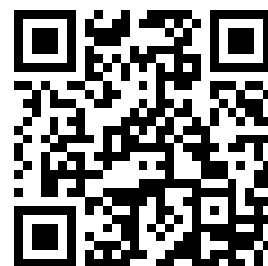

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TM 11-969

WAR DEPARTMENT TECHNICAL MANUAL

MOTOR GENERATOR PU-33/C

RESTRICTED. **DISSEMINATION OF RESTRICTED MATTER.**
The information contained in restricted documents and the essential characteristics of restricted material 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. 23b, AR 380-5, 15 Mar 1944.)

WAR DEPARTMENT

20 NOVEMBER 1944



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WAR DEPARTMENT TECHNICAL MANUAL

TM 11-969

This manual supersedes TM 11-969, 20 September 1944.

MOTOR GENERATOR PU-33/C



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WAR DEPARTMENT
WASHINGTON 25, D. C., 20 November 1944

TM 11-969, Motor Generator PU-33/C, is published for the information and guidance of all concerned.

[AG 300.7 (5 Aug 44).]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:

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The Adjutant General

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IBn 11 T/O & E 11-400 Sig AW Orgn, Bn Hqs (B).

IC 11 T/O & E 11-107, 11-127, 11-237, 11-287, 11-587, 11-592, 11-597.

For explanation of symbols see FM 21-6.

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DESTRUCTION NOTICE

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

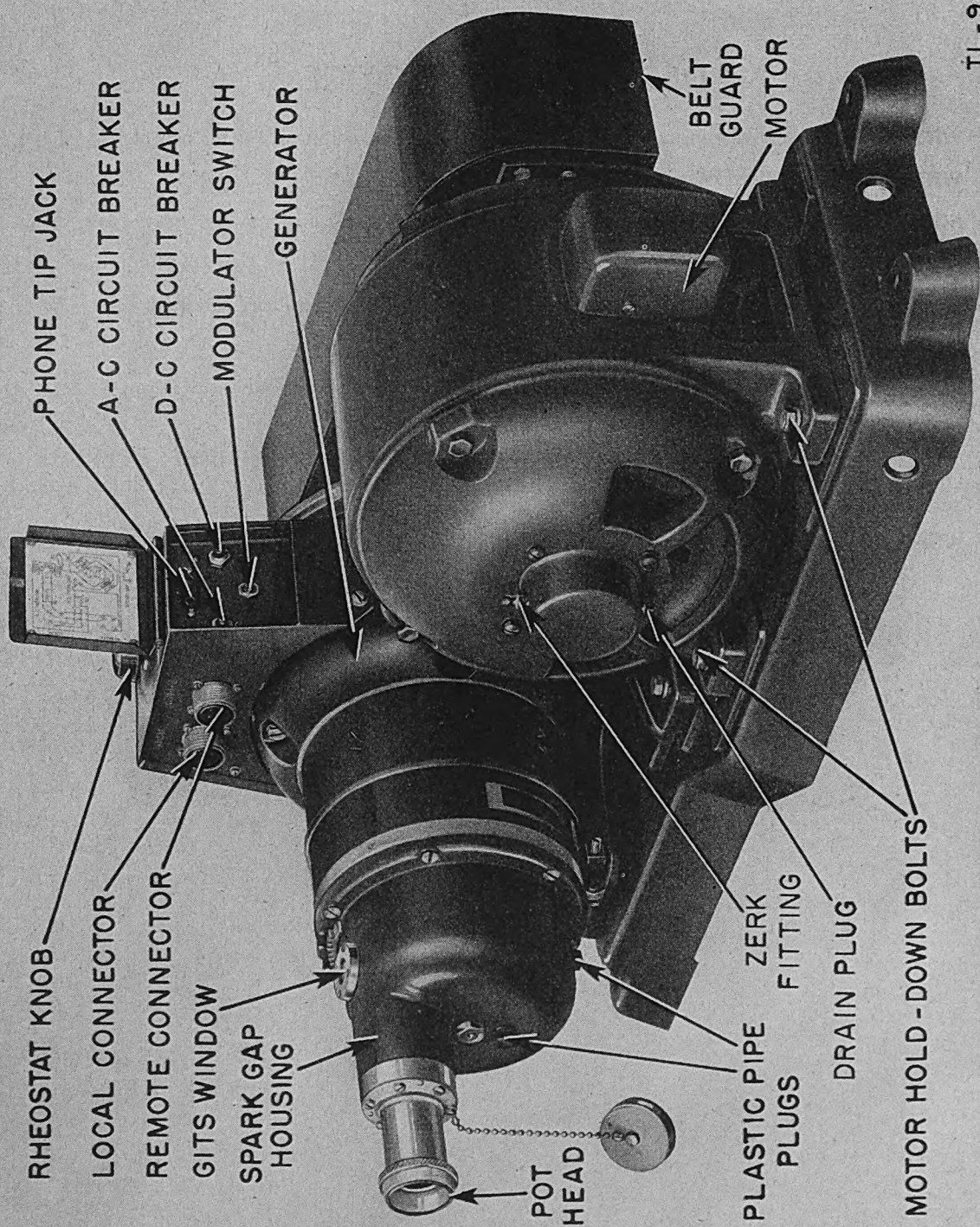
WHEN — When ordered by your commander.

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 — All castings.
2. Cut — All cables and wires.
3. Burn — Instruction manual, all papers pertaining to the operation of the unit.
4. Bend — Control box and panel.
5. Bury or scatter—Any or all pieces mentioned above after breaking.

DESTROY EVERYTHING



TL-94282

Figure 1. Motor Generator PU-33/C.

RESTRICTED

This manual supersedes TM 11-969, 20 September 1944.

SECTION I

DESCRIPTION

1. MOTOR GENERATOR PU-33/C (fig. 1).

a. Motor. The motive power for this unit is a 5-horsepower, 3,600-revolution per minute (rpm), 220/440-volt, 3-phase, 60-cycle electric motor.

b. Generator. The generator assembly consists of a 1,400-watt, 120-volt, 400-cycle inductor-alternator, and a 400-watt, 27-volt, direct-current (d-c) generator. The alternator rotor and the d-c generator armature are mounted on a common shaft which is dual-belt-driven by the electric motor. The alternator stator is mounted in a shell which is fastened to the fan housing. The d-c yoke, field-coil assembly, and brush head are fastened to this shell. A spark-wheel assembly is mounted on the end of the armature shaft. A spark-gap housing with pothead incloses the spark wheel.

c. Control Box. A weatherproof output box is mounted on the top of the stator shell. It contains a rheostat, adjustable resistor, two pin jacks for plugging in an alternating-current (a-c) voltmeter, one LOCAL and one REMOTE connector (receptacle) for plug-in

power connections, one a-c circuit breaker, and one d-c circuit breaker. A double-pole, single-throw toggle switch is installed in the d-c circuit of the LOCAL connector (receptacle).

d. Tools and Spare Parts. A cloth bag containing the following tools and spare parts is shipped with each power unit:

Spare Parts

- 8 generator brushes (165)
- 2 capacitors (166-1)
- 4 V-belts (133)

Tools

- 1 wrench, 7/16 inch box and open end
- 1 wrench, 11/16 inch by 9/16 inch open end
- 1 screwdriver, 8 inch
- 1 wrench, short, for 5/16 inch socket setscrew
- 1 crocus cloth sheet

2. DIMENSIONS.

Motor Generator PU-33/C is 28 inches wide, 33 inches long, and 18 inches high, and weighs 285 pounds.

SECTION II

INSTALLATION AND OPERATION

3. INSTALLATION.

a. Motor Generator PU-33/C is fastened to the base of a wooden case. This base must be removed before the unit is set up for operation. Construct a level wooden or concrete base. Bolt the unit to the base securely, using suitable bolts. Connect the electric power line to the motor. Follow wiring instructions as indicated on the motor. Check the tension of the V-belts before operation. Placing light pressure on the belts should cause a deflection of approximately 1/2 inch (par. 14).

b. A spark-gap housing (fig. 1) incloses the spark wheel which has six equally spaced collet screws (fig. 5). Different modulator circuits require three or six electrodes on the spark wheel. Units are shipped with three equally spaced installed electrodes. Three additional electrodes are in the spare parts bag. Before the unit is placed in operation, turn pulley slowly by hand. Check the number of electrodes installed on the spark wheel by looking through the gits window. *The number of electrodes must be correct for the particular modulator circuit used.* Change the number of electrodes if necessary (par. 17).

4. OPERATION.

a. General. Remove the two plastic pipe plugs (fig. 1) inserted in the back and bottom of the spark-gap housing before the unit is operated. These plugs are used to seal the housing from dirt and moisture during shipment.

b. Connections for Operation (fig. 1). (1) Plug the low-voltage cable of the using equipment into the LOCAL connector. Connect the short high-voltage cable

to the pothead (fig. 1) on the end of the generator. Plug the other cable from the equipment into the REMOTE connector.

(2) Make sure the modulator switch on the control panel is OFF before the unit is started. *Do not turn to ON until the motor generator has been in operation for at least 30 seconds.*

(3) Check the voltage (under load) of the a-c output by plugging the voltmeter leads into the phone tip jack located on the control panel. The voltage is regulated by turning the rheostat knob on top of the control box.

5. PREPARATION FOR STORAGE.

a. Extended Storage. (1) Clean all external surfaces of the motor generator.

(2) Paint all spots where the original paint is off or brush on a coating of rust-preventive compound. Thin film rust-preventive compound (CT) applied cold or light rust-preventive compound (CL) applied hot is satisfactory for coating external surfaces.

(3) Seal openings with greaseproof paper and tape. For this purpose, use Paper, Wrapping, Greaseproof, Spec No. AXS-840, and Tape, Adhesive, Non-hygroscopic, Spec No. AXS-871.

(4) Attach a tag to the unit stating that it has been prepared for storage, and the date it was treated.

(5) Use only dry-cleaning solvent (SD), or Diesel fuel oil for cleaning fluid.

b. Stand-by Storage. Follow the procedure described in subparagraph *a* above. If the unit is stored for a short time, and is not to be kept in an extremely humid atmosphere, it will not be necessary to seal openings.

SECTION III

FUNCTIONING OF PARTS

6. MOTOR.

The motive power for Motor Generator PU-33/C is a conventional, 220/440-volt, 3-phase, 60-cycle, 3,600-rpm electric motor.

7. GENERATOR.

a. D-c Generator and Exciter. A compound-wound, four-pole, d-c generator supplies 400 watts of useful output at 27-volt dc. It also excites the field of the 400-cycle alternator. No manual control of the useful output voltage of this generator is used.

b. Alternator, 400-cycle. This is a 400-cycle, inductor-type generator having its excitation winding and output winding both on the stator. The rotor has six equally spaced metal projections which cause the flux through the stator teeth to pulsate and thus generate voltage. The field rheostat, controlling the current from

the d-c generator (exciter), is used to control the output voltage of this alternator.

8. CONTROL BOX.

The function of the control box is to provide an easy, accessible means for controlling and regulating the output of the motor generator. The rheostat is used to control the amount of current being fed from the d-c generator to the field (rotor) of the alternator, thus increasing or decreasing the a-c output voltage. A-c and d-c circuit breakers are used to open the respective circuits in the event of an overload. No fuses are used. Pin jacks are connected across the a-c line to provide access for the reading of the voltage and frequency with suitable instruments. An ordinary a-c voltmeter (for 60 cycles) should not be used to read the voltage. Procure a voltmeter designed for 400-cycle operation.

SECTION IV

MAINTENANCE

NOTE: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on W.D., A.G.O. Form No. 468 (Unsatisfactory Equipment Report). If Form No. 468 is not available, see TM 38-250. Failure or unsatisfactory performance of equipment used by Army Air Forces will be reported on Army Air Forces Form No. 54 (unsatisfactory report).

9. REASON FOR PREVENTIVE MAINTENANCE.

The man-hours spent in performing preventive maintenance are few compared with the man-hours spent in repairing broken-down equipment. Maintenance required by Motor Generator PU-33/C is limited for the most part to lubrication and cleaning. These two operations, if performed at suitable intervals, will prolong the life of the unit and minimize equipment failures.

