# TM 11-2519

AR DEPARTMENT TECHNICAL MANUAL

U.S. Dept. of Army

# VIBRATOR TYPE INVERTER

# 12-VOLT DC TO 110-VOLT AC)

**RESTRICTED.** DISSEMINATION OF RESTRICTED MATTER. The information contained in restricted documents and the essential characteristics of restricted materiel may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also par. 28, AR 380-5, 15 Mar 1944.)

*WAR DEPARTMENT* *31 JULY 1944*

*WAR DEPARTMENT TECHNICAL MANUAL*

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WAR DEPARTMENT,
WASHINGTON 25, D. C., 31 JULY 1944.

TM 11-2519, Vibrator Type Inverter (12-volt dc to 110-volt ac), is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
*Chief of Staff.*

OFFICIAL:
J. A. ULIO,
*Major General,*
*The Adjutant General.*

DISTRIBUTION:
"X"
(For explanation of symbols see FM 21–6.)

# TABLE OF CONTENTS

# DESTRUCTION NOTICE

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

**WHEN**—When ordered by your commander.

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

2. Cut —Use axes, handaxes, machetes.

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

4. Explosives—Use firearms, grenades, TNT.

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

**USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.**

**WHAT**—1. Smash—Vibrator, transformer, assemblies, switch, all other filter parts.

2. Cut —Cables, leads.

3. Burn —Technical manual.

4. Bury or scatter—All parts after smashing.

## DESTROY EVERYTHING

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# SAFETY NOTICE

**Severe electric shock may result from contact with a-c power output of this equipment. Always disconnect the cables from the storage battery when working on the unit.**

# SECTION I
# DESCRIPTION

**1. GENERAL.** The vibrator type inverter (fig. 1) converts 12-volt direct current (dc) to 110-volt, 60-cycle alternating current (ac) at a continuous output wattage of 100 watts, for the operation of a-c radio equipment, or other electronic apparatus having a power factor not lower than 80 percent and an input rating not exceeding 90 watts. The complete unit weighs 17 pounds, and is 7-7/8 inches wide, 8-3/16 inches deep, and 4-1/2 inches high.

## 2. COMPONENTS.

**a. Chassis and Attached Components.** The inverter chassis, on which the transformer, vibrator, and primary filter assembly are mounted, is enclosed in a sheet metal case. The chassis acts as a partition separating the vibrator and transformer from the filter assemblies. It is held in position by screws on the top and bottom of the case and by the transformer mounting bolts.

**b. Case and Attached Components.** The sheet metal case is fitted with two metal covers. The following parts, mounted on the front cover, are visible from the exterior of the unit: voltage regulator switch; a-c output receptacle; fuse mounting, 15-amp. Internally, the front cover has the secondary filter assembly mounted on it. This cover is held in place by two metal screws sealed in solder. The back cover has no parts mounted on it and is also held in place by two metal screws. The back cover can be removed when it is necessary to replace the plug-in vibrator unit.

**c. D-c Input Cables.** The d-c input is brought to the vibrator type inverter through two rubber-covered cables, approximately 3 feet long, equipped with battery clips. The clips are not polarized. These cables enter the cabinet through insulated grommets at the upper left-hand corner of the front panel.

## 3. POWER.

**a. Input.** The input current is approximately 11.2 amperes from a 12-volt storage battery when operating a load of 100 watts at unity power factor (for example, a 100-watt lamp bulb). When the vibrator type inverter is operating with no load, the input current is approxi-

