EO 40-10BL-3

ROYAL CANADIAN AIR FORCE

REPAIR & OVERHAUL INSTRUCTIONS

ENGINE-DRIVEN DC GENERATORS TYPES 30E16-1A, 30E16-1C & 30E16-11-C

(BENDIX-AVIATION)

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22 JAN 57
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LIST OF RCAF REVISIONS

DATE	PAGE NO	DATE	PAGE NO

This Cover and "A" page is issued to identify as an EO, TO 8D6-3-3-3
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All revisions to this Publication will be issued under this Engineering Order.

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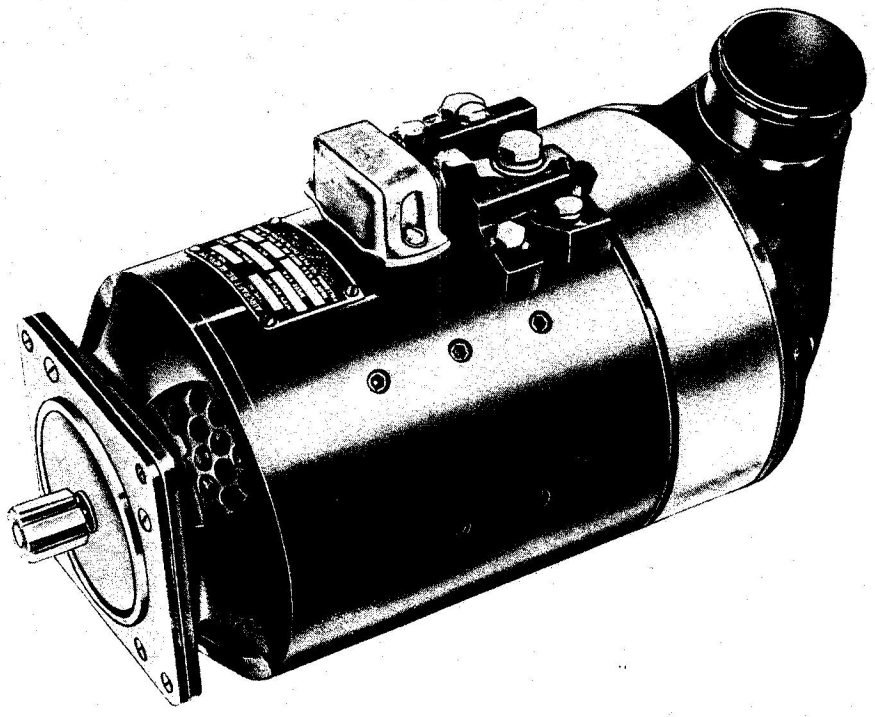


Figure 1-1. Type 30E16-1-A, Engine-Driven Generator

SECTION I

INTRODUCTION

1-1. GENERAL.

1-2. This handbook contains overhaul instructions and test procedure for the type 30E16-1-A, Engine-Driven D-C Generator. This equipment is manufactured by the Red Bank Division, Bendix Aviation Corporation, Eatontown, New Jersey.

1-3. PURPOSE OF EQUIPMENT. The generator is designed to provide an engine-driven source of d-c electrical energy in 24-volt generating systems.

1-4. LEADING PARTICULARS. The leading particulars of this equipment are listed in table I.

1-5. DIFFERENCE DATA SHEETS.

1-6. Sections II and III of this handbook contain overhaul instructions and test procedure for the type 30E16-1-A, Engine-Driven D-C Generator. Overhaul instructions and test procedure for additional types are provided in Section IV by the use of Difference Data Sheets. The additional types covered in Section IV are listed in Section IV.

1-7. Overhaul instructions and test procedure for types covered in Section IV are the same as those given in Sections II and III, except for the differences noted in the Difference Data Sheets.

NOTE

Many repair parts for equipment covered in this publication are provided in the form of kits. Refer to applicable Illustrated Parts Breakdown for details.

