621-74	C	TRANSFORMER: for gyromotor in gyrostat S#1231835.	1	*	...	...	...	*
	2J5BP4	OS	TUBE: JAN-5BP4 (VT-111)	1	*	...	...	...	*
	2J6AC7	R, OS	TUBE: JAN-6AC7 (VT-112)	2	*	...	...	...	*
	2J5T4	OS, R	TUBE: JAN-5T4 (VT-114)	3	*	...	...	...	*
	2J6L6	OS	TUBE: JAN-6L6 (VT-115)	6	*	...	...	...	*
	2J6SJ7	OS, R	TUBE: JAN-6SJ7 (VT-116)	2	*	...	...	...	*
	2J6SK7	R	TUBE: JAN-6SK7 (VT-117)	4	*	...	...	...	*
	2J832	R	TUBE: JAN-832 (VT-118)	1	*	...	...	...	*
	2J2X2	OS	TUBE: JAN-2X2 (VT-119)	2	*	...	...	...	*
	2J954	R	TUBE: JAN-954 (VT-120)	2	*	...	...	...	*
	2J1630	R	TUBE: JAN-1630 (VT-128)	1	*	...	...	...	*
	WL532A	R	TUBE: Spark Gap GA-5-A; WEMCO type WL-532-A.	1	*	...	...	...	*
	2J955	R	TUBE: JAN-955 (VT-121)	1	*	...	...	...	*
	2Z2712	OS	TERMINAL: grid clip #12	2	...	...	...	...	*
	4G1668B/T4	OS	TERMINAL: with ¼" hole	18	...	...	...	...	*
	3Z3915-10A	OS	TERMINAL: Cinch #1510A	3	...	...	...	...	*
	3Z3915-30	OS, R	TERMINAL: Cinch #1530	6	...	...	...	...	*
	2Z9468	OS	TERMINAL: Patton MacGuyer; #4019	25	...	...	...	...	*
	4G1668B/T2	OS	TERMINAL: Patton MacGuyer; #4035	20	...	...	...	...	*
	2ZK9404.18	OS	TERMINAL BOARD: 3-term; Cinch 1532	4	...	...	...	...	*
	3Z12059-4	OS	TERMINAL BOARD: 4-term; Cinch 1532	3	...	...	...	...	*
	3Z12059-2	OS	TERMINAL: brass; #2506-6	5	...	...	...	...	*
	3Z12059-3	OS, R	TERMINAL: brass; #2506-8	12	...	...	...	...	*
	4G1668B/T11	OS, R	TERMINAL: 5-term	10	...	...	...	...	*
	2Z9406-76	R	TERMINAL: 6-term	4	...	...	...	...	*
	3Z3915-12	R, OS	TERMINAL: Cinch #1512	4	...	...	...	...	*
	3Z3915-20	OS, R	TERMINAL: Cinch #1520	3	...	...	...	...	*
	4G/668B/T13	R, OS	TERMINAL: Cinch #1520A	5	...	...	...	...	*
	3Z12050	OS	TERMINAL: Patton MacGuyer; #4003	10	...	...	...	...	*
	4G1668C/S5/2	OS	BAR: copper; #14 B&S gauge (0.0641"); 2½" x 4⅞" x 4⅞".	2	...	...	*	*	*
	3H305-33	C	BEARING: for motor generator S#1200927	1	...	...	...	...	*
	3H3421/B5	C	BRUSH: for motor generator S#1200927	1	...	...	*	...	*
	3H3421-B5	C	BRUSH: for motor S#1200926	1	...	...	*	...	*
	3H525	C	BRUSH: for rate motor	1	...	...	...	...	*
		C	BRUSH HOLDERS: for generator S#1200927	1	...	...	...	...	*
	3H3421/H10	C	BRUSH HOLDERS: including insulation and springs for motor generator S#1200927	1	...	...	...	...	*