10. OUTLINE OF PREVENTIVE MAINTENANCE AND REPAIR.

a. Maintenance. Paragraph 11 lists the U. S. Army approved lubricants which are used for all lubricating, cleaning, and rust-preventive work done on Motor Generator PU-33/C. Paragraphs 12 to 17 inclusive describe the procedures to follow for maintaining the motor generator. Paragraph 18 lists maintenance operations and their time intervals between applications. References to appropriate paragraphs may be used to help locate more detailed information.

b. Repair. Paragraphs 20 to 23 inclusive contain trouble-shooting charts and repair procedures. The necessary disassembly and assembly steps are outlined in their natural sequence of operations. Appropriate illustrations are given to facilitate the understanding of the more complex instructions. Break-downs should be few because the equipment is simple in construction and rugged in design. Before attempting trouble shooting or disassembly of the unit, check the generator load for defects which may reflect upon the operation and electrical readings of the motor generator. Moistureproofing and fungiproofing procedures are described in paragraph 19.

11. RECOMMENDED LUBRICANTS.

The following table lists the lubricating material necessary in servicing the equipment:

Approved symbol	Standard nomenclature	Specification No.
WB2	Grease, General Purpose No. 2	U. S. Army 2-108
SD	Solvent, Dry Cleaning	Federal P-S-661a
DA or DX	Oil, Fuel, Diesel for High Speed Automotive Type Diesel Engines	U. S. Army 2-102C
CT	Compound, Rust Preventive, Thin Film	AXS-673
CL	Compound, Rust Preventive, Light	U. S. Army 2-84 (latest revision)

12. LUBRICATION.

a. Motor. After every 512 operating hours, lubricate the motor as follows:

- (1) Shut down the unit.
- (2) Remove the cover over the belts.
- (3) Remove the drain plugs at the bottom of both bearings (fig. 1).
- (4) Apply general purpose grease (WB2) through the Zerk fittings, using the supplied grease gun, until grease appears at the drain hole.
- (5) Expel excess grease by running the motor until operating temperature is reached.
- (6) Replace the drain plugs.
- (7) Using a dry, clean cloth and dry-cleaning solvent (SD), if necessary, wipe dirt and excess grease from the motor housing.

b. Generator. No lubrication is required for the sealed bearings of the alternator and exciter unit.

c. Sealed Bearings. Although sealed bearings contain sufficient lubricant to last for the life of the generator, bearing replacement may have to be made if bearing noises develop. Do not attempt to lubricate the sealed

bearings. When making replacements, use extreme care to keep dirt from entering the bearing surface. Keep the bearing wrapped in its original packing until ready for use. Keep the work bench and hands clean.

13. MOTOR BEARING WASHING PROCEDURE.

a. Washing Bearings. Occasionally the motor bearings should be purged of old and hardened grease. Proceed as follows:

- (1) Clean the grease gun, Zerk fittings, and hands.
- (2) Prepare a clean area in which to work. Abrasives which enter into the bearing area are not easily removed with solvents.
- (3) Remove the Zerk fittings and drain plugs.
- (4) With a fairly sharp tool of suitable size (small screwdriver), clean the plug holes of hardened grease.
- (5) Fill a syringe or similar device with dry-cleaning solvent (SD) and inject a small quantity into the bearing housing through the fitting hole. As the grease becomes diluted or thinned, it will drain out through the drain hole. Continue to add the solvent until it drains clear. Run the motor during this operation (not more than a few minutes). Be careful to avoid splashing the solvent on the motor windings through the ventilating openings.
- (6) After all the solvent has drained from the bearings, replace Zerk fittings and proceed with the greasing as described in paragraph 12.

b. Clean-up after Washing Bearings. After the bearings have been greased, and the drain plug replaced, wipe the entire bearing housing with a clean cloth dipped in dry-cleaning solvent (SD). Finish the job by cleaning the entire motor generator.

14. V-BELT MAINTENANCE.

Inspect the two V-belts every 64 operating hours for the proper tension. Proper tension is a degree of belt tightness, which, with moderate finger pressure exerted on the belt midway between the pulleys (fig. 2), will allow a belt depression of about 1/2 inch. If the belt is too slack, loosen the motor hold-down bolts (fig. 1) and move the motor away from the generator. Tighten the hold-down bolts and check the tension. Repeat the process until the proper tension is obtained.

CAUTION: Excessive tension will stretch the belts beyond use, and shorten bearing life.

15. D-C GENERATOR COMMUTATOR AND BRUSH ASSEMBLY.

a. Commutator. Check every 512 operating hours. The commutator surface should normally be a mahogany

brown color. Do not attempt to maintain a highly polished surface. Sand the commutator only if the copper segments are rough, pitted, or extremely carbonized. Proceed as follows:

- (1) Loosen the headband screw under the brush headband (fig. 3) and slide the band over to the side to expose the commutator and brush assembly.
- (2) Attach a piece of canvas to a suitable piece of wood. Place the canvas on the commutator while running the generator. If the canvas cleaning does not remove the dirt, use dry-cleaning solvent (SD). If the commutator is scored, place a piece of #00 sandpaper over a piece of wood and, while the generator is running, place the sandpaper on the copper segments with a slight pressure. Move the sandpaper from side to side until the commutator is smooth and clean. Finish up with the canvas cloth on the wooden stick. If the sandpaper does not remove the grooves or scoring, the commutator may have to be turned down on a lathe.

CAUTION: Do not use emery cloth or paper on the commutator. Emery, a conductor of electricity, will short-circuit the commutator segments.

b. Brushes and Brush Assembly. Check the brushes and brush assembly every 512 operating hours. The brushes should last about 1,000 hours; however, excessive arcing will shorten their life. The four brushes in the d-c generator must make firm contact with the commutator surface to prevent arcing. The spring tension needed to make good contact is about 14 ounces. Check the tension with the finger when making routine checks. If in doubt about the proper tension, use a spring scale to measure the pull. Replace the brush when its length is reduced to the point which permits the brush spring to ride on the brush holder. If the brush holder binds the brush, remove the brush and sand that side which shows evidence of binding. Replace brush in its holder and check for further binding. The brush must fit freely in its holder.

16. SPARK WHEEL BRUSH (fig. 4).

Inspect the spark wheel grounding brush every 512 operating hours. When removing the brush from the spark wheel housing, be careful not to drop the grounding brush out of the brush holder. To do so will necessitate the removal of the entire spark wheel housing in order to retrieve the brush. Replace the brush if its length is less than 1/2 inch.

17. SPARK WHEEL ELECTRODES (fig. 5).

The electrodes will become pitted as a result of normal operation. Polishing the electrodes is not necessary if

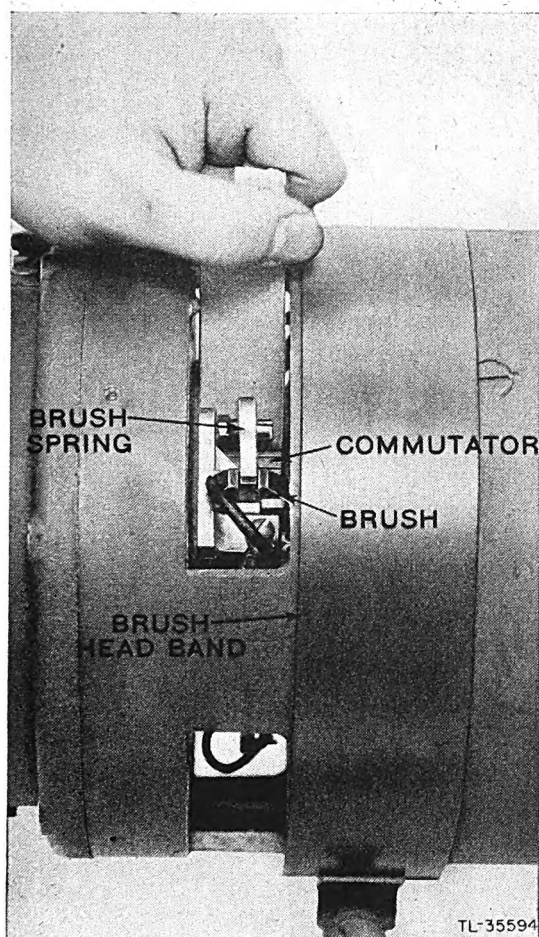


Figure 3. Cleaning commutator.

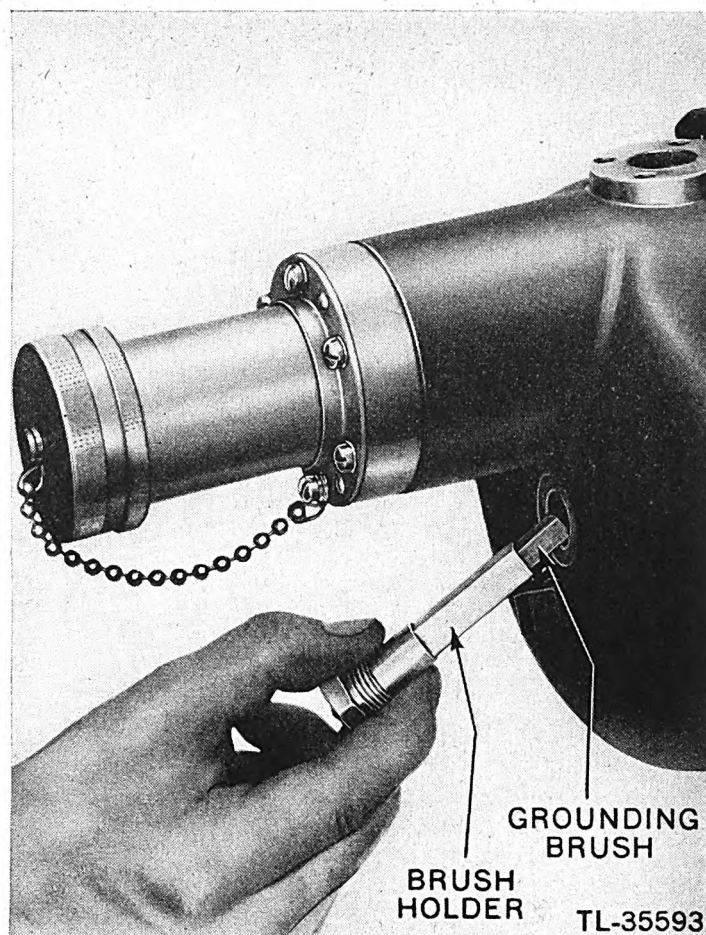


Figure 4. Inspecting grounding brush.

this occurs. Inspect electrode condition every 200 operating hours. Replace electrodes only when their length is insufficient to maintain a normal gap. To replace the electrodes, proceed as follows:

- a. Stop the motor.
- b. Remove the six screws which hold the clamp ring to the brush head.
- c. Lift off the spark wheel housing as shown in figure 5.
- d. Loosen the collet nuts on the spark wheel with a suitable wrench and pull out the electrodes.
- e. Insert new electrodes. Position them so that the electrode ends are flush with the backs of the collet screws. Tighten the nuts.
- f. If three electrodes are used, they must be evenly spaced on the spark wheel.
- g. Replace the spark wheel housing. Check the position of the electrodes by looking through the gits window (peephole).

18. PREVENTIVE MAINTENANCE SCHEDULE.

The following table covers maintenance operations

to be carried out on Motor Generator PU-33/C at the time intervals shown.