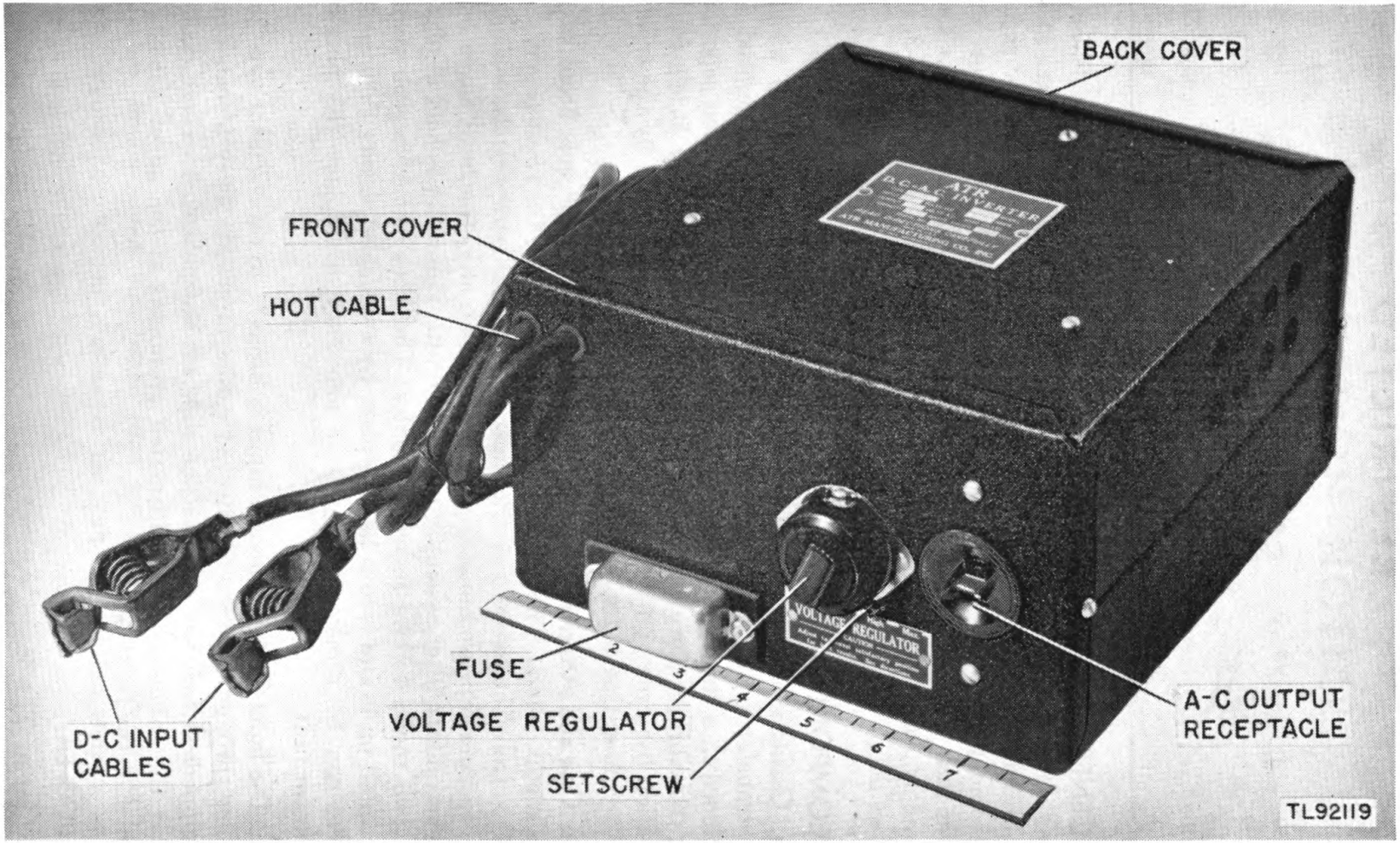


*Figure 1. Vibrator type inverter (12-volt dc to 110-volt ac).*

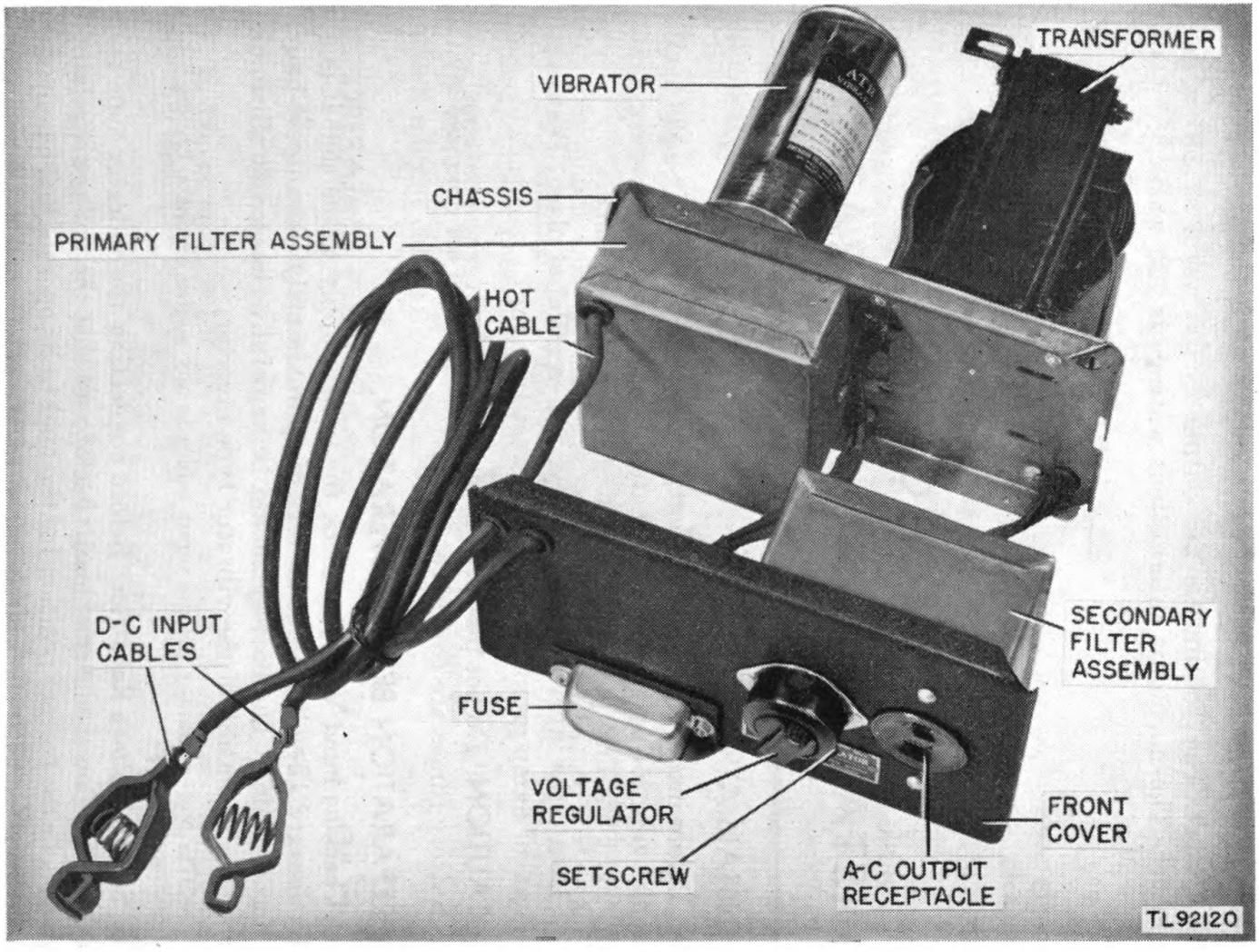


*Figure 2. Vibrator type inverter (12-volt dc to 110-volt ac), case removed.*

mately 0.7 amperes with the voltage regulator set in the MAX position.

**b. Output.** The continuous a-c output is 100 watts at 110 volts, 60 cycles. The maximum intermittent wattage is 125 watts.

# SECTION II
# INSTALLATION AND OPERATION

## 4. INSTALLATION.

**a.** Before installing the equipment, remove the back cover and check that the vibrator unit is properly seated in its socket. If necessary, seat it by light but firm pressure of the fingers. **Do not use force.**

**b.** Locate the inverter in a cool, dry, well-ventilated place. It should be kept off damp ground and out of direct sunlight.

**CAUTION:** Do not place the inverter directly over the battery. Battery fumes are corrosive.

## 5. PREPARATION BEFORE OPERATION.

**a. Checking Input Voltage.** Check the power supply to see that it is a fully charged 12-volt storage battery of approximately 100-ampere-hour or higher rating. The battery should be kept fully charged at all times for proper operation of the vibrator type inverter.

**NOTE:** Never connect the d-c input cables to any source except a 12-volt storage battery.

**b. Setting Voltage Regulator.** Before connecting the vibrator type inverter to the power source or load, check to see that the voltage regulator switch is in the correct position for the load to be operated. The output of the inverter with the switch in the LOW, MED, or HIGH positions is approximately 25, 50, or 75 watts, respectively. Check the rating of the equipment to be operated, and adjust the voltage regulator switch on the inverter to the **lowest** satisfactory operating position. This will reduce the danger of feeding excessive a-c voltage to the load. After turning the switch to the proper position, tighten the setscrew provided (fig. 1) to prevent the switch knob from being turned accidentally.