TABLE I. LEADING PARTICULARS

PERFORMANCE DATA	
Volts*	30
Amperes	100
GENERAL CHARACTERISTICS	
Speed range	2500 to 4500 rpm
Rotation (Viewed from generator drive end)	Counterclockwise
Air-blast cooling Inlet pressure	6 inches H_2O (static plus velocity head) with ambient temperature of 25°C (77°F) ±15°C (27°F) and air inlet temperature within ±5°C (9°F) of ambient
Volume	75 cfm
*The rated voltage of the generator is not to be confused with the setting of the accessory voltage regulator which is specified.	

SECTION II

OVERHAUL INSTRUCTIONS

2-1. SPECIAL TOOLS.

2-2. Special tools and test equipment required to overhaul the generator are listed in table II. Standard tools are listed in table III.

2-3. DISASSEMBLY.

2-4. DISASSEMBLY INTO BASIC COMPONENTS. Disassemble the generator in the order of key index numbers shown in figure 2-1. Note that attaching parts immediately follow the parts they attach. Observe the following special procedures:

NOTE

Do not disassemble the generator further than necessary to perform cleaning, inspection, and testing described in paragraphs 2-7 through 2-23. In particular, this applies to the anti-drive end head assembly (28, figure 2-1) and complete housing and field coil assembly (73). If further disassembly is required to replace parts, disassemble only enough to replace those parts. (Refer to paragraphs 2-5 and 2-6.)

TABLE II. SPECIAL TOOLS AND TEST EQUIPMENT

PART NO.	NOMENCLATURE	PROCURING SERVICE STOCK NO.
QB72370-2	Spanner Wrench	
QB80000-1	Screwdriver Press	
QB80001-7	Bearing Pusher	
QB80004-1	Spring Scale	
QB80005-34	Plug Gage	
QB80008-4	Pole Shoe Expander	
QB80009-5	Piloted Bearing Pusher	
QB80009-6	Piloted Bearing Pusher	
QB80027-1	Screwdriver Bit	
QB80028-1	Vee Block Adapter	
QB80059-1	Splined Wrench	

PART NO.	NOMENCLATURE	PROCURING SERVICE STOCK NO.
QB80063-2	Spline Shaft Holder	
QB80078-2	Brush Spring Pilot	
QB80079-1	Brush Spring Assembly Anvil	
QB80097-1	Lock Ring Pilot	
QB80100-1	Brush Spring Expander	
QB80110-1	Swivel Adapter	
QB80277-1	Hook	
QB80311-1	Plug	
QB80513-1	Brush Box Aligner	
1106900-1-A	Insulation Breakdown Tester	

TABLE III. STANDARD TOOLS

PART NO.	NOMENCLATURE	PROCURING SERVICE STOCK NO.
Catalog No. 4020-A. Plomb-Tool Co. Jamestown, N.Y.	Puller - Medium 2 Jaw	
Catalog No. 70A Snap-On-Tools Corp. Kenosha, Wisc.	Brake Key Pliers	

NOTE: Detailed test circuit components are not listed in tables II and III. Such items are shown in figures 3-1 and 3-2.

a. Remove the screws (9) and lock washers (10) which attach the two jumper assemblies (8) and the four brush assemblies (13) to the four brush box and post assemblies (32 and 33). Using hook QB80277-1, lift up each of the four brush springs (44) and remove the brush assemblies from the brush boxes.

NOTE

The two brush jumper assemblies (8, figure 2-1) cannot be removed at this time as they are secured by the clamps (38).

b. Mount the generator in spline shaft holder QB80063-2. Bend back the tabs of the tab lock (19) and remove the bearing nut (18), tab lock, and front slinger (26) from the commutator end of the armature assembly (67). Remove the self-locking nut (21), washer (22), and spring (23) from the commutator end of the drive shaft assembly (20).

CAUTION

Compress the spring slightly before removing the nut and washer to prevent the spring, nut, and washer from flying off.

c. Lift off the complete housing and field coil assembly (73). The drive shaft assembly (20), lining (24), and front plate (25) will remain in the holder.

d. Using screwdriver press QB80000-1, plug QB80311-1, and the puller (refer to table III), pull the anti-drive end head assembly (28) and ball bearing (27) off the armature assembly (67) shaft. Using screwdriver press QB80000-1, swivel adapter QB80110-1, and piloted bearing pusher QB80009-6, press out the ball bearing and back slinger (26).