Job to be done	Every 8 hours	Every 64 hours	Every 200 hours	Every 512 hours	Every 1,024 hours
Clean unit	X				
V-belts inspection (par. 14)		X			
Spark wheel electrodes (par. 17)			X		
Spark wheel grounding brush (par. 16)				X	
Motor bearings, lubrication (par. 12)				X	
Generator bearings (sealed, no lubrication required)					
Commutator, d-c generator (par. 15)				X	
Brushes, d-c generator (par. 15)				X	
Motor bearings, wash (par. 13)					X

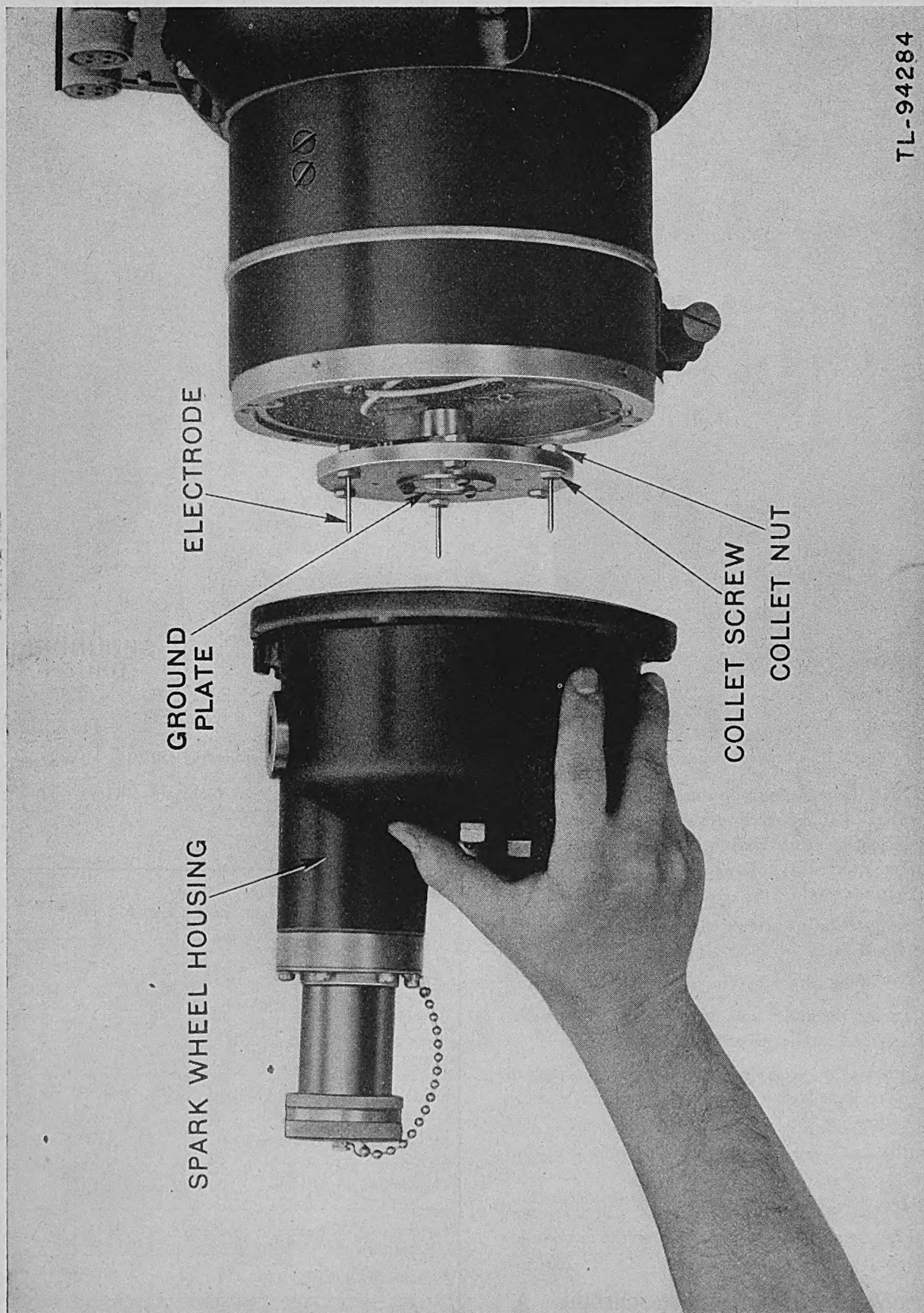


Figure 5. Inspecting electrodes.

19. MOISTUREPROOFING AND FUNGIPROOFING.

a. General. The operation of Signal Corps equipment in tropical areas, where temperature and relative humidity are extremely high, requires special attention. The following items represent problems which may be encountered in operation:

- (1) Resistors, capacitors, coils, etc., fail.
- (2) Electrolytic action takes place in coils, resistors, etc., causing eventual break-down.
- (3) Hook-up wire and cable insulation breaks down. Fungus growth accelerates deterioration.
- (4) Moisture forms electrical leakage paths on terminal boards and insulating strips.

b. Treatment. A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungus-resistant lacquer applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing, and of tools and materials used.

CAUTION: Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

c. Step-by-step Instructions for Treating Motor Generator PU-33/C.

(1) **PREPARATION.** Make all repairs and adjustments necessary for proper operation of the equipment.

(2) **DISASSEMBLY** (fig. 6). Remove the control box from the generator frame for baking and spraying. To disconnect the box, remove all the wires leading from the generator yoke as follows:

(a) Remove the four screws holding the control box to the generator frame and turn back the box to expose the inside.

(b) Remove the lead with the red marking band from the d-c circuit breaker terminal, 1.

(c) Remove the lead with the green marking band from the ground lug, 2, on the filter capacitor.

(d) Replace the remaining three leads on the capacitor ground lug and tighten the screw.

(e) Remove the white lead from the rheostat arm terminal, 3.

(f) Replace the remaining two wires on this terminal and tighten the screw.

(g) Remove the white lead with the black tracer from the other rheostat terminal, 4.

(h) Loosen slightly the locknut on the modulator switch, and rotate the body of the switch so that the white lead with the black tracer may be removed from terminal, 5.

(i) Replace the remaining lead on this switch terminal and tighten the screw.

(j) Remove the generator lead with the green marking band from the a-c circuit breaker terminal, 6. Replace the remaining lead and tighten the screw.

(k) Remove the control box (to be treated).

(l) Remove the six screws holding the spark wheel housing to the brush head (fig. 5). Lift off the spark wheel housing (to be treated).

(m) Remove the three screws and take off the ground plate (fig. 7).

(n) Remove the armature bolt with the collet washer, and back off the rear hexagonal nut on the armature shaft to remove the spark wheel (fig. 7).

(o) Pull the brush out of the brush holder, 9, (fig. 8) in the spark wheel housing.

(p) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(3) **MASKING** (fig. 8). Cover the following parts with masking tape:

(a) The bare wire portion of the rheostat, 1.

(b) The contact, 2, on the rheostat arm.

(c) The bare wire portion, 3, of the resistor.

(d) The openings in the power outlet receptacles, 4.

(e) The terminal, 5, on the d-c circuit breaker from which the lead was removed.

(f) The terminal, 6, on the rheostat from which the lead was removed.

(g) The spark wheel electrode pins, 7, after wrapping with paper.

(h) The stationary electrode, 8, after wrapping with paper.

(i) The opening in the brush holder, 9, on the spark wheel housing.

(j) The shaft openings, 10, and the three holes for the grounding plate screws on the spark wheel hub.

(4) **DRYING.** Place equipment in oven or under heat lamps and dry for 2 to 3 hours at 160° F.

(5) **VARNISHING.** Spray three coats of Lacquer, Fungus-resistant, Spec No. 71-2202 (Stock No. 6G1005.3) or equal, on the following parts:

(a) The inside of the control box.

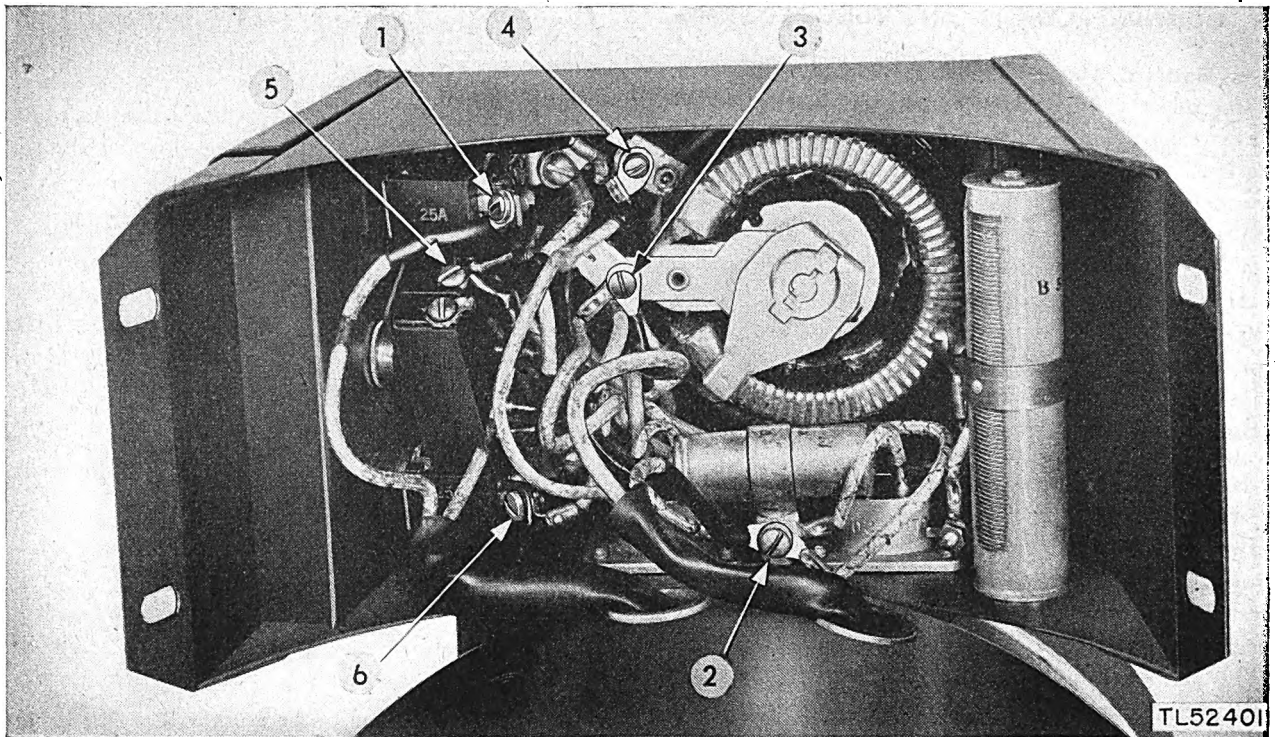


Figure 6. Removing control box.

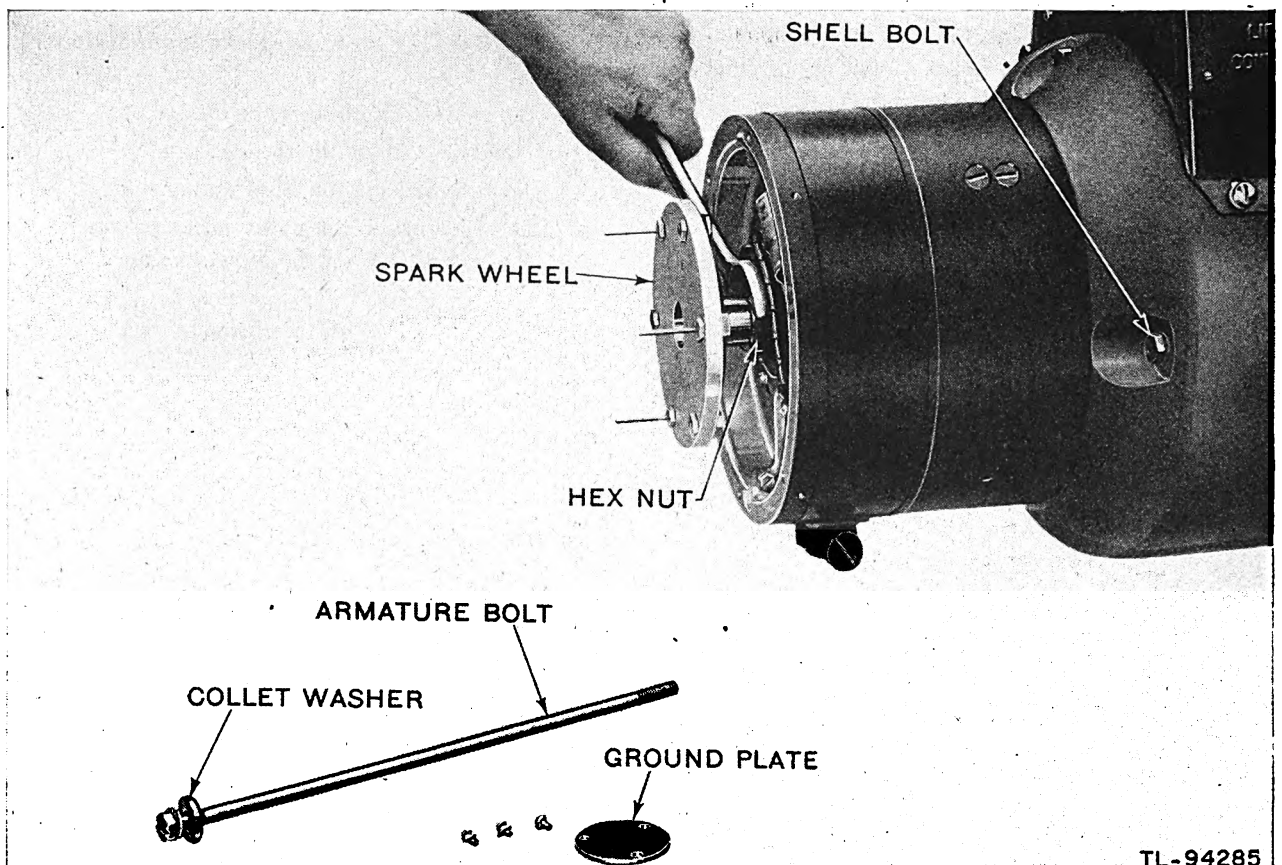


Figure 7. Removing spark wheel.