	3H2730/H5	C	BRUSH HOLDERS: including insulation and springs for motor S#1200926	1	...	...	...	...	*
	4G1668C/S5/3	OS	BUSHING: brass; ¾" hex head; ½-20 threads; 33/64" lg; part of phase-shifter unit.	1	...	...	...	...	*
	4G1668D/D1	OS	DIAL: translucent; lamicoid; 7⅝" OD x 1/16" thick.	1	*	...	...	...	*
	2C4404A/D1	R	DIAL: tuning	1	...	...	...	...	*
	2Z4870-5	OS	GEAR: pinion; 48-pitch; 10 teeth; part of trombone ass'y.	1	...	...	...	...	*
	4G1668C/H2	OS	HANDWHEEL: bakelite 1⅝"	4	*	...	*	*	*
	4G1668C/H1	OS	HANDWHEEL: bakelite 2¼"	1	...	...	*	*	*
	4G1668C/H3	OS	HANDWHEEL: "Celeron"; type #100-453	1	...	...	*	*	*
	4G1668D/B1	OS	JACK BOARD: ⅜" x 29/32" x 2 3/16"	2	...	...	...	...	*
	2Z5840-2	R	KNOB ASSEMBLY: molded phenolic	2	...	...	...	...	*
	4G1668C/S5	OS	PHASE-SHIFTING UNIT	1	...	...	...	...	*
	4G1668C/P3	OS	PIN: brass rod 1/32" diam x ⅜" lg	1	...	...	...	...	*
	4G1668C/P2	OS	PIN: brass rod 1/16" diam x 3/16" lg	4	...	...	...	...	*
	2Z7370	R	RACK ASSEMBLY	1	...	...	...	...	*
	6J922B/R2	BD99, BD111	RECTIFIER: dry disk for use with transformer 6J922B/T3.	1	*	...	...	...	*
	4G1668B/R8	OS	RING: brass; 6¾" OD x 5¾" ID x ½" thick	2	...	...	...	...	*
	4G1668C/R5	OS	RING: brass tubing; 1/32" thk x 1" ID x 3/16" w	1	...	...	...	...	*

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	3H2480–392/S6	C	SPRINGS AND SHOES: for damping; gyrostat S#1231835.	1	...	...	...	...	*
	6J922B/T6	R	TROMBONE ASSEMBLY	1	...	...	...	...	*
	6Z984	OS	BLOWER: 110 v; 60 cycles; single phase	1	...	...	...	...	*
	3H3421	C	MOTOR GENERATOR: S#1200927	1	...	...	...	...	*
	3H300–68	C	MOTOR: rate complete for control unit	2	...	...	...	...	*
	3H2417	C	MOTOR: synchro-tie; S#1231188; type 6DG	1	...	...	...	...	*
	3H2347	C	MOTOR: synchro-tie; S#1231189; synchro generator type 6G.	2	...	...	...	...	*
	3H3118	C	MOTOR: synchro-tie; S#1231727	1	...	...	...	...	*
	3H2348	C	MOTOR: synchro-tie; S#1231190; type 5F	2	...	...	...	...	*
	2H688A	C	CONTROL MC–298	1	...	...	...	...	*
	4G1668	OS	OSCILLOSCOPE BC–403–( )	1	...	...	...	...	*
	2C–4404	R	RECEIVER BC–404–( )	1	...	...	...	...	*
	2Z2324	C	CONTROL UNIT: S#1233380 (BC–1011–A)	1	...	...	...	...	*