NOTE

Do not unsolder the terminals from the jumper assembly, condenser assembly, lead assembly, or complete field coil and pole assembly unless necessary for replacement (refer to paragraph 2-29).

e. Using screwdriver press QB80000-1 and bearing pusher QB80001-7, remove the assembled armature assembly (67), ball bearing (68), slingers (70), and lock ring (69), as a unit, from the assembled back head (71) and complete housing and field coil assembly (73).

f. Using the brake key pliers (refer to table III), remove the lock ring (69). Remove the outer slinger (70). Using screwdriver press QB80000-1, plug QB80311-1, and the puller (refer to table III), pull the ball bearing (68) from the drive end of the armature assembly (67).

2-5. DISASSEMBLY OF ANTI-DRIVE END HEAD ASSEMBLY. Do not disassemble the anti-drive end head assembly (28, figure 2-1) unless repair or replacement of parts is indicated by inspection and testing, paragraphs 2-14 and 2-20. If necessary, disassemble in the order of key index numbers shown in figure 2-1. Use brush spring expander QB80100-1 to remove the brush springs (44) from the sleeves (42).

2-6. DISASSEMBLY OF COMPLETE HOUSING AND FIELD COIL ASSEMBLY. Do not disassemble the complete housing and field coil assembly (73, figure 2-1) unless repair or replacement of parts is indicated by inspection and testing, paragraphs 2-16 and 2-22. If necessary, disassemble as follows:

a. Place the complete housing and field coil assembly (73) in vee block adapter QB80028-1. Using screwdriver press QB80000-1 and screwdriver bit QB80027-1, remove the pole shoe screws (75).

b. Bake the housing and field coil assembly for one hour at approximately 121°C (250°F) in order to loosen the varnish and facilitate removal of the complete field coil and pole assembly (74). Pull out the complete field coil and pole assembly from the housing (79), noting the position of the insulating strips on each field coil connection.

NOTE

Presence of a new part in the applicable repair kit eliminates the necessity of cleaning, inspection, or rework of the equivalent used part removed from the assembly being repaired. Removed parts in this category shall be administratively condemned. Removed parts not supplied in applicable kit shall be handled in accordance with the following instructions.

2-7. CLEANING.

2-8. GENERAL.

a. Use only trichlorethylene, Specification MIL-T-7003, naphtha, aliphatic hydrocarbons, or a solvent conforming to Federal Specification P-S-661 to clean all generator parts thoroughly. Refer to paragraphs 2-9 and 2-10 for specific cleaning instructions for the armature assembly, complete housing and field coil assembly, anti-drive end head assembly, and back head.

WARNING

When using cleaning solvent, take precaution against burning the skin or inhaling the fumes. Use solvent in a well-ventilated room only.

b. Ultrasonic cleaning equipment may be used, however, consult the manufacturer of this equipment for the proper cleaning solutions and methods.

c. After cleaning, bake all parts in an oven for two hours at 121°C (250°F) or three hours at 93°C (200°F). After baking, apply a light film of oil, Specification MIL-L-7870, or an approved anti-corrosion preparation to all ferrous-metal surfaces to prevent rusting.

CAUTION

Do not get oil on the commutator.