- (b) The inside of the spark wheel housing.
- (c) All sides of the spark wheel.

(6) REASSEMBLY.

- (a) Remove all masking tape.
- (b) Clean all contact surfaces with varnish remover, and burnish the contacts.
- (c) Reassemble the motor generator and test its operation.

(7) MARKING. Mark the set with "MFP" and the date of treatment.

EXAMPLE: MFP—6 September 1944.

20. MOTOR GENERATOR TROUBLE CHART.

<i>Trouble</i>	<i>Possible Cause</i>
a. Motor fails to start or is not up to speed.	(1) Low voltage of power supply. (2) Failure of power supply.
b. Arcing occurs at brushes.	(1) Defective capacitor on brush head. (2) Commutator dirty or scored. (3) Worn brushes. (4) Brushes stuck in holders or reversed. (5) Broken or weak brush spring. (6) Short circuit in system. (7) Shorted field coil. (8) Open or shorted coil in armature.
c. Motor generator fails to generate current.	(1) Circuit breakers on control panel open. (2) Brushes stuck in holders or reversed. (3) Defective capacitor on brush head. (4) Worn brushes. (5) Dirty commutator. (6) Broken or loose connections. (7) Defective armature. (8) Defective rheostat or resistor. (9) Defective field coil. (10) Defective stator winding (a-c). (11) Loss of residual magnetism (d-c field).

Trouble

- d. Motor generator fails to deliver rated output (1,400-watt ac in addition to 400-watt dc).
- e. Radio reception is noisy.

Possible Cause

- (1) Motor not up to speed.
- (2) Dirty commutator.
- (3) Worn brushes.
- (4) Brushes not properly seated.
- (5) Short circuit in system.
- (6) Broken or weak brush spring.
- (7) Defective capacitor on brush head.
- (1) Defective capacitor on brush head.
- (2) Loose connections.
- (3) Excessively dirty commutator.
- (4) Arcing at brushes.
- (5) Defective capacitor in control box.
- (6) Internal-external lockwashers not used on screws in the following places:
 - (a) Secure capacitor in brush head.
 - (b) Secure capacitor in control box (two external lockwashers used).

21. DISASSEMBLY OF MOTOR GENERATOR.

CAUTION: Internal-external-tooth lockwashers must be reinstalled on all screws exactly as removed to prevent radio interference. See paragraph 20e for location of these lockwashers.

a. Removing Spark Wheel Housing (fig. 5). Take out the six screws in the clamp ring, holding the spark wheel housing to the brush head. Then remove the complete housing.

b. Disassembling Generator. (1) Remove the ground plate by taking out the three screws. (2) Remove the armature bolt with collet washer, and back off the rear hexagonal nut on the armature shaft to remove the spark wheel (fig. 7). Remove the brush head-band and lift the four brushes out of their holders. (3) Remove the four shell bolts (fig. 7), insert a large screwdriver in the notch on the side of the shell, and pry off the complete generator assembly (fig. 9). The armature shaft is keyed on the countershaft. To remove it, pry with a wooden bar placed between the generator mounting bracket and the a-c rotor (fig. 10). Remove the key from the countershaft.

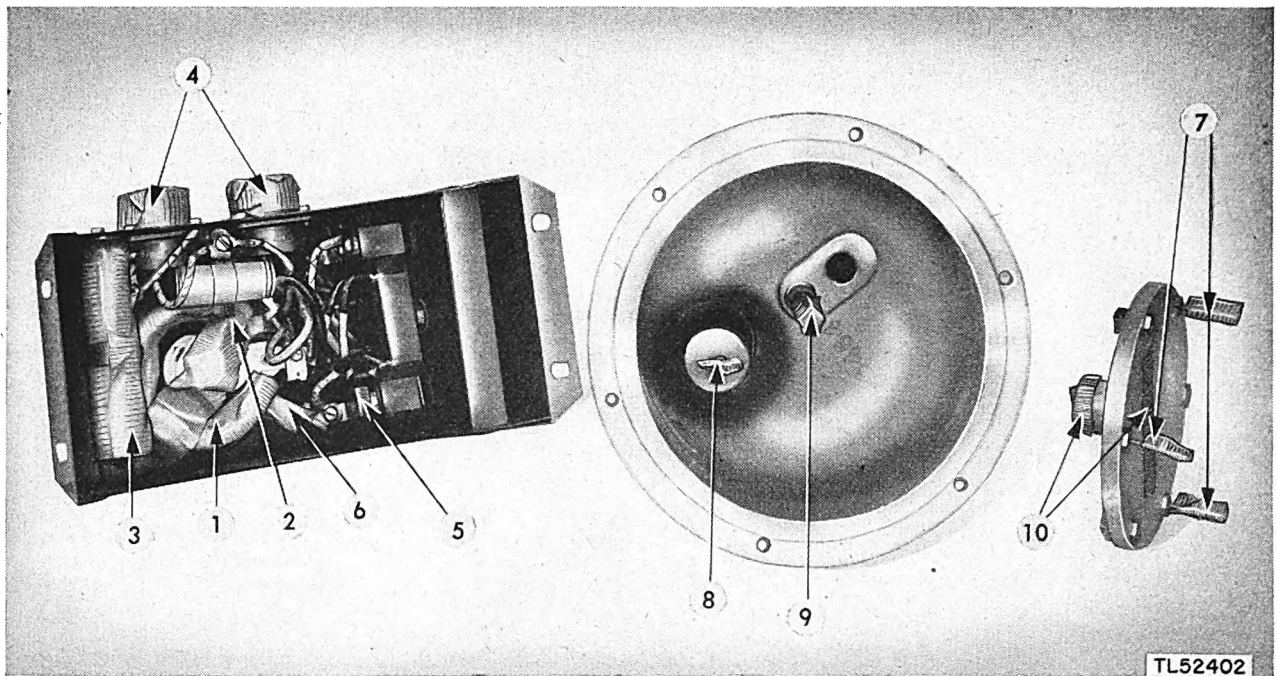


Figure 8. Generator parts masked for spraying.

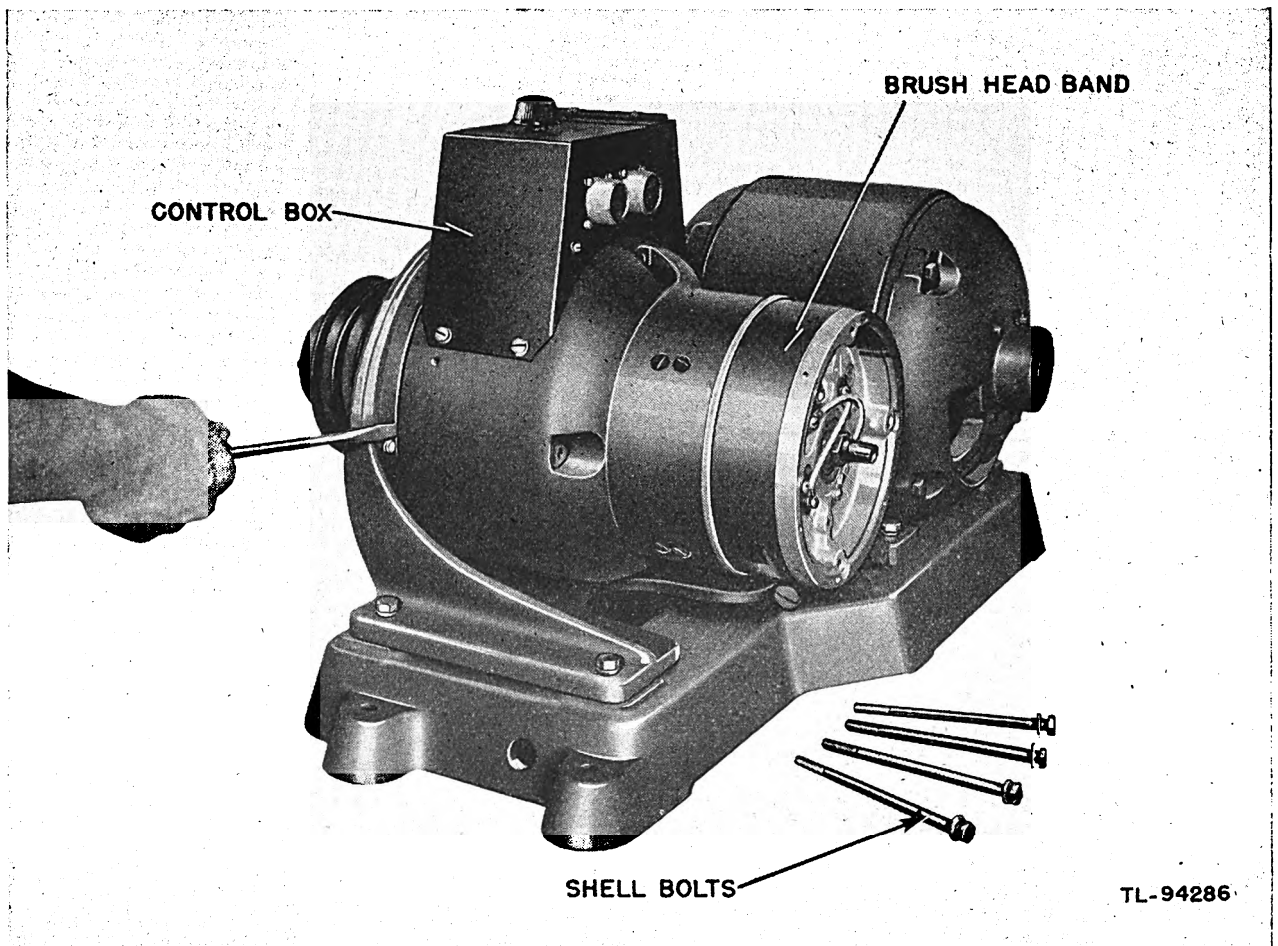


Figure 9. Removing generator assembly.