	3H2480/392	C	GYROSTAT UNIT: S#1231835 (BC–1011–A)	1	...	...	...	...	*
2	3D9015V–5	TW	CAPACITOR: var; 15 mmfd; air	1	...	...	...	...	*
12	3D9140V–3	TW	CAPACITOR: var; air dielectric; 140 mmfd; 9 rotor; 10 stator plates.	1	...	...	...	...	*
30	3D9300–2	TW	CAPACITOR: 300 mmfd; 600 v; ±10%; mica.	1	*	...	*	*	*
4	3D9500–10	TW	CAPACITOR: 500 mmfd; 500 v; ±5%	1	*	...	*	*	*
35	3DA2.100V	TW	CAPACITOR: var; 660–2,100 mmfd; air	1	...	...	*	*	*
30	3DA1–46	TW	CAPACITOR: 1,000 mmfd; 1,000 v; ±2%; mica.	1	*	...	*	*	*
29	3DA1–55	TW	CAPACITOR: 1,000 mmfd; 500 v d-c; mica	2	*	...	*	*	*
14–1, 14–2	3D281	TW	CAPACITOR: 10,000 mmfd; 400 v d-c; ±10%	2	*	...	*	*	*
28–1	3DA13–7	TW	CAPACITOR: 13,000 mmfd ±1%; mica	1	...	...	*	*	*
16	3D284	TW	CAPACITOR: 50,000 mmfd; 400 v; ±10%	1	*	...	*	*	*
13–1, 13–2	3D177A	TW	CAPACITOR: 500,000 mmfd; 400 v d-c; +14% −6%; per SC–D–512; ES–D–5687–13.	2	...	...	*	*	*
34–1	3DB8–18	TW	CAPACITOR: 8 mfd; 250 v d-c; dry electrolytic.	1	*	...	*	*	*
8–1	3DB8–16	TW	CAPACITOR: 8–8 mfd; 475 v; electrolytic	1	*	...	*	*	*
31	2C2454A/C7	TW	COIL: antenna	1	...	...	...	...	*
6	3C316	TW	COIL: choke	1	...	...	...	...	*
1	2C4554A/C3	TW	COIL: r-f	1	...	...	...	...	*
26	2C2454A/C5	TW	COIL: retarding	1	...	...	...	...	*
.	2Z5544	TW	JACK: long frame	1	...	...	...	...	*
	6Z7810–5	TW	RECEPTACLE: 4-prong; type F6854	1	...	...	...	...	*
10	3Z1927	TW	FUSE: 2-amp; 250 v; 3AG	1	*	...	*	*	*
	3Z8131	TW	SWITCH SW–131; toggle; SPST: 3-amp; 250 v	1	...	...	*	...	*
11	2Z7276.4	TW	POTENTIOMETER: 40,000 ohms	1	...	...	*	*	*
	3Z6020–7	TW	RESISTOR: fixed; 200 ohms ±5%; ½ W; carbon.	1	*	...	*	*	*
24–1	3Z6045–2	TW	RESISTOR: fixed; 450 ohms ±10%; 1 W; wirewound.	1	*	...	*	*	*
37–1, 37–2	2C2683/26A	TW	RESISTOR: fixed; 40,000 ohms; 2 W; carbon	2	*	...	*	*	*
36–1	3Z802–11	TW	RESISTOR: fixed; 2 megohms ±20%; ½ W; carbon.	1	*	...	*	*	*
3	3Z6810–4	TW	RESISTOR: fixed; 10 megohms ±10%; 1 W; carbon.	1	*	...	*	*	*
15–1	3Z6625–15	TW	RESISTOR: adjustable; 25,000 ohms; 50 W; type EPA.	1	*	...	...	*	*
	2Z8762.1	TW	SOCKET: tube filter; standard 4-prong	1	*	...	*	*	*
	2Z8761.1	TW	SOCKET: for acorn tubes	7	*	...	*	*	*
7	2Z9959	TW	TRANSFORMER: 6F6 to output; Amertran J871.	1	*	...	*	*	*