TABLE IV. WEAR INSPECTION MEASUREMENTS

LOCATION	CHECK POINTS	DIMENSIONS		FIT
		MIN	MAX	
Armature shaft in anti-drive end head ball bearing (27, figure 2-1)	Armature shaft OD	0.7875	0.7877	0.0007T to 0.0001T
	Ball bearing ID	0.7870	0.7874	
Armature shaft in back head ball bearing (68, figure 2-1)	Armature shaft OD	0.9843	0.9846	0.0005T to 0.0000T
	Ball bearing ID	0.9841	0.9843	
Ball bearing (27, figure 2-1) in anti-drive end head	Ball bearing OD	1.8500	1.8504	0.0004T to 0.0003L
	Bearing liner ID	1.8500	1.8503	
Ball bearing (68, figure 2-1) in back head	Ball bearing OD	2.0470	2.0472	0.0004T to 0.0001L
	Bearing liner ID	2.0468	2.0471	
Drive shaft splines	Anti-drive end (over 0.072 in. pins)	0.549	0.552	
	Drive end tooth width	0.214	0.216	
	Drive end tooth dia	0.863	0.865	
Armature assembly	Internal spline (between 0.060 in. pins)	0.389	0.391	
Armature assembly	Commutator OD	2.764		
T denotes interference (tight) fit - L denotes clearance (loose) fit				

TABLE V. INSPECTION AND TESTING PROCEDURES

FIG. NO.	INDEX NO.	PART NOMENCLATURE	PROCEDURE
2-1	13	Brush assemblies	Replace at overhaul (see paragraph 2-33).
2-1	27, 68	Ball bearings	Replace at overhaul. (In an emergency, reconditioned ball bearings may be used.)
2-1	67	Armature assembly	Check shaft dimensions in table IV. Inspect for wear and damage (see paragraph 2-13). Perform electrical tests (see paragraph 2-19).
2-1	28	Anti-drive end head assembly	Check brush springs and brush rigging (see paragraph 2-14). Test brush rigging (see paragraph 2-20).
2-1	8, 57	Jumper and lead assemblies	Check for damage (see paragraph 2-15). Make continuity tests (see paragraph 2-21).
2-1	48	Condenser assembly	Check for damage (see paragraph 2-15). Perform electrical tests (see paragraph 2-23).
2-1	73	Complete housing and field coil assembly	Check wear and damage (see paragraph 2-16). Perform electrical tests (see paragraph 2-22).
2-1	20	Drive shaft assembly	Check spline dimensions in table IV. Inspect splines for burrs and scoring; check front spline for free fit in armature shaft spline. Inspect vibration dampener plate front lining surface for scoring, roughness, and distortion. Perform magnetic particle inspection in accordance with Specification MIL-I-6868. Check for discoloration indicating weakness (see paragraph 2-17).
2-1	23	Vibration dampener spring	Check compression. Load required to compress spring to assembled length of 7/8 inch should be between 42-3/4 and 47-1/4 pounds.
2-1	24	Vibration dampener lining	Check for tearing, cracking, wear, oil soaking, and smooth surfaces.
2-1	25	Vibration dampener front plate	Inspect lining surface and taper bore for scores, roughness, and distortion. Check match fit of taper bore on armature shaft.
2-1	45, 71	Anti-drive end and back heads	Check dimensions in table IV. Inspect for cracks, breaks, and corrosion. Check that all foreign matter has been removed. Repair liners if necessary (see paragraph 2-30).
2-1	1, 4	Air spout and window strap assy	Check for burning, cracks, breaks, and corrosion.
2-1	46, 55 63	Clamp, bracket, and terminal block	Check for burning, slightest cracks, and breaks.
2-1	54, 78	"B" and "E" post connectors	Check for cracks, corrosion, burning, and loose connections.
2-1	12, 52, 53, 61, 62, 76, 77	Terminal lugs and terminals	Examine for loose connections to leads. Check for burning, corrosion, or damage.
2-1	21	Self-locking nut	Examine for wear; replace if necessary.

2-9. ARMATURE AND COMPLETE HOUSING AND FIELD COIL ASSEMBLIES. Use a stiff, non-wire brush dipped in solvent to wash the armature assembly (67, figure 2-1) and complete housing and field coil assembly (73). Scrub the armature thoroughly, making certain to remove any carbon or copper particles which may be imbedded in the mica insulation between the commutator bars.

CAUTION

Do not soak the armature assembly or complete housing and field coil assembly in cleaning solvent.

2-10. END HEADS. Use a stiff, non-wire brush dipped in solvent to remove foreign matter such as copper chips, solder, or carbon dust from the anti-drive end head (45, figure 2-1) and back head (71). Finish cleaning with a clean, lint-free cloth moistened in the solvent.