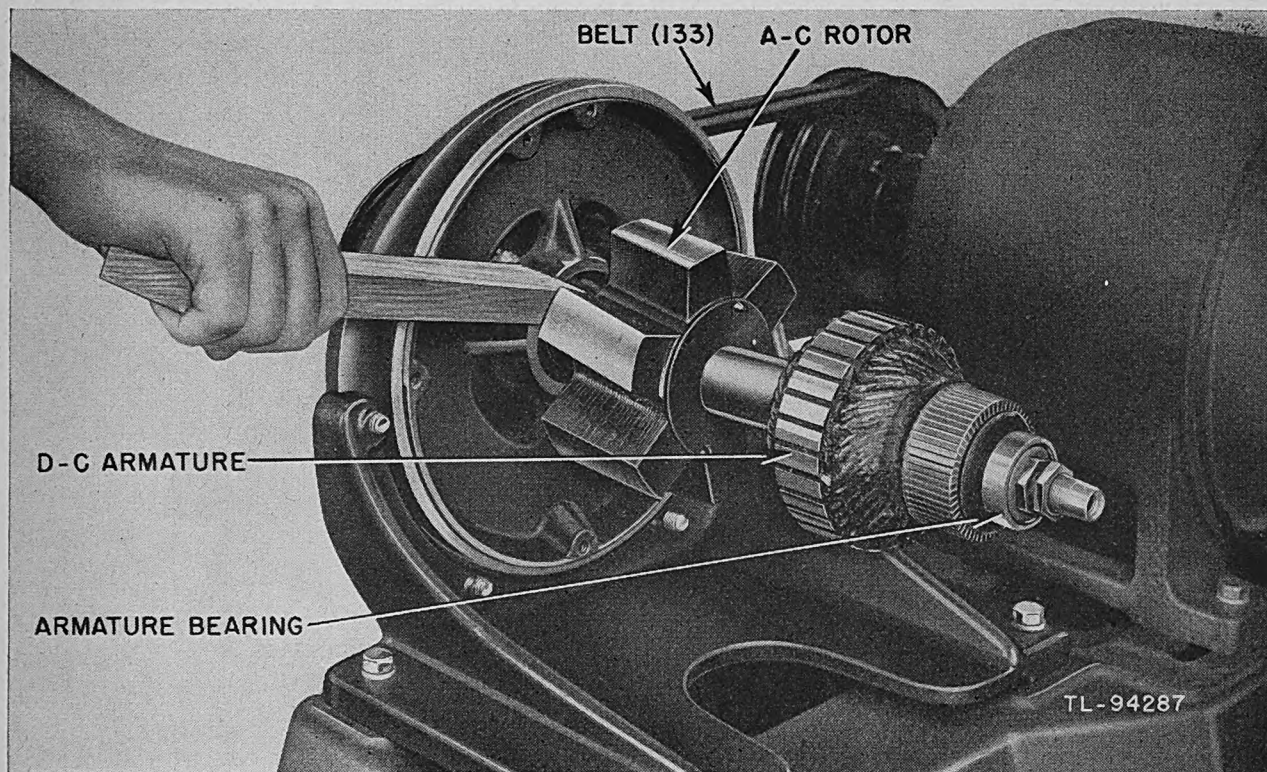


Figure 10. Removing armature assembly.

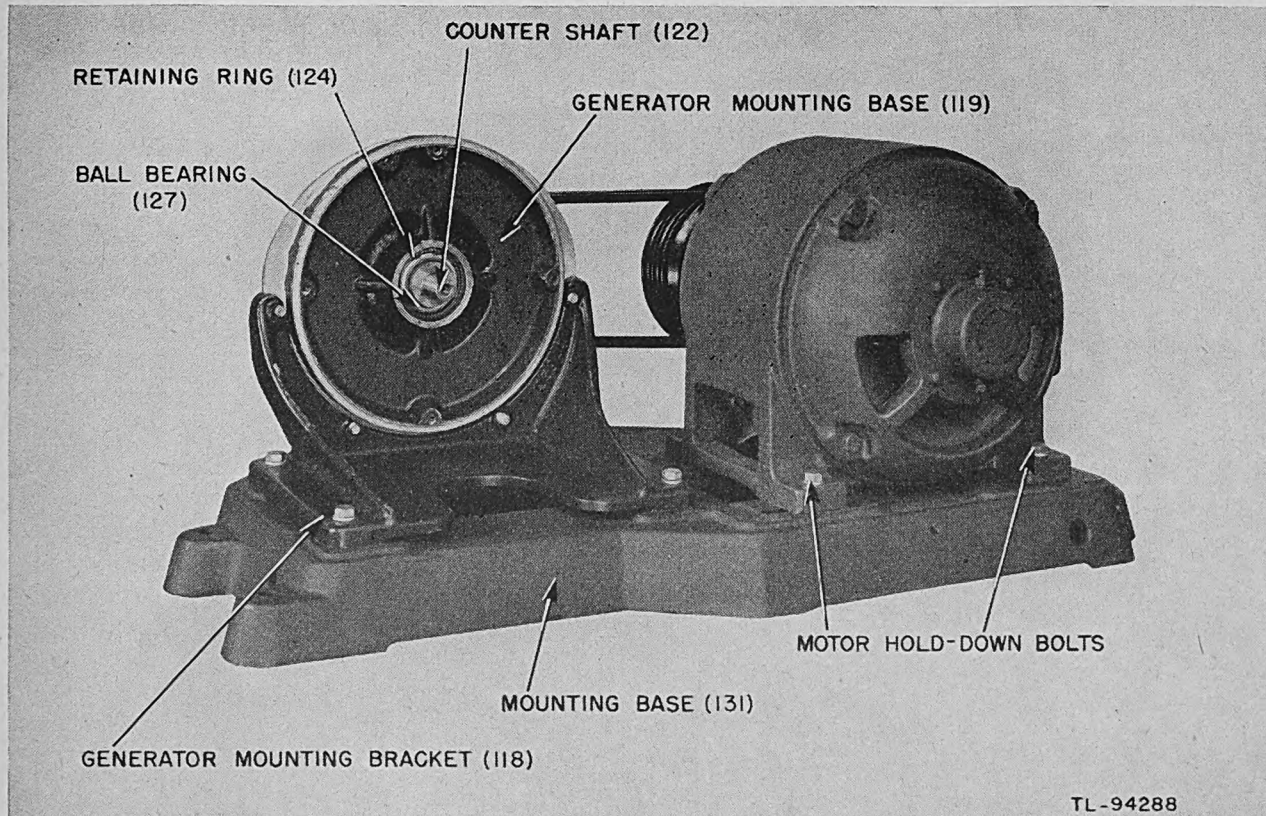


Figure 11. Mounting with generator and belt guard removed.

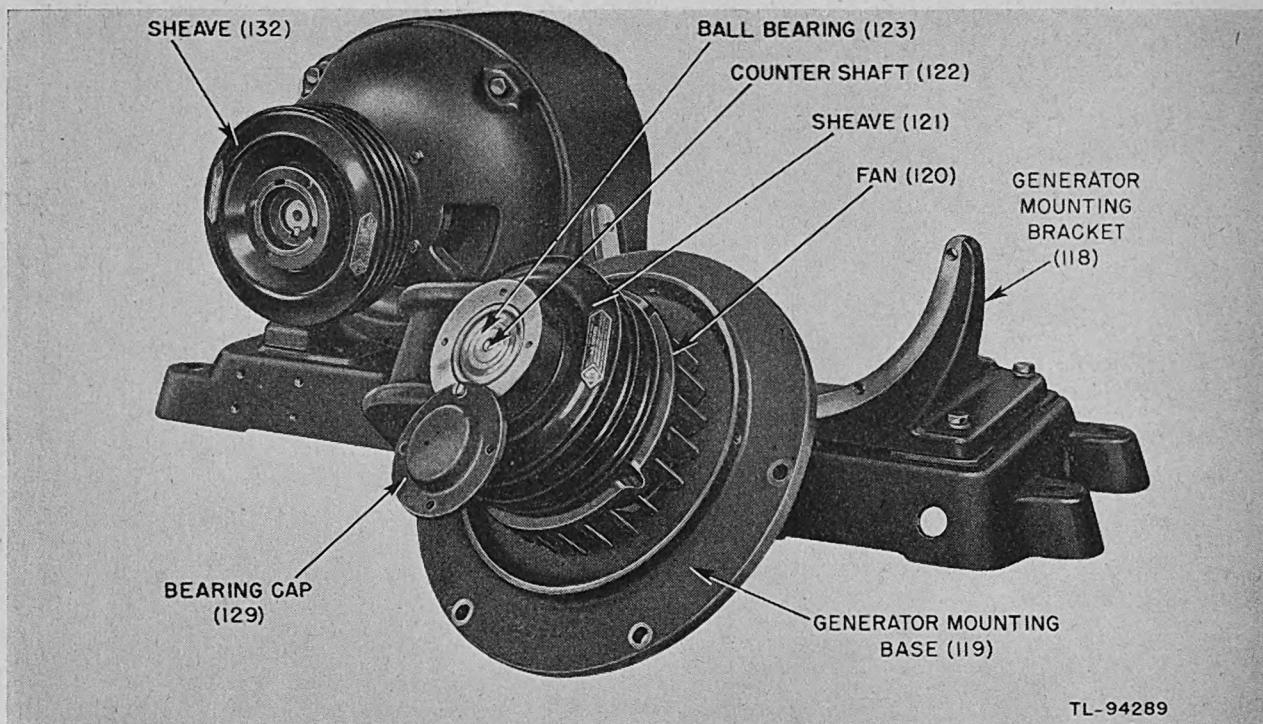


Figure 12. Generator mounting base assembly removed from bracket.

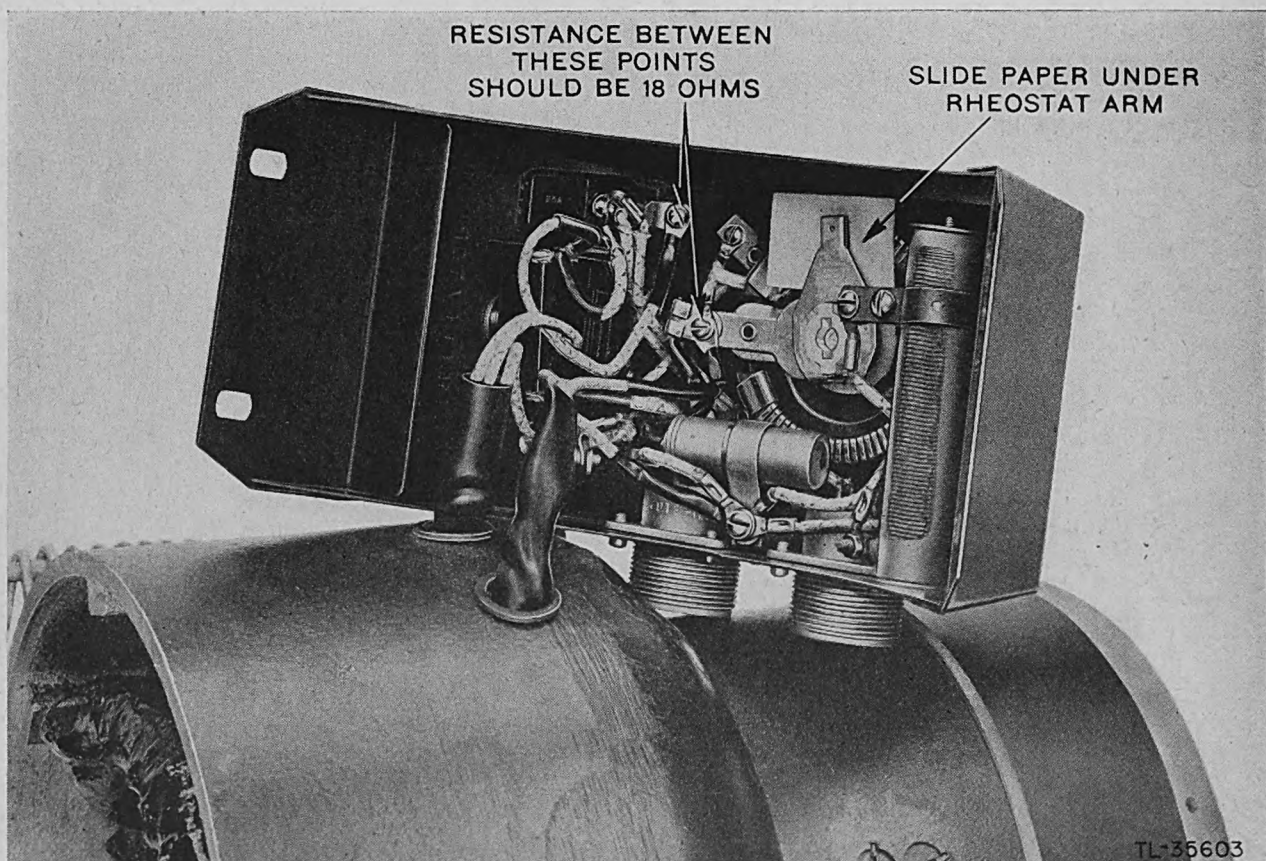


Figure 13. Points for testing shunt winding of d-c field.

c. Disassembling Generator Mounting. (1) Remove the three No. 10-32 screws holding the belt guard to the generator mounting base (fig. 1).