5	2Z9958	TW	TRANSFORMER: 115/770; Thord. T70R61	1	...	...	...	*	*
	2J6F6	TW	TUBE: JAN–6F6 (VT–66)	1	*	...	...	...	*
	2J6J7	TW	TUBE: JAN–6J7 (VT–91)	1	*	...	...	...	*
	2J5W4	TW	TUBE: JAN–5W4 (VT–97)	1	*	...	...	...	*
	2J955	TW	TUBE: JAN–955 (VT–121)	1	*	...	...	...	*
	3Z12051	TW	TERMINAL: Patton MacGuyer 4018	3	...	...	...	...	*
	3Z1011	TW	CLIP: fuse; brass; #1011	2	...	...	...	...	*
	3Z1927.1	TW	FUSE: post	1	...	...	...	...	*
	3G–1838–60	TW	INSULATOR: phenolic plate; 3¾" x 1⅞" x ⅛".	1	...	...	...	...	*
	6L21230–2	TW	STUD: brass; No. 8–32 thread; ½" OD; 2½" lg.	1	...	...	...	...	*
2	3D9010–27	PI	CAPACITOR: 10 mmfd; 1,000 v	1	*	...	...	...	*
5	3DA100–117	PI	CAPACITOR: 100,000 mmfd; 600 v	1	*	...	...	...	*
4	3DA500–30	PI	CAPACITOR: 500,000 mmfd; 600 v; oil filled	2	*	...	...	...	*

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3	3DB8–37	PI	CAPACITORS: 8 mfd; 450 v; electrolytic	4	*	...	...	...	*
15	2Z7276.2	PI	POTENTIOMETER: 500 ohms	1	*	...	*	*	*
14	2Z7276.1	PI	POTENTIOMETER: 10,000 ohms	1	*	...	*	*	*
45	2Z7296–100M	IR	POTENTIOMETER: 100,000 ohms; modified exponential taper; taper A; type CS; International Resistance Co.	1	*	...	*	*	*
14	3Z6010–53	IR	RESISTOR: 100 ohms; ½ W; wirewound	2	*	...	*	...	*
	3Z6010–27	PI	RESISTOR: 100 ohms; 1 W; wirewound	1	*	...	*	...	*
18	3Z6015–29	PI	RESISTOR: 200 ohms; 1 W; wirewound	1	*	...	*	...	*
	3Z6025–39	PI	RESISTOR: 250 ohms; 1 W; wirewound	1	*	...	*	...	*
20	3Z4525	IR	RESISTOR: 1,000 ohms; ½ W; carbon	1	*	...	*	...	*
28	3Z6120–2	IR	RESISTOR: 1,200 ohms; 1 W; carbon	1	*	...	*	...	*
12	3Z6200–12	PI	RESISTOR: 2,000 ohms; 1 W; ±5%; carbon	1	*	...	*	...	*
22	3Z6220–16	IR	RESISTOR: 2,200 ohms; ½ W; carbon	1	*	...	*	...	*
26	3Z6250–38	IR	RESISTOR: 2,500 ohms; 2 W; carbon	4	*	...	*	...	*
23	3Z6270–7	IR	RESISTOR: 2,700 ohms; 2 W; carbon	1	*	...	*	...	*
21	3RC21AE332M	IR	RESISTOR: 3,300 ohms; ½ W; carbon	1	*	...	*	...	*
7	3Z6400–5	PI	RESISTOR: 4,000 ohms; 1 W; carbon	1	*	...	*	...	*
16	3Z6470–13	IR	RESISTOR: 4,700 ohms; ½ W; carbon	1	*	...	*	*	*
27	3Z6506–10	IR	RESISTOR: 5,600 ohms; 2 W; carbon	3	*	...	*	*	*
17	3Z6610–44	IR	RESISTOR: 10,000 ohms; ½ W; carbon	2	*	...	*	*	*
8	3RC31BE103J	PI	RESISTOR: 10,000 ohms; 1 W; carbon	1	*	...	*	*	*