**c. Checking Fuse.** Remove the fuse holder cover and check to see that the 15-ampere fuse is in place. **Never operate the inverter with a fuse having a rating in excess of 15 amperes.**

**d. Connecting the Load.** Plug the cable to the load into the a-c receptacle located on the front of the inverter (figs. 1 and 2), and leave it in that position.

## 6. CONNECTING D-C INPUT CABLES.

**a. General.** The d-c input cables on the vibrator type inverter are not polarized. Therefore, if the 12-volt storage battery is used with this unit alone, it will make no difference which inverter input cable is connected to the positive battery terminal or the negative.

**b. When Battery is Grounded.** When the storage battery used to operate the vibrator type inverter has one terminal grounded, as in the case of a vehicular installation, connect the ungrounded ("hot") input cable (figs. 1 and 2) to the ungrounded side of the battery and the grounded input cable (fig. 3) to the grounded side of the battery.

## 7. OPERATION.

**a. General.** When the input cables are properly connected to the battery terminals (par. 6), the vibrator unit in the inverter will begin to operate, emitting an audible 60-cycle mechanical buzz. Switch the load ON and leave it in that position.

**b. Stopping the Inverter.** To turn off the inverter, disconnect one of the d-c input cables from the battery terminal.

## 8. OPERATING PRECAUTIONS.

**a. Never operate the inverter without a load.** Be sure to disconnect the inverter whenever the a-c load is not being used.

**b.** Never operate the inverter with a load of greater wattage input rating than the maximum output of the inverter. This will cause the fuse to blow, and will shorten the life of the inverter.

**c.** Do not use the inverter longer than 3 or 4 hours at a time when the operating load exceeds 100 watts.

**d.** To minimize interference in radio equipment using the inverter as an a-c source, be sure to ground the radio and equip it with a good aerial. Locate the radio and aerial lead-in as far from the inverter as practicable. Excessive noise in the radio may further be minimized by reversing the plug in the inverter output receptacle.

# SECTION III
# FUNCTIONING OF PARTS

**9. CIRCUIT.** Figure 3 is a circuit diagram of the vibrator type inverter, showing the various components in relation to one another. The functions of the parts shown on the diagram are discussed in paragraphs 10 through 15.

**10. TRANSFORMER** (fig. 3). The primary winding of the transformer is center-tapped and is connected through the vibrator and the 15-ampere line fuse to the 12-volt storage battery. The secondary winding is tapped at points corresponding to the LOW, MED. HIGH, and MAX positions on the voltage regulator switch. The output of the transformer secondary can be varied by use of this switch, which is connected to these secondary taps (fig. 3). The transformer secondary is shielded from the primary by an electrostatic shield, which is grounded.

**11. VIBRATOR.** The vibrator used is connected to the primary of the transformer (fig. 3), which is center-tapped to form a full-wave vibrator circuit. The vibrator is in effect a double-pole, double-throw, vibrating switch. It is a 10-contact, plug-in unit, with dual contact arms, using eight ¼-inch diameter tungsten power contacts and two silver alloy driver contacts. Two sets of the power contacts are mounted on the vibrator reed, and the other two sets are stationary. The vibrator reed is set in motion by an electromagnet energized when the d-c input is applied, and operates at its tuned frequency of 60 cycles per second. When the vibrator reed is in operation, each set of stationary contacts is closed alternately, sending direct current through the half of the center-tapped primary to which it is connected. The pulsating direct current flowing alternately in opposite directions in the center-tapped primary induces a 60-cycle current in the transformer secondary.

**12. VOLTAGE REGULATOR.** The voltage regulator (fig. 3) is a tap-changing switch, and has markings of LOW, MED, HIGH, and MAX on the dial for indexed contacts connected to corresponding taps on the secondary of the transformer. The LOW, MED, and HIGH positions represent approximately ¼, ½, and ¾ of the total output of the inverter.