(2) Remove the two $\frac{3}{8}$ -inch hexagonal screws holding the belt guard bracket to the mounting base. Lift off the belt guard.

(3) Loosen the four bolts holding the motor to the mounting base and slide the motor toward the generator. Remove the two V-belts from the sheaves (fig. 12 (132)).

(4) Remove the retaining ring (fig. 11 (124)) from behind the bearing on the alternator end of the countershaft.

(5) Remove the four $\frac{3}{8}$ -inch hexagonal screws holding the generator mounting base to the generator mounting bracket, and remove the base with all parts attached (fig. 12).

(6) Remove the bearing cap (fig. 12 (129)) by taking out the four No. 10-32 screws.

(7) Remove the two socket setscrews from both the sheave (fig. 12 (121)) and the fan (fig. 12 (120)).

(8) Tap on the end of the countershaft (fig. 12 (122)) which was covered by the bearing cap (fig. 12 (129)) until it is driven through all parts. The front bearing will remain in the generator mounting base, and the rear bearing will remain on the countershaft.

(9) The generator mounting bracket or the motor may now be removed from the base by removing the four screws holding each. The sheave (fig. 12 (132)) on the motor and the sheave (fig. 12 (121)) on the countershaft are attached to their shafts with setscrews.

22. GENERATOR TESTING (A-C AND D-C).

a. Generator Tests. (1) **PRELIMINARY TESTS.** Make the following tests with the stator and yoke assembled, the armature removed or the brushes lifted from commutator, and all wires connected.

(a) Remove the four screws holding the control box to the shell. Turn back the box to expose the inside. Do not disconnect any wires.

(b) Slide a piece of paper under the rheostat arm (fig. 13) to insulate it from the winding. Connect an ohmmeter between the positive lead of the d-c circuit breaker and the center arm of the rheostat. The normal reading of approximately 18 ohms is the resistance of the shunt winding of the d-c generator field. Remove the paper after this test.

(c) Connect an ohmmeter between the right-hand top brush holder and the C terminal of the REMOTE receptacle. The resistance should be less than 1 ohm. This tests the continuity of the series winding of the d-c field.

(d) Place the ohmmeter prods between the A and B terminal of either REMOTE or LOCAL receptacle. Read-

ing should be less than 1 ohm. The B terminal of both receptacles is grounded to the control box.

(e) Turn the rheostat completely clockwise, and throw the modulator switch to ON. Connect the ohmmeter between the D terminals of the REMOTE and LOCAL receptacles. Normal reading of the alternator field winding is approximately 5 ohms.

(2) **INDIVIDUAL TESTING.** If the readings in subparagraph (1) above are not normal, check all connections. Then proceed to test the individual parts:

(a) *Rheostat.* Resistance, when fully cut-in, is 10 ohms.

(b) *Resistor.* The maximum resistance of the variable resistor is 5 ohms.

(c) *Circuit Breakers.* Check for open circuit with ohmmeter.

(d) *D-c Field.* The small wires coming from the shell are the shunt winding leads. The resistance for all four coils is approximately 16 ohms. The resistance of the individual field coil is approximately 4 ohms at room temperature (24° C). The larger diameter wires are the series field winding leads. Resistance for all four coils, or for one coil, should be almost zero. If the field coils are removed, be sure to mark the pole piece so that they may be replaced in original location and exact position.

(e) *Alternator.*

1. **A-C WINDING.** The green-coded wires coming from the stator shell are the a-c winding leads. Resistance between them should be 0.125 ohm at 24° C.

2. **FIELD WINDING.** The black-coded wires coming from the stator shell are the field winding leads. The resistance between them should be approximately 4 ohms at 24° C.

(f) *Spark Wheel.* Examine the spark wheel for burned electrodes (par. 7).

(g) *Armature (d-c).*

1. **SHORT CIRCUIT.** Test by use of a growler.

2. **OPEN CIRCUIT.** Hook up four 6-volt storage batteries in series. Insert a 10-ohm rheostat (150 watt) in series with one side of the 24-volt line. Place the arm of the rheostat at the center of its travel (about the midpoint of the resistance winding). About 5 amperes should flow through the above described circuit if the battery voltage is 24 volts and the test prods are short-circuited. Now apply the test prods to clean surfaces on adjacent segments of the commutator, and adjust the rheostat arm slightly clockwise or counterclockwise until the ammeter (if used) reads 5 amperes. If no ammeter is available, keep the rheostat arm at the center of its travel. Keep the shaft of the armature in a horizontal position. Place a compass 1/16 inch above armature core. The compass needle will

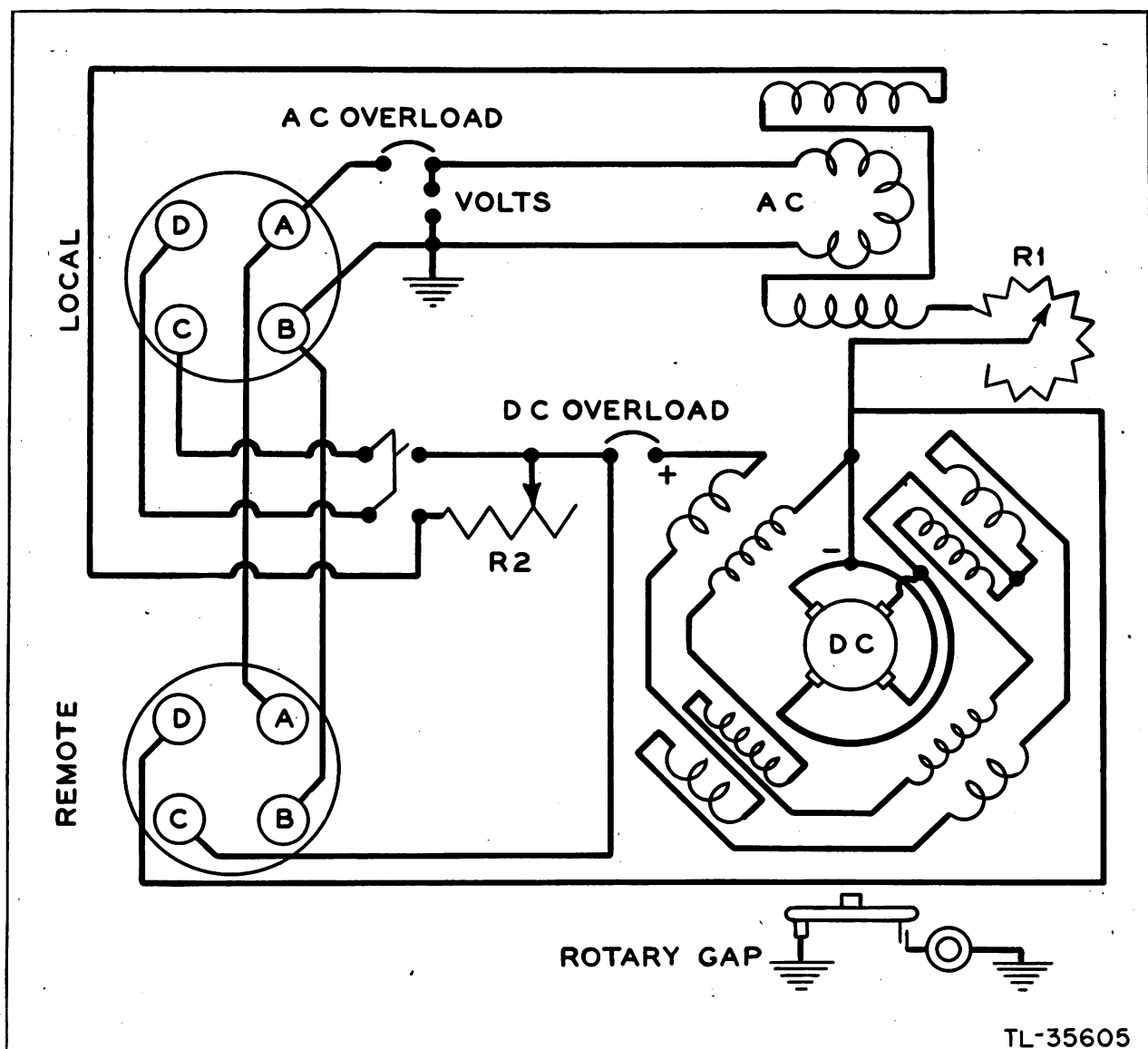


Figure 14. Schematic wiring diagram.

pull down if the winding is continuous. No deflection of the needle indicates an open circuit. This test must be made on every commutator segment.

3. **GROUND TESTS.** Apply 500 volts between the core or shaft, and a commutator segment. These are normally insulated from each other. An indicating device of some kind should be in series with the 500-volt line to indicate passage of current (if a short circuit exists). If high voltage is not available, screw a 75- or 100-watt bulb in a socket. Then connect one socket terminal to one side of the 110-volt lighting circuit. Connect the other terminal of the socket to the armature shaft. Then connect the other side of the lighting circuit to a commutator segment. If the bulb lights, the armature is grounded.

b. Countershaft and Bearings. (1) Examine the

bearing surfaces of the countershaft. If they are scored, replace the entire shaft.

(2) If ball bearings are rough turning, noisy, or have excessive radial play, replace them.

c. Sheaves and Fan. The sheaves and fan require replacement if they are broken, or have sharp edges which are cutting the V-belts.

d. Mounting Parts. Replace the generator mounting base if the bearings do not fit snugly in each end or if they are broken.

23. ASSEMBLY OF MOTOR GENERATOR.

CAUTION: Internal-external-tooth lockwashers must be reinstalled on all screws exactly as removed

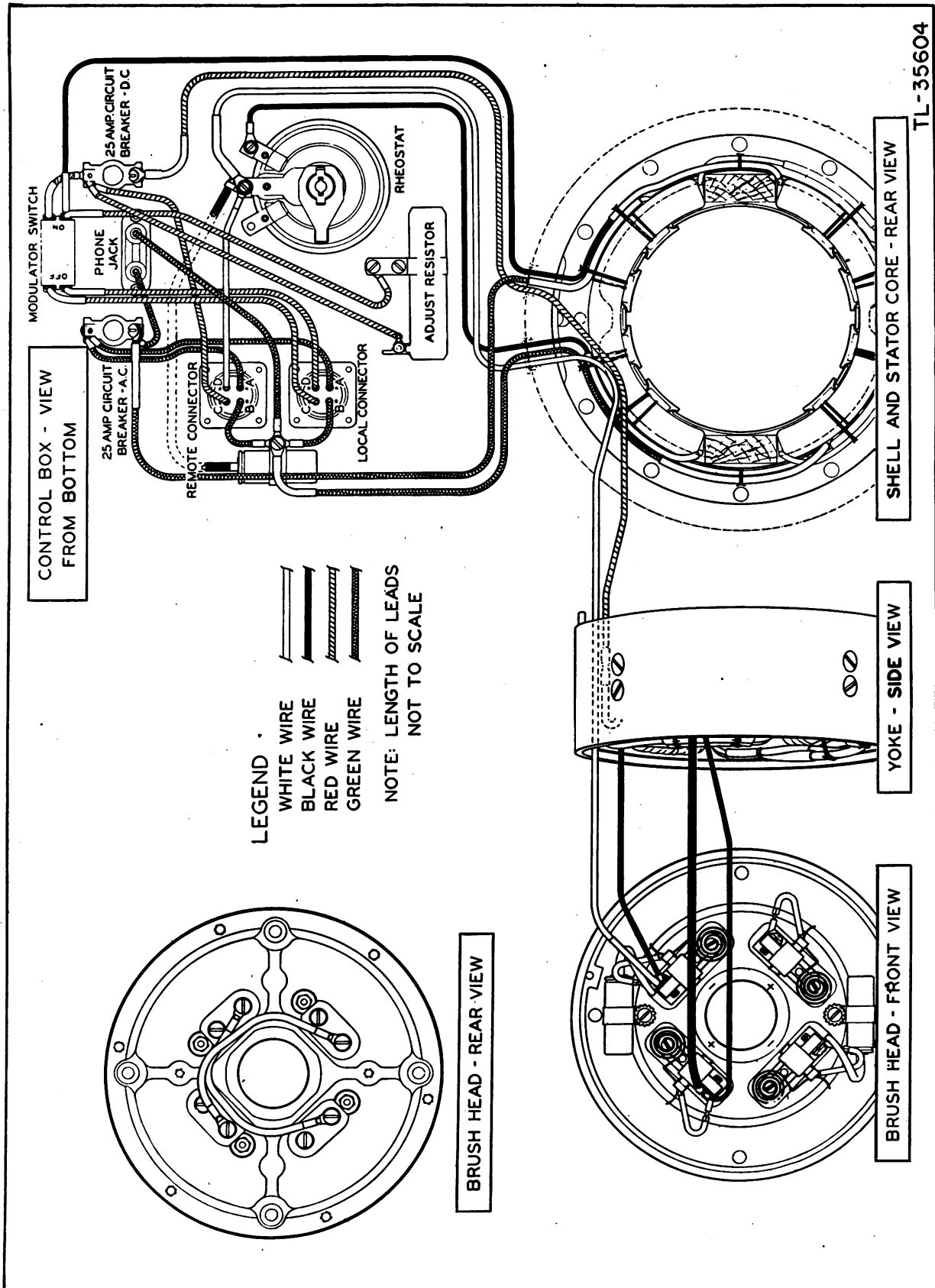


Figure 15. Practical wiring diagram.

to prevent radio interference. See paragraph 20e for location of these lockwashers.

a. Countershaft Assembly. (1) Press the rear bearing (fig. 11 (127)) on the countershaft (fig. 12 (122)).