18	3Z6615–1	IR	RESISTOR: 15,000 ohms; ½ W; carbon	2	*	...	*	*	*
27	3Z6650–14	IR	RESISTOR: 56,000 ohms; ½ W; carbon	3	*	...	*	*	*
30	3Z6662–7	IR	RESISTOR: 62,000 ohms; 1 W; carbon	2	*	...	*	*	*
15	3Z6662–2	IR	RESISTOR: 62,000 ohms; 2 W; carbon	4	*	...	*	*	*
	3Z6675–24	PI	RESISTOR: 75,000 ohms; 1 W; carbon	1	*	...	*	*	*
17	3Z6675–10	PI	RESISTOR: 75,000 ohms; 2 W; carbon	1	*	...	*	*	*
14	3RC31BE104K	PI	RESISTOR: 100,000 ohms; 1 W; carbon; IRC, BT–1; dwg ES–20169.	1	*	...	*	*	*
29	3Z6715–35	IR	RESISTOR: 150,000 ohms; 1 W; carbon	1	*	...	*	*	*
19	3Z6739–2	IR	RESISTOR: 390,000 ohms; ½ W; carbon	1	*	...	*	*	*
	2S270B/C12	CO	CORD CO–293: 1-cond #10; shielded h-v cable 100 ft lg.	1	...	...	...	...	*
	2S270B/C11	CO	CORD CO–290: 1-cond or #10 shielded h-v cable; 20 ft lg.	1	...	...	...	...	*
	1B802.3	CO	CABLE: 1-cond #2 stranded; SBRC	200	...	...	...	...	*
	3Z2660.3	K30	FUSE: 60-amp; 250 v	3	*	...	*	*	*
	3Z2630.8	K30	FUSE: 30-amp; 25 v; 1¼″ x 9⁄32″	1	*	...	*	*	*
	3Z1939	K30	FUSE HOLDER	1	...	...	...	...	*
	6Z6812–6	K31, K30	LAMP: 12 v; 25 W; inside frosted	6	*	...	...	...	*
	6Z6820–5	K31, K30	LAMP: 120 v; 60 W; inside frosted	6	*	...	...	...	*
	2S271/R35	K30	SWITCH: push button	1	...	...	...	...	*
	3Z8146–A	K30	SWITCH: light	1	...	...	...	...	*
	3Z98292–10–1	K30	SWITCH: 60-amp; 230 v	1	...	...	...	...	*
	3Z7080	K30	RHEOSTAT: 80 ohms; for azimuth control	1	...	...	...	...	*
	3H3105	K22	MOTOR: winch type	1	...	...	...	...	*
	5B508B–7	K22	ANCHOR: mushroom	3	...	...	...	...	*
	6Z1802	K22	CHAIN: ⅜″ OD x 10″ lg	1	...	...	...	...	*
	5B4106	K22	CLIP: wire rope; ⅜″ OD	6	...	...	...	...	*
	2Z770	K30	CUSHION: rubber	1	...	...	...	...	*
	6Z3601	K30	DISK: rubber	1	...	...	...	...	*
	6Z4929	K30	GUARD: lamp	3	...	...	...	...	*
	6Z7950	K22	GUY: ⅜″ wire; 10 ft lg	1	...	...	...	...	*
	6Z7951	K22	GUY: ⅜″ wire; 20 ft lg	1	...	...	...	...	*
	6Z7952	K22	GUY: ⅜″ wire; 55 ft lg	1	...	...	...	...	*
	6Z7908–1	K22	GUY: ⅝″ manila rope; 60 ft lg	1	...	...	...	...	*
	2S270B/H5	K22	HOOK: size ½″	3	...	...	...	...	*
	6Z5082	K30, K31	HINGE: screen door	2	...	...	...	...	*
	6Z6918–2	K30	LATCH: 1²⁹⁄₃₂″ x 9⁄16″	2	...	...	...	...	*
	2S270B/L5	K22	LINK: lap; for ⅜″ chain	...	...	...	...	...	...