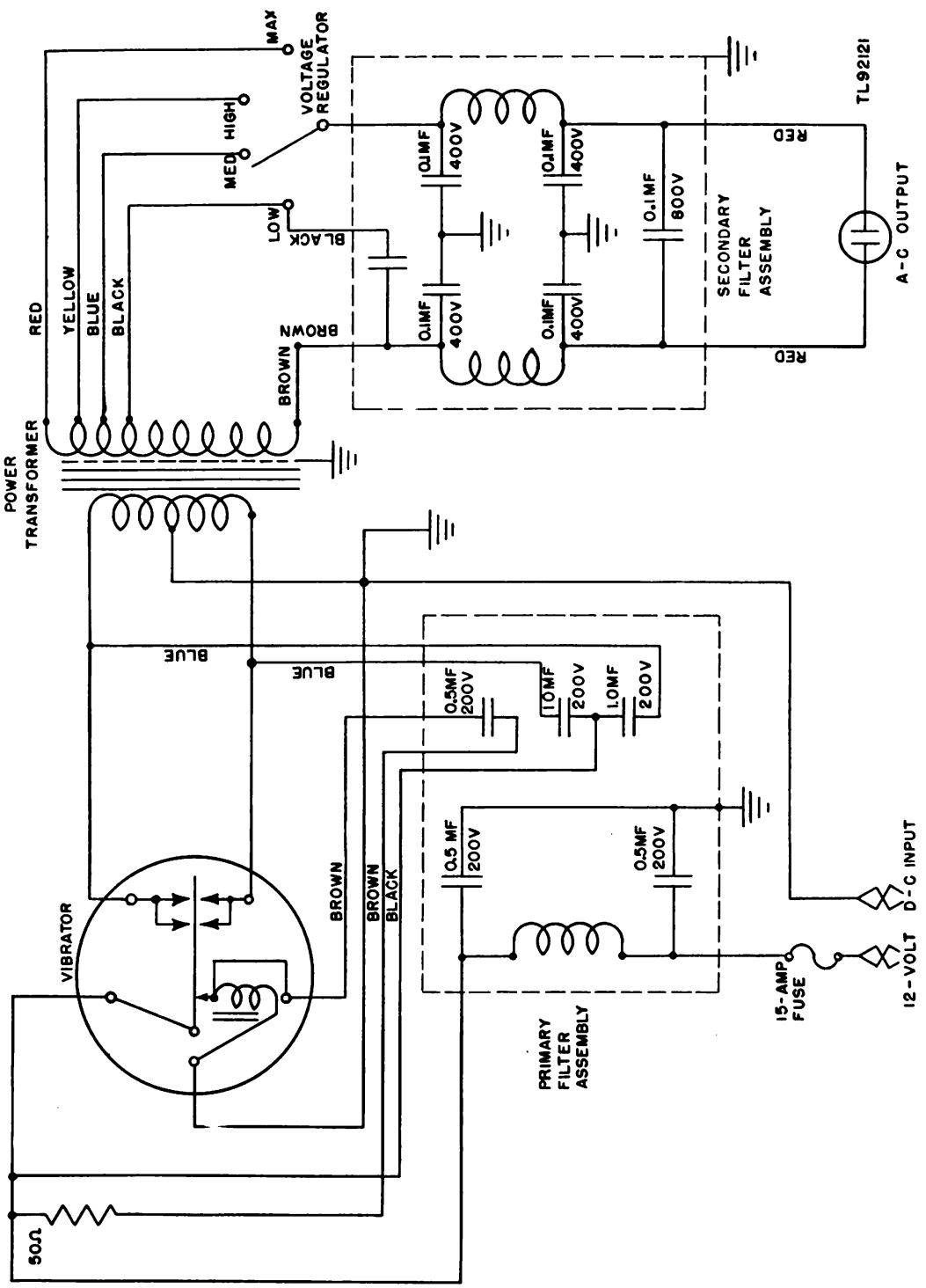


*Figure 3. Vibrator type inverter (12-volt dc to 110-volt ac), circuit diagram*

**13. PRIMARY FILTER ASSEMBLY.** The primary filter assembly (fig. 3) consists of a radio-frequency choke coil and suitable capacitors. The coil and capacitors are connected so as to eliminate any radio-frequency interference in the primary circuit.