(2) Insert key in countershaft keyway. Insert countershaft through generator end of generator mounting base and slide the fan and then the sheave (fig. 12 (121)) on the shaft. Align the keyway in the sheave and the fan with the key in the countershaft.

(3) Insert the countershaft into the front bearing (fig. 12 (123)), and tap on the end of the shaft with a soft mallet until it is tightly fitted.

(4) Tighten the socket setscrews in the sheaves and the fan. Install the retaining ring (fig. 11 (124)), behind the rear bearing (fig. 11 (127)) and the bearing cap (fig. 12 (129)) over the front bearing (fig. 12 (123)), fastening with four No. 10-32 screws and lockwashers.

(5) Replace the generator mounting base (fig. 12 (119)) on the generator mounting bracket (fig. 12 (118)), fastening with four $\frac{3}{8}$ -inch hexagonal screws and lockwashers. If the mounting bracket was removed from the base (fig. 11 (131)), replace it.

b. V-belts and Guard Assembly. Replace the two belts on the sheaves and slide the motor on the base to obtain proper tension. Tighten the four bolts holding the motor after tension adjustment is made (par. 14).

(2) Replace the belt guard. Slide the guard over the

belts and sheaves, and fasten it on the generator end with three No. 10-32 screws and lockwashers.

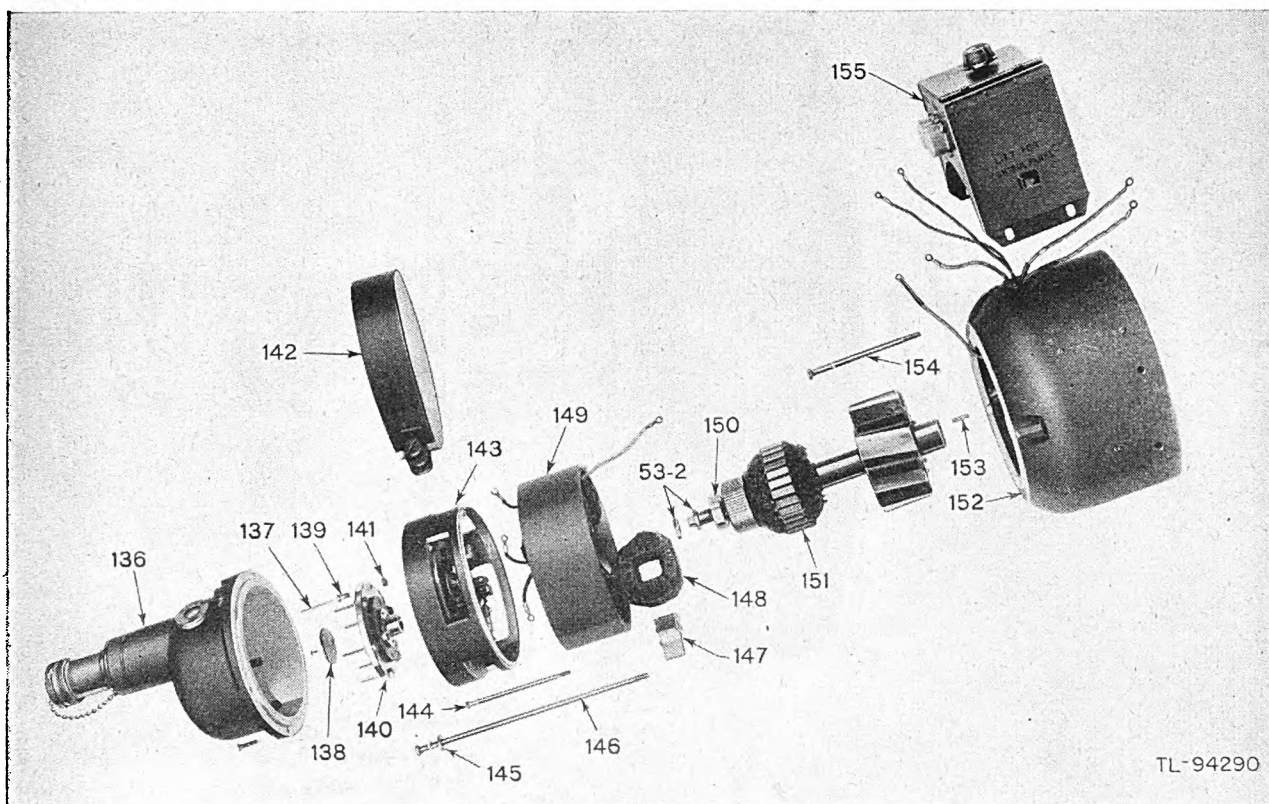
(3) Bolt the belt guard bracket to the base with the $\frac{3}{8}$ -inch hexagonal screws and lockwashers.

c. Generator Assembly. (1) Place the key in the countershaft, align the keyway in the armature shaft, and slide the armature over the countershaft until it is flush with the shoulder of the shaft.

(2) If the yoke and control box have been removed from the shell, reassemble them. Note that the brush head and yoke are fastened to the shell by four yoke bolts. *Refer to wiring diagrams (figs. 14 and 15) to make sure that all connections are correct.* Slide the complete yoke, shell, and brush head assembly over the armature. Fasten the shell to the generator mounting base with four shell bolts and lockwashers (fig. 9).

(3) Tighten the two locknuts on the armature shaft and slide the spark wheel assembly on the shaft. Place a lockwasher and collet washer (fig. 7) on the armature bolt. Then insert the bolt in the armature shaft and tighten. Fasten the ground plate to the spark wheel with three screws and lockwashers. Replace the brushes in their respective holders so that they seat properly on the commutator. Fasten the brush headband in place with the thumbscrew provided.

(4) Place the electrode grounding brush in its holder (fig. 4). Then assemble the spark wheel housing on the generator end, being careful not to drop out the brush. Fasten screws through the clamp ring into the brush head.



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Figure 16. Generator parts.

Key to reference numbers in figure 16

53-2	Locknut	146	Armature bolt
136	Spark-gap housing assembly	147	Pole piece
137	Electrode	148	Field coil
138	Brush plate	149	Yoke and coil assembly
139	Collet screw	150	Generator bearing
140	Spark wheel assembly	151	Armature and rotor assembly
141	Collet nut	152	Shell assembly
142	Brush headband	153	Armature key
143	Brush head assembly	154	Shell bolt
144	Brush head bolt	155	Control box assembly
145	Collet washer		

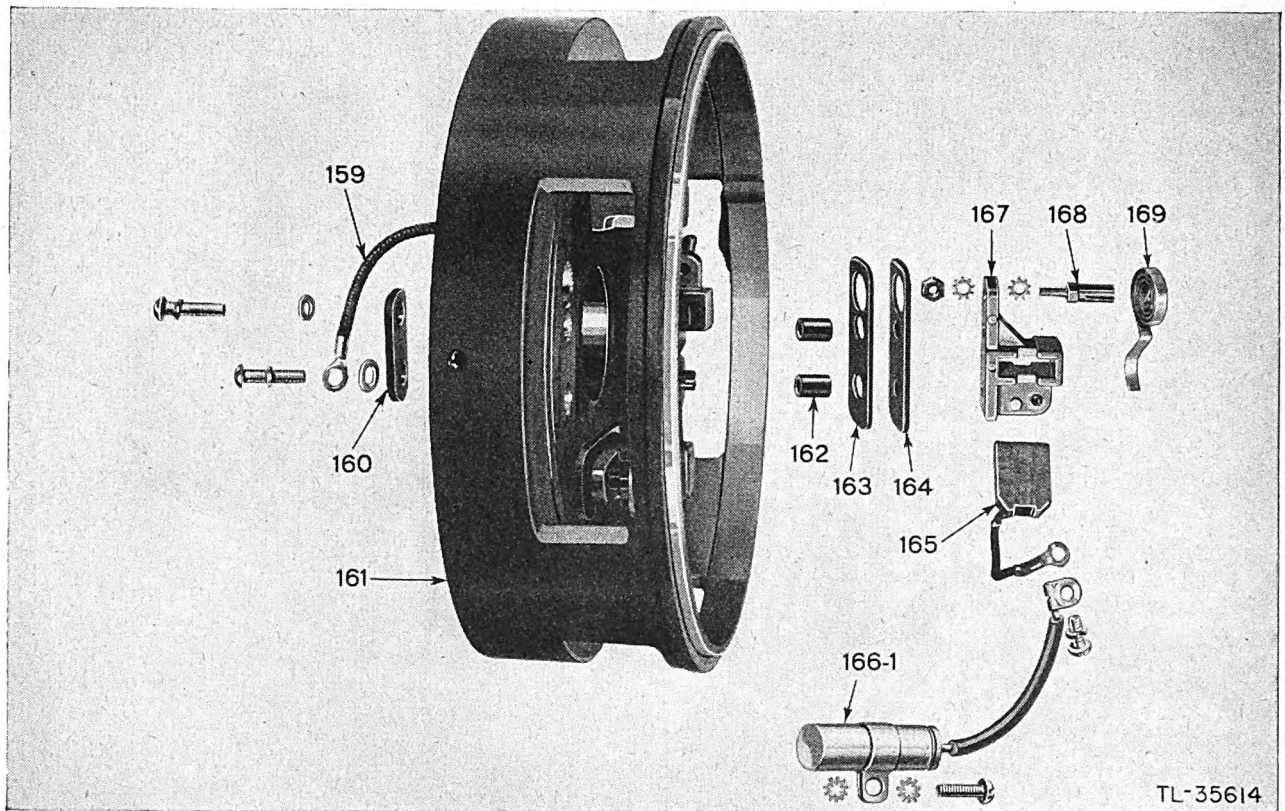
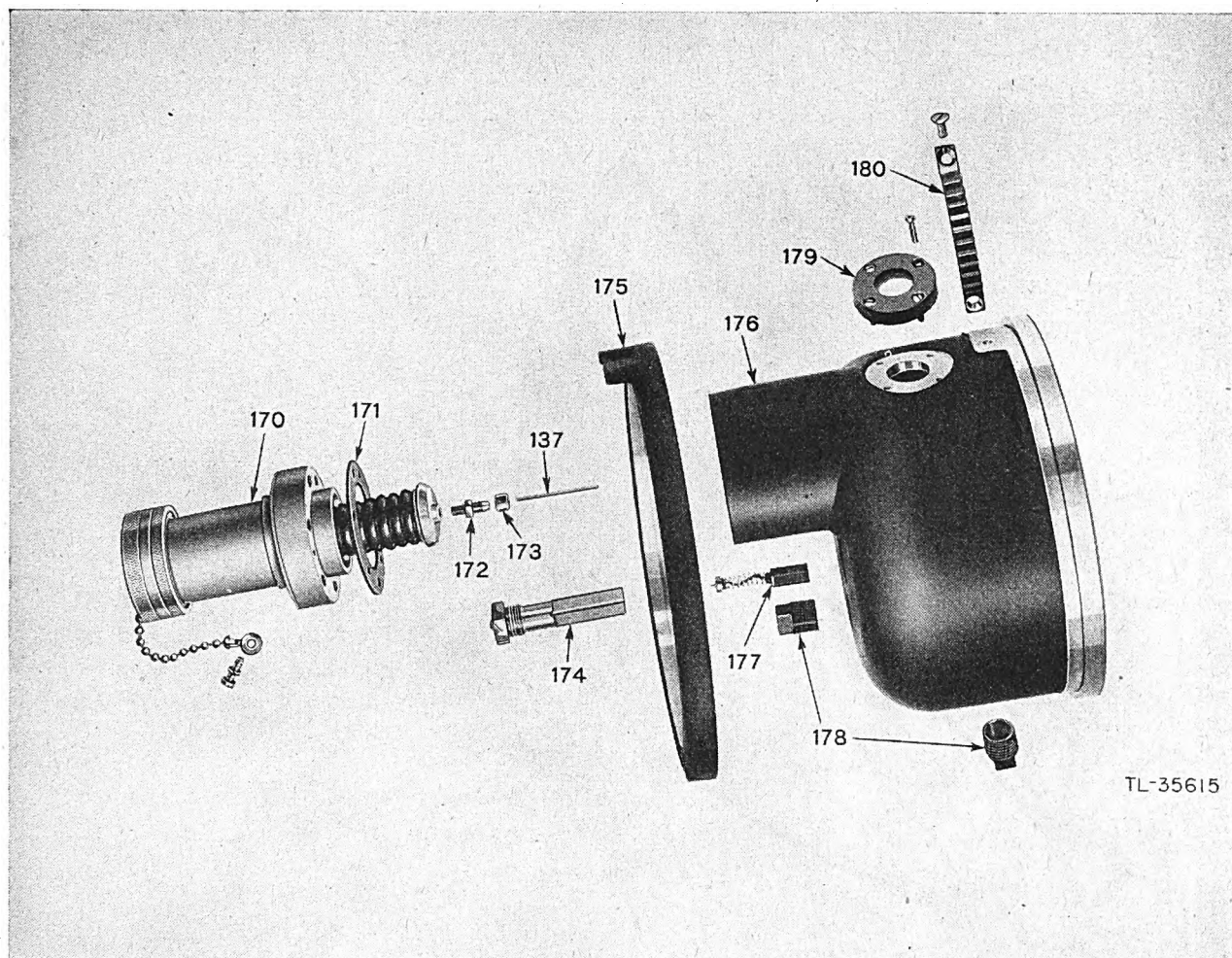