	6G20306–20	K30	SCREW: wing	2	...	...	...	...	*
	2Z8401–5HP12	K30	SHOCKMOUNT: monel metal	4	...	...	...	...	*
	2Z8406–1	K30	SHOCKMOUNT: monel metal	4	...	...	...	...	*
	2Z8401–PH4	K30	SHOCKMOUNT: part of shockmount for tubes.	4	...	...	...	...	*
	2Z8403		SHOCKMOUNT	4	...	...	...	...	*
	2Z8408–1	K30	SHOCKMOUNT	4	...	...	...	...	*
	2Z8483–813AJ	K30, K31	SHOCKMOUNT	8	...	...	...	...	*

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	2Z8483-814J	K30	SHOCKMOUNT	4	...	...	...	...	*
	2Z8483-812J	K31	SHOCKMOUNT	4	...	...	...	...	*
	6L31304	K30	STUD: brass; 10½" lg; 5⁄16" diam	4	...	...	...	...	*
	2Z9405-3	K30	TERMINAL BLOCK	1	...	...	...	...	*
	3Z12522	K30	TERMINAL BLOCK	1	...	...	...	...	*
	2S270B/T10	K22	TURNBUCKLE: ½" jaw and eye 12" lg	3	...	...	...	...	*
	3E3155-60-1	CO	CABLE: 5-cond; stranded #14; SBRC; 600 v; neoprene jacket.	100	...	...	...	...	*
	2S270B/C12	CO	CORD CO-293: 1-cond #10; shielded h-v cable; 100 ft lg.	1	...	...	...	...	*
	2S270B/C11	CO	CORD CO-290: 1-cond #10; shielded h-v cable; 20 ft lg.	1	...	...	...	...	*
	1B8023	CO	CABLE: 1-cond #2; stranded; SBRC; 600 v	200	...	...	...	...	*
	3Z2660.3	K30	FUSE: 60-amp; 250 v	3	*	...	*	*	*
	3Z2630.8	K30	FUSE: 30-amp; 25 v; 1¼" x 9⁄32"	1	*	...	*	*	*
	3Z1939	K30	FUSE HOLDER	1	...	...	...	...	*
	6Z6812-6	K31, K30	LAMP: 12 v; 25 W; inside frosted	6	*	...	...	...	*
	6Z6820-5	K31, K30	LAMP: 120 v; 60 W; inside frosted	6	*	...	...	...	*
	2S271/R35	K30	SWITCH: push button	1	...	...	...	...	*
	3Z8146-A	K30	SWITCH: light	1	...	...	...	...	*
	3Z98292-10-1	K30	SWITCH: 60-amp; 230 v	1	...	...	...	...	*
	2Z7080	K30	RHEOSTAT: 80 ohm; for azimuth control	1	...	...	...	...	*
	2Z7770	K30	CUSHION: rubber	1	...	...	...	...	*
	6Z3601	K30	DISK: rubber	1	...	...	...	...	*
	6Z4929	K30	GUARD: lamp	3	...	...	...	...	*
	6Z5082	K30	HINGE: screen door spring	2	...	...	...	...	*
	6Z6918-2	K30	LATCH: 1²⁹⁄₃₂" x 9⁄16"	2	...	...	...	...	*
	6G20306-20	K30	SCREW: wing	2	...	...	...	...	*
	228401-5HP12	K30	SHOCKMOUNT: monel metal	4	...	...	...	...	*
	2Z8406-1	K30	SHOCKMOUNT: monel metal	4	...	...	...	...	*
	228401-PH4	K30	SHOCKMOUNT: part of shockmount for tubes	4	...	...	...	...	*
	2Z8403	K30	SHOCKMOUNT	4	...	...	...	...	*
	2Z8483-812J	K31	SHOCKMOUNT	4	...	...	...	...	*
	2Z8483-813AJ	K31	SHOCKMOUNT	8	...	...	...	...	*
	2Z8404-1	K30	SHOCKMOUNT	4	...	...	...	...	*
	2Z8483-814J	K30	SHOCKMOUNT	4	...	...	...	...	*
	6L31304	K30	STUD: brass; 10½" lg x 5⁄16" diam	4	...	...	...	...	*
	2Z905-3	K30	TERMINAL BLOCK	1	...	...	...	...	*
	3Z12522	K30	TERMINAL BLOCK	1	...	...	...	...	*
	3E2142	CO	CABLE: #12; RWSB; white; 600 v	100	...	...	...	...	*
	3E2142.1	CO	CABLE: stranded; #12; RWSB; black; 600 v	100	...	...	...	...	*