**14. SECONDARY FILTER ASSEMBLY.** The secondary filter assembly (fig. 3) is composed of radio-frequency choke coils and capacitors connected for the purpose of eliminating radio-frequencies from the a-c output circuit of the inverter.

**15. FUSE.** The 15-ampere fuse (fig. 3), connected in the ungrounded ("hot") cable on the input side of the inverter, protects the vibrator and transformer from excessive input current.

# SECTION IV
# MAINTENANCE

**16. INSPECTIONS.** When installed, the inverter requires little attention. Keep the unit dry and free from dust and dirt. Use dry compressed air, cloth, or brush to remove any accumulated dust and dirt. Keep the battery clips clean.

**17. LUBRICATION.** Coat the jaws of the clips with grease or oil to prevent corrosion; otherwise, the inverter requires no lubrication.

**18. INITIAL PROCEDURE IN CASE OF FAILURE.** Check the following immediately if the vibrator type inverter fails:

**a. All Connections.** The d-c input cables should be securely attached to the 12-volt storage battery terminals. The power cord of the inverter load should be plugged into the a-c receptacle. The voltage regulator should be properly connected and making contact.

**b. Battery.** It should be fully charged and in good condition. The terminals should be clean.

**c. Fuse.** It should be held firmly in place by the fuse clips. If the fuse is blown, replace it with a 15-ampere fuse.

**NOTE:** Always disconnect one d-c input cable from the battery before replacing a blown fuse.

## 19. TROUBLE CHART.

| *Symptom* | *Cause* | *Remedy* |
|---|---|---|
| **a.** No d-c input voltage. | Storage battery discharged. | Repair or replace defective parts. |
| | Poor battery connections. | |
| | Burned-out d-c fuse. | |
| | Loose fuse in fuse mounting. | |
| **b.** No a-c output voltage. | Plug in output receptacle not making good contact. | Repair or replace defective parts. |
| | Voltage regulator switch not properly connected. | |
| | Voltage regulator switch contacts dirty. | |
| | Transformer secondary winding open. | |
| | Vibrator socket not making good contact with plug prongs. | |
| | Defective vibrator. | Replace vibrator. |
| **c.** Low a-c output voltage. | Storage battery not fully charged. | Charge battery. |
| | Voltage regulator setting incorrect. | Adjust setting. |
| | Vibrator worn. | Replace vibrator. |
| | Excessive load. | Reduce load. |
| **d.** Blowing of fuses. | Shorted capacitors in primary filter assembly. | Replace defective parts. |
| | Shorted capacitors in secondary filter assembly. | |
| | Shorted secondary transformer winding. | |
| | Vibrator contacts burned and stuck. | |
| | Excessive input voltage. | Check battery. Replace if necessary. |
| | Improper or defective load. | Correct load. |

**20. LOCATING TROUBLE.** Make a voltage check of the inverter circuit, starting at the input side and working to the a-c output side. Tables of normal output voltages and input current readings, transformer circuit resistances, and circuit capacitances are given below.

**a. Normal Output Voltage and Input Current Readings.** Use the following table to check the functioning of the inverter:

## TABLE I

## NORMAL OUTPUT VOLTAGE AND INPUT CURRENT READINGS

| INPUT | | VOLTAGE REGULATOR | OUTPUT | |
|---|---|---|---|---|
| Volts | Amps | Setting | Volts | Lamp (load in watts) |
| 12.75 | 11.2 | MAX | 110 | 100 |
| 12.75 | 8.5 | HIGH | 108 | 75 |
| 12.75 | 6.2 | HIGH | 117 | 50 |
| 12.75 | 2.5 | MED | 110 | 25 |
| 12.75 | 1.2 | LOW | 105 | 10 |

**NOTE:** The voltage regulator setting shown is the normal setting. However, if the input voltage is above or below normal, or if the output is below normal because of worn vibrator contacts, raise or lower the voltage regulator setting to compensate for these differences.

**b. Transformer Circuit Resistances.** Measurements below are made with the parts under test connected to their associated components in a normal manner, except for the vibrator unit which must be removed (fig. 3).