2-11. INSPECTION.

2-12. GENERAL. Carefully inspect all parts for wear, damage, or corrosion. Check for stripped or damaged threads. Check washers, screws, nuts, tab locks, slingers, and lock ring for distortion and wear. Check the dimensions listed in table IV; if the dimension of any part or the clearance between any two mating surfaces exceeds the permissible tolerance, replace the part or parts. Use the procedures and values given in table V as a guide in inspecting parts; replace damaged parts except where a procedure is given for repair.

2-13. ARMATURE ASSEMBLY.

a. Examine the female spline inside the commutator end of the armature assembly (67, figure 2-1) shaft for scoring or burrs. Assemble the drive shaft assembly (20) into the armature shaft and check the freedom of fit in the armature spline.

b. Check the banding wire and clips to see that they are firmly soldered and tight. Check that the commutator bars are tight and in alignment. Measure the depth of undercut between bars. The depth should not be less than 0.021 inch. Check for high bars. Inspect the contact surface of the commutator, which should be even, highly burnished, and copper in color. Measure the diameter of the commutator. The diameter should not be less than 2.764 inches. If the contact surface is rough, pitted, scored, burned, or darkened by a hard film of carbon or oil that cleaning will not remove, refer to paragraph 2-27.

NOTE

Badly burned commutator bars are an indication of open-circuited armature coils.

c. Inspect the armature windings for burned, cracked, or frayed insulation. Check that all conductors are firmly soldered into the commutator risers. The depths of the conductors in the armature slots should be approximately equal, and each conductor should be firmly fixed in its slot. Check for flaring of the conductors at the drive end of the armature core.

2-14. ANTI-DRIVE END HEAD ASSEMBLY. Inspect the anti-drive end head assembly (28, figure 2-1) and its brush rigging, as follows:

a. Use spring scale QB80004-1 to measure the tension of each assembled brush spring (44). Hook the scale underneath the spring end and lift the spring until its end surface (which normally rests on the top of the brush) is 7/32 inch above the top of the brush box. The tension should be between 28 and 32 ounces.

b. Check the brush box and post assemblies (32 and 33) and assembled parts for cracks, corrosion, burns, burrs, and loose mounting.

2-15. JUMPER, LEAD, AND CONDENSER ASSEMBLIES. Check the jumper assemblies (8, figure 2-1), lead assembly (57), and condenser assembly (48) for damaged, loose, or corroded terminals or terminal posts, broken wire strands, and burned or cracked insulation.

2-16. COMPLETE HOUSING AND FIELD COIL ASSEMBLY. (See figure 2-1.) Check the insulation of the complete field coil and pole assembly (74) windings for wear, burning, and cracking. Check the terminals (76 and 77) and "E" post interpole connector (78) for damage, burning, and looseness. Check the pole shoe assemblies for tightness and see that the pole shoe screws (75) are secure. Use plug gage QB80005-34 to check the clearance of the armature assembly (67) in the complete field coil and pole assembly.

2-17. DRIVE SHAFT ASSEMBLY. Procedure for inspection of the drive shaft assembly (20, figure 2-1) is given in table V. When inspecting for evidence of overheating bear in mind that, although discoloration may indicate a weakened shaft, the condition can also be present in a sound shaft. Uniform discoloration along the pencil section of a new shaft may be disregarded; if, however, localized or blotchy discoloration is noted, overheating in service is indicated. If slight blueing has occured, the shaft may still be serviceable, provided a magnetic particle inspection (MIL-I-6868) reveals no surface cracks. If black discoloration is present, the shaft should be discarded. Steps should also be taken to eliminate the cause of the condition, such as overload or excessive vibration.

2-18. TESTING.

2-19. ARMATURE ASSEMBLY.

a. When a series test lamp circuit is specified for electrical check, use 110 volts at a commercial frequency with a 10-watt lamp connected in series.

b. Using the series test lamp circuit, check the armature assembly (67, figure 2-1) for grounds by applying one test prod to the armature shaft and the other test prod to one of the commutator bars. If the assembly is grounded, replace it.