	1B814.46	CO	CABLE: 1-cond; stranded; #14; RWSB; green; 600 v.	140	...	...	...	...	*
	3E3151.3-420	CO	CABLE: 1-cond; stranded; #14; RWSB; white; 600 v.	75	...	...	...	...	*
	3E3141.6-420	CO	CABLE: 1-cond; stranded; #14; RWSB; red; 600 v.	100	...	...	...	...	*
	1D999	CO	CABLE: 3-cond; #0, with ground return; Parkway nonmetallic; type RJ; with ground wire 600 v.	100	...	...	...	...	*
	1B804.4	CO	CABLE: 1-cond; stranded; #4; RWDB; white; 600 v.	20	...	...	...	...	*
	3E3151.5-168	CO	CABLE: 1-cond; stranded; #4; RWDB; black; 600 v.	20	...	...	...	...	*
	3E3151.10-240	CO	CABLE: 1-cond; stranded; #8; RWDB; white; 600 v.	70	...	...	...	...	*
	1B808.2	CO	CABLE: 1-cond; stranded; #8; RWDB; black; 600 v.	70	...	...	...	...	*
	3E3140-72	CO	CABLE: 1-cond; stranded; #10; RWSB; white; 600 v.	50	...	...	...	...	*
	3E3140.1-384	CO	CABLE: 1-cond; copper; #10; stranded; RWSB; black; 600 v.	100	...	...	...	...	*
	3E3151.20-252	CO	CABLE: 1-cond; #14; RWSB; NEC; 600 v; brown.	35	...	...	...	...	*
	1B814.24	CO	CABLE: 1-cond; #14; RWSB; NEC; 600 v; blue.	200	...	...	...	...	*
	1B3018-62	CO	CABLE: 6-cond; #18	5	...	...	...	...	*
	3E3141-180	CO	CORD: 1-cond; ¼" insulation; 15 ft lg; molded terminals; high-voltage.	1	...	...	...	...	*
	3E3141.1-300	CO	CORD: 1-cond; #10; stranded; 25 ft lg; terminal lugs; h-v.	1	...	...	...	...	*

Note.—Order maintenance parts by stock number, name, and description. Only maintenance parts can be requisitioned.

Reference Symbol	Signal Corps Stock No.	Major Component	Name of part and description	Quantity per unit	Organization stock 1st ech	Organization stock 2d ech	3d ech	4th ech	Depot stock
	3Z1903-30	BD99, BD111	FUSE: 30-amp; 250 v; cartridge; renewable	12	*	...	*	*	*
	3Z1905-30	BD99, BD111	FUSE: 100-amp; 250 v; cartridge; renewable	2	*	...	*	*	*
	3Z3030-2	BD99, BD111	LINK: 30-amp; 250 v; for fuse 3Z1903-30	12	*	...	*	*	*
	3Z3100.2	BD99, BD111	LINK: 100-amp; 250 v; for fuse 3Z1905-30	2	*	...	*	*	*
	3F8150	BD99, BD111	METER: 0–150 v; a-c	3	...	...	...	...	*
	2S270B/M1	BD99, BD111	METER: 0–150 v; a-c; const v	1	...	...	...	...	*
	3H5307	BD99, BD111	STARTER: De-ion type 709 for Starting Box BE–80; WEMCO.	2	...	...	...	...	*
	3H4111-51	BD99, BD111	SWITCH: rotary brush; 100-amp; 250 v	1	...	...	...	...	*
	2S270B/C12	CO	CORD CO–293: 1-conductor; #10 shielded high-voltage cable; 100 ft long.	1	...	...	...	...	*
	2S270B/C11	CO	CORD CO–290: 1-conductor; #10 shielded high-voltage cable; 20 ft long.	1	...	...	...	...	*
	1B802.3	CO	CABLE: 1-conductor; #2 stranded; SBRC	200	...	...	...	...	*
	3E4036-360-2	CO	CORD: 1-conductor; #16 stranded; SBRC; 600 volts.	200	...	...	...	...	*
	2S270B/C4	CO	CORD: 1-conductor; steel; #4 stranded; bare	150	...	...	...	...	*