Figure 17. Brush head parts.

Key to reference numbers in figure 17

- | | | | |
|-----|-------------------------|-------|-------------------|
| 159 | Brush jumper | 165 | Brush |
| 160 | Brush head insulation | 166-1 | Capacitor |
| 161 | Brush head | 167 | Brush holder |
| 162 | Brush head bushing | 168 | Brush spring post |
| 163 | Brush-holder insulation | 169 | Brush spring |
| 164 | Brush-holder insulation | | |

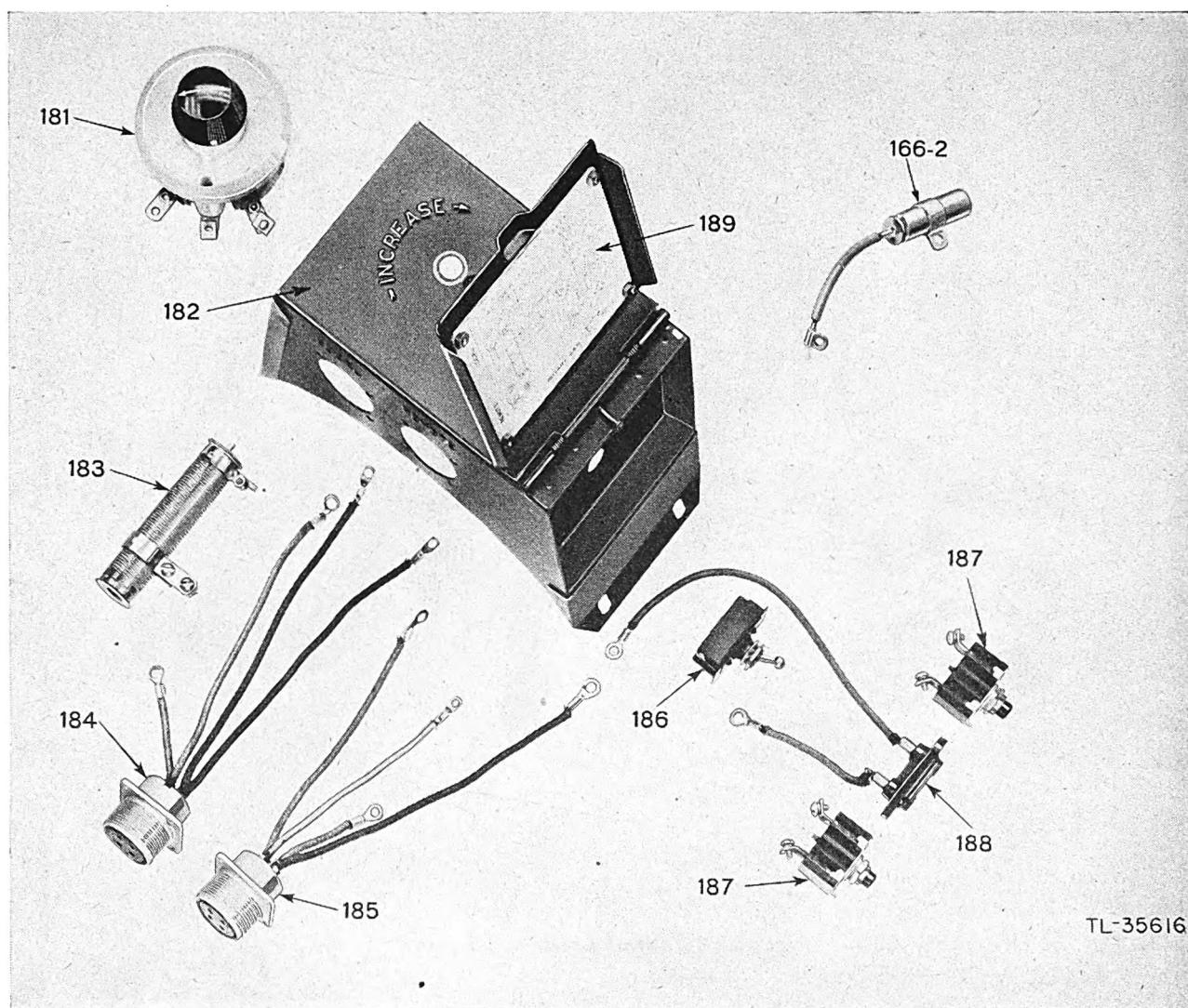


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Figure 18. Spark wheel housing parts.

Key to reference numbers in figure 18

137	Electrode	175	Clamp ring
170	Pothead assembly	176	Spark-gap housing
171	Pothead gasket	177	Grounding brush assembly
172	Electrode chuck	178	Pipe plug
173	Chuck nut	179	Gits window
174	Brush holder	180	Phasing segment



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Figure 19. Control box parts.

Key to reference numbers in figure 19

166-2	Capacitor	185	Local connector assembly
181	Rheostat	186	Switch
182	Control box	187	Circuit breaker
183	Resistor assembly	188	Phone jack assembly
184	Remote connector assembly	189	Instruction plate

SECTION V

SUPPLEMENTARY DATA

24. MAINTENANCE PARTS LIST FOR MOTOR GENERATOR PU-33/C.

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Run-ning spares	Orgn stock	3d ech	4th ech	5th ech	Depot stock
DRIVE GROUP									
133 (fig. 10)	6Z8874.1	BELT, "V" type: Allis-Chalmers Texpore Super 7, AC-A-42; (driving medium); or similar; Goodyear ✕0430.	2	4	*	*	*		
127 (fig. 11)	3H305-84	BEARING, ball: single row radial, double shielded; bore 0.7874", OD 2.0472", wd 0.5906"; 7 balls; 13/32" diam; ND ✕77604; (support countershaft).	1	0			*		
123 (fig. 12)	3H320-13	BEARING, ball: single row radial, double shielded; bore 1.1811", OD 2.4409"; wd 0.6299"; 9 balls; 1/8" diam; ND 77506; (support counter-shaft).	1	0			*		
GENERATOR GROUP									
150 (fig. 16)	3H2342/B2	BEARING, ball: single row radial, double shielded; bore 0.669"; OD 1.5748"; wd 0.4724"; 8 balls; 9/32" diam; ND 77503; HL (to guide outboard end of armature).	1	0			*		
165 (fig. 17)	3H2422/B30	BRUSH: Morganite grade CM-9; HL ✕25198-1; (collect load current).	4	8	*	*	*		
177 (fig. 18)	3H2422/B31	BRUSH ASSEMBLY: ground; with pressure spring and shunt; HL ✕AA-711; (ground rotor assembly).	1		*	*	*		
166-1 (fig. 17)	3DA100/205	CAPACITOR: 0.1 mf + 10%; 40 v; oil-impregnated and oil-filled; tubular 3/8" diam x 1 3/4"; ✕22 wire lead 2 7/8" long with flag terminal, with 3/32" hole; Tobe 2354; (suppress radio interference).	3	2	*	*	*		
172 (fig. 18)	3H2422/C20	CHUCK: special brass clamp; HL 25554; (holds electrode).	1			*	*		
137 (fig. 16)	3H1916/E25	ELECTRODE: tungsten rod; HL 25495; (spark gap).	7		*	*	*		

* Indicates stock available.

24. MAINTENANCE PARTS LIST FOR MOTOR GENERATOR PU-33/C (contd).

Ref symbol	Signal Corps stock No.	Name of part and description	Quan per unit	Run-ning spares	Orgn stock	3d ech	4th ech	5th ech	Depot stock
173 (fig. 18)	3H2422/N10	NUT, chuck: special; brass; HL #25553; (local chuck).	1			*	*		
141 (fig. 16)	3H1916/N20	NUT, collet: special; brass, nickel-plated; 1/4-28; hex; HL #81052; (lock collet screw).	6			*	*		
138 (fig. 16)	3H1916/P16	PLATE, brush: copper disk; HL #25491; (ground return).	1			*	*		
139 (fig. 16)	3H1916/S12	SCREW, collet: special; brass, nickel-plated; HL #25492; (retain electrode).	6			*	*		
145 (fig. 16)	3H1916/W2	WASHER, collet: special; steel; HL 25496.	1			*	*		
187 (fig. 19)	3H900-25-13	BREAKER, circuit: double-contact thermal type; 25 amp; 1 3/8" lg x 7/8" wd x 3/4"; neck-mounted; Spencer Therm PSM-25; (function overload).	2			*	*		
155 (fig. 16)	3H2422/B50	CONTROL BOX ASSEMBLY: HL #A5109.	1			*	*		
181 (fig. 19)	3Z7010-10	RESISTOR, variable: wire wound; 10 ohm; 100 w; tapered; 3-1/3" diam x 1 3/4"; Ohmite model K; HL #25475; (adjust a-c volt output).	1			*	*		
183 (fig. 19)	3Z4805-9	RESISTOR ASSEMBLY, adjustable: 5 ohm; 3 1/2" lg with mounting parts; HL #AA-815; (to compensate for modulator load).	1			*	*		
186 (fig. 19)	3Z9508	SWITCH, toggle: DPST; 6 amp, 250 v; 12 amp, 125 v; 1 3/4" lg x 7/8" wd x 5/8"; AH & A; #1350; (control modulator).	1			*	*		

* Indicates stock available.

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