CAUTION

Make test prod contacts outside the brush paths on the commutator bars to avoid pitting brush contact surfaces.

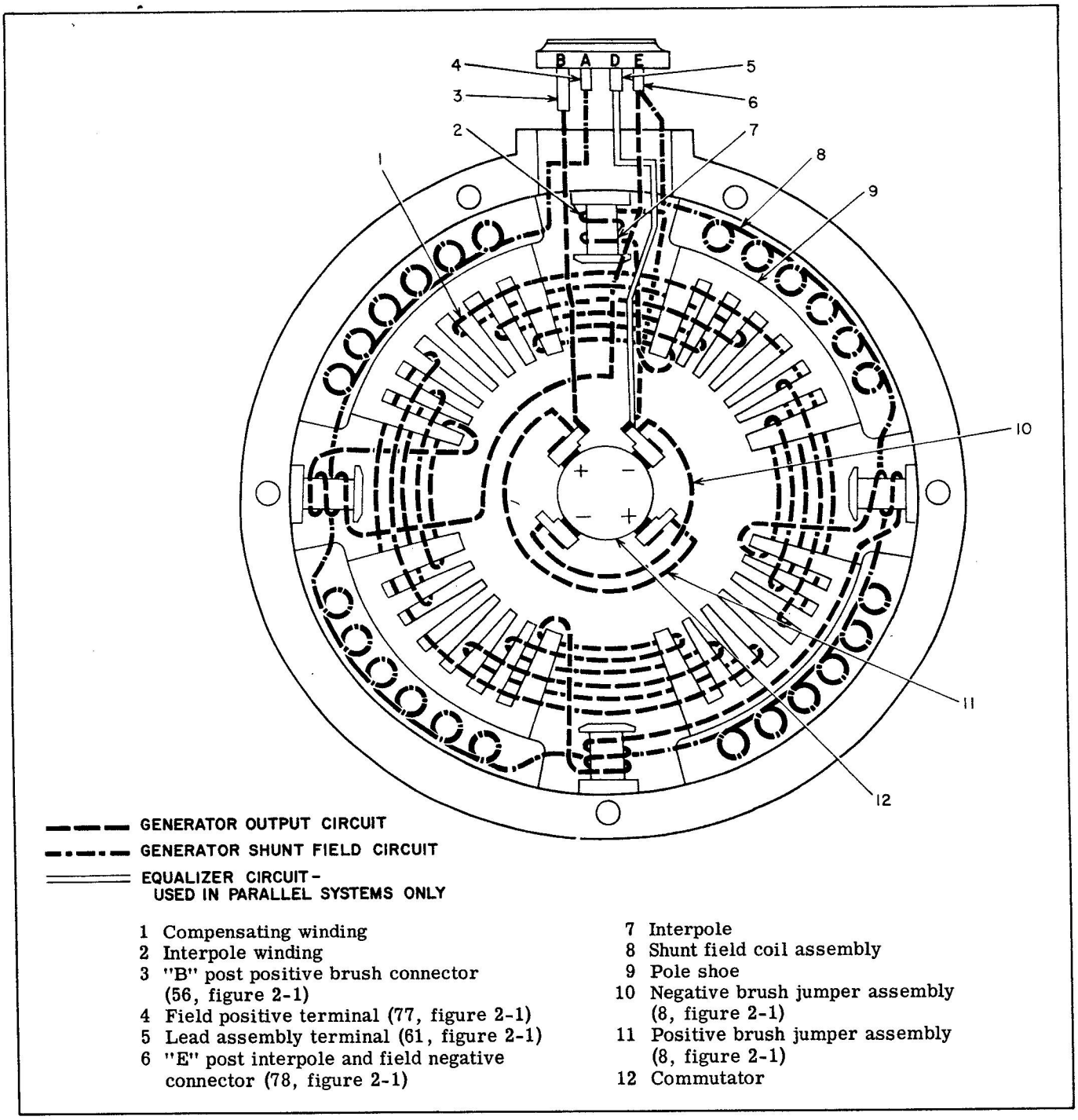


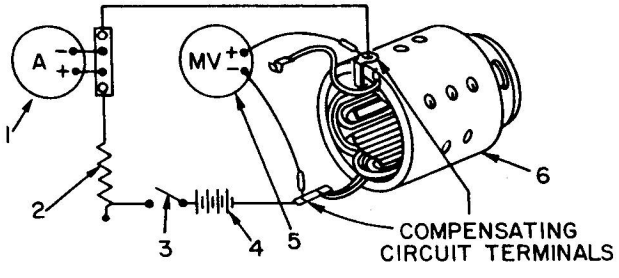
Figure 2-2. Internal Wiring Diagram

WARNING

Take precaution to avoid accidental contact with conductors carrying high voltage.

c. Use a "growler" to test the armature for shorts. Place the armature assembly in the "growler" and hold a thin strip of steel, such as a hacksaw blade, over the armature core while slowly rotating the armature shaft. If the steel strip vibrates, the armature is short-circuited; replace the armature assembly.

2-20. ANTI-DRIVE END HEAD ASSEMBLY. (See figure 2-2.) Test the brush rigging of the anti-drive end head assembly (28, figure 2-1). Using a series test lamp circuit (paragraph 2-19, step a), check the brush boxes for grounds. Apply one test prod to the anti-drive end head (45) and the other test prod to each brush box of the brush box and post assemblies (32 and 33) in succession. If a brush box is grounded, replace the faulty part. In reassembly, use new brush box insulators (39), bushings (40), and plate (41). After reassembly, repeat the test for grounds.



NOTE

All cables except the millivoltmeter test leads are to be AWG No. 00.

1 D-c ammeter, with 200-amp external shunt, Weston Electrical Instrument Corp., Newark, N.J., Model 45, range 0-200 amp (or equivalent)
2 Compression carbon rheostat, James G. Biddle Co., Philadelphia, Pa., catalog No. 30, rating 400 amp, 0.01-2.00 ohms, 1500 watts
3 Switch, knife, spst, 125-amp capacity
4 Battery, 120-volt
5 D-c millivoltmeter, Weston Electrical Instrument Corp., Newark, N.J., Model 280, range 0-1 and 0-10 V (or equivalent)
6 Complete housing and field coil assembly

Figure 2-3. Test Set-Up for Measuring Interpole and Compensating Windings Voltage Drop