	1B7818-2	CO	CORD: 2-conductor; #18 stranded; shielded, rubber covered; 600 volts.	65	...	...	...	...	*
	2Z7672.1	K64	CONTACTOR: 208 volts, 60 cycles	1	...	...	*	...	*
	2Z7672.1/1	K64	CONTACTS: set; for contactor item above	1	...	...	...	...	*
	2Z7672.2	K64	CONTACTOR: complete with coil	1	...	...	*	...	*
	2Z7672.2/1	K64	CONTACTS: set; for contactor item above	1	...	...	...	...	*
	3Z9867.3	K62	SWITCH: 2 contacts, 10-amp	1	*	...	...	...	*
	3Z9827-4	K62	SWITCH: spring plunger type; normally closed.	......	*	...	...	...	*
	3Z9827-3	K62	SWITCH: spring plunger type; normally open	......	*	...	...	...	*
	3Z9892-10.1	K62	SWITCH: safety; 60 amperes; 3-pole; altered	1	...	...	...	...	*
	3Z8146-A	K30	SWITCH: light	1	*	...	...	...	*
	5B508B-7	K64	ANCHOR: mushroom	3	...	...	...	...	*
	6Z1802	K64	CHAIN: ⅜″ OD x 10″ long	1	...	...	...	...	*
	5B4106	K64	CLIP: wire rope; ⅜″ OD	6	...	...	...	...	*
	2Z770	K62	CUSHION: rubber	1	...	...	...	...	*
	6Z3601	K62	DISK: rubber	1	...	...	...	...	*
	6Z4929	K62	GUARD: lamp	3	...	...	...	...	*
	6Z7950	K64	GUY: ⅜″ wire, 10 ft long	1	...	...	...	...	*
	6Z7951	K64	GUY: ⅜″ wire, 20 ft long	1	...	...	...	...	*
	6Z7952	K64	GUY: ⅜″ wire, 55 ft long	1	...	...	...	...	*
	6Z7908-1	K64	GUY: ⅝″ manila rope, 60 ft long	1	...	...	...	...	*
	2S270B/H5	K64	HOOK: size ½″	3	...	...	...	...	*
	6Z5082	K62, K31	HINGE: screen door	2	...	...	...	...	*
	6Z6918-2	K62	LATCH: $1\frac{29}{32}$″ x $\frac{9}{16}$″	2	...	...	...	...	*
	2S270B/L5	K64	LINK: lap; for ⅜″ chain	......	...	...	...	...	*
	6L20506-205	K62	SCREW: wing	2	...	...	...	...	*
	2Z8401-5HP12	K62	SHOCKMOUNT: Monel metal	4	...	...	...	...	*
	2Z8406-1	K62	SHOCKMOUNT: Monel metal	4	...	...	...	...	*
	2Z8401-PH4	K62	SHOCKMOUNT: part of shockmount for tubes.	4	...	...	...	...	*
	2Z8403	....	SHOCKMOUNT	4	...	...	...	...	*
	2Z8404-1	K62	SHOCKMOUNT	4	...	...	...	...	*
	2Z8483-813AJ	K62, K31	SHOCKMOUNT	8	...	...	...	...	*
	2Z8483-814J	K62	SHOCKMOUNT	4	...	...	...	...	*
	2Z8483-812J	K31	SHOCKMOUNT	4	...	...	...	...	*
	6L31304	K62	STUD: brass, 10½″ long, $\frac{5}{16}$″ diam	4	...	...	...	...	*
	2Z9405-3	K62	TERMINAL BLOCK	1	...	...	...	...	*
	3Z12522	K62	TERMINAL BLOCK	1	...	...	...	...	*
	2S270B/T10	K64	TURNBUCKLE: ½″ jaw and eye; 12″ long	3	...	...	...	...	*
	6R50202	K64	MOTOR: winch type (K64)	1	...	...	...	...	*
	2S270B/C12	CO	CORD CO–293: 1-conductor; #10; shielded high-voltage cable; 100 ft long.	1	...	...	...	...	*
	2S270B/C11	CO	CORD CO–290: 1-conductor; #10 shielded high-voltage cable; 20 ft long.	1	...	...	...	...	*
	1B802-3	CO	CABLE: 1-conductor; #2 stranded; SBRC	200	...	...	...	...	*
	3E4035-47	CO	CORD: 1-conductor; #10 stranded; high-voltage cable; 30 ft long.	1	...	...	...	...	*

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