## TABLE II

## TRANSFORMER CIRCUIT RESISTANCES

| PRIMARY | |
|---|---|
| Terminals | Resistance (ohms) |
| Total winding | 0.18 |

| SECONDARY | |
|---|---|
| Terminals | Resistance (ohms) |
| Brown to black | 7.6 |
| Brown to blue | 9.3 |
| Brown to yellow | 11. |
| Brown to red | 12.7 |

**NOTE:** In making the above resistance measurements for the primary, simply insert test leads in the two filament prongs of the vibrator socket. For the secondary, insert test leads in a-c output receptacle and vary the voltage regulator switch from LOW to MAX, which corresponds to the terminals indicated above (fig. 3).

**c. Circuit Capacitances.** Measurements are made with the parts under test connected to their associated components in a normal manner, except for the vibrator unit, which must be removed (fig. 3).

## TABLE III
## CIRCUIT CAPACITANCES

| PRIMARY FILTER ASSEMBLY | | SECONDARY FILTER ASSEMBLY | |
|---|---|---|---|
| Test prods are inserted in vibrator socket prongs as indicated. | | Test prods are inserted in receptacle as indicated. Voltage regulator switch must be *off contact* (midway between two positions). | |
| Terminals | Capacitance (mf) | Terminals | Capacitance (mf) |
| Cathode to plate. | 0.5 | Chassis to one side of receptacle. | 0.3 |
| Cathode to filament. | 2.8 | | |
| Cathode to filament. | 2.8 | Chassis to other side of receptacle. | 0.3 |
| Cathode to grid. | 2.8 | | |
| Chassis to filament. | 0 | Both sides of receptacle. | 0.22 |
| Chassis to filament. | 0 | | |
| Chassis to plate. | 0.43 | Chassis to black lead which must be disconnected from LOW position on switch. | 0.33 |
| Chassis to cathode. | 2.8 | | |
| Chassis to grid. | 0 | | |

## 21. REPLACING PARTS.

**a. Vibrator Unit.** The vibrator unit can easily be replaced after removing the back cover of the inverter. The unit plugs into its socket in the same manner as a radio tube. For satisfactory performance, replace the vibrator unit every 500 operating hours.

**NOTE:** Do not use force when plugging in a new vibrator.

**b. Other Parts.** The other parts of the vibrator type inverter can be easily removed and replaced by the use of a soldering iron and other small shop tools.

**CAUTION:** When replacing parts be sure to reconnect all leads correctly. Refer to paragraph 20 for tables of voltages, resistances, and capacitances for testing the inverter, after replacing parts and before placing it into service.

# SECTION V
# SUPPLEMENTARY DATA

## 22. MAINTENANCE PARTS LIST FOR VIBRATOR TYPE INVERTER (12-VOLT DC TO 110-VOLT AC).

**NOTE:** Order maintenance parts by stock number, name, and description. Only maintenance parts listed can be requisitioned.

| Ref symbol | Signal Corps stock No. | Name of part and description | Station stock | Region stock | Quan per unit |
|---|---|---|---|---|---|
| | 3H2570–1 | INVERTER: vibrator type; 12-v d-c input, 110-v a-c output; 60-cps; 100-watt; (including radio filter). | | | |
| | 3Z1894–13.2 | FILTER ASSEMBLY: primary; consists of r-f choke; 7 capacitors of 0.5 mf, 200 v dc (working). | * | * | 1 |
| | 3Z1894–13 | FILTER ASSEMBLY: secondary; consists of 2 r-f chokes; 4 capacitors of 0.1 mf, 400-v dc (working); 1 capacitor of 0.1 mf, 800-v dc (working); 1 capacitor of 0.35 mf, 600-v dc (working). | * | * | 1 |
| | 3Z2615.4 | FUSE: 15-amp; 25-v; type 3AG. | * | * | 1 |
| | 3Z6002–72 | RESISTOR: wire-wound; 50-ohm; 2-watt. | * | * | 1 |
| | 3Z9825–22 | SWITCH: rotary; voltage-regulator; (5 amp at 125 v). | | * | 1 |
| | 2Z9625–22 | TRANSFORMER: power; (to deliver 110-v ac, 60 cps; primary 42 v, center tap; secondary, tapped at 450, 550, 650, 750 v; 125-watt capacity). | | * | 1 |
| | 3H6691–6 | VIBRATOR: plug-in type; heavy-duty; 10-contact. | | * | 1 |

*Indicates stock available.