2-21. JUMPER AND LEAD ASSEMBLIES. Using a series test lamp circuit (paragraph 2-19, step a), check the continuity of the jumper assemblies (8, figure 2-1), lead assembly (57), and "B" post connector (54). Replace damaged leads, terminals, or connector.

2-22. COMPLETE HOUSING AND FIELD COIL ASSEMBLY.

a. Using insulation breakdown tester 1106900-1-A, check the complete housing and field coil assembly (73, figure 2-1) for grounds by applying 110 volts between the housing and, in turn, each terminal of the complete field coil and pole assembly (74). If a ground exists, replace the complete field coil and pole assembly (refer to paragraphs 2-6 and 2-38).

CAUTION

Do not apply high voltage across field coil assembly windings.

b. Measure the resistance of the shunt field with a Wheatstone bridge, or similar device. The resistance between the "A" and "E" terminals should be between 1.935 and 2.365 ohms at 20° C (68° F). If the resistance is not within the prescribed limits, the complete field coil and pole shoe assembly is either open or shorted; replace it.

CAUTION

When a device using a d-c source is used to measure resistance, be sure the positive and negative terminals of the device are connected to terminals of like polarity at the field coil assembly to prevent reversal or demagnetization of the generator field.

c. Check the interpole compensating winding circuit by causing a current to flow through the circuit and measuring the resulting voltage drop. (See figure 2-3.) An internal "growler," if available, also may be used, as described in paragraph 2-19c, to determine if any winding of the field coil and pole assembly is short-circuited. To measure the voltage drop of the compensating circuit, make the test connections shown in figure 2-3, and proceed as follows:

CAUTION

Use care to prevent damage to the meter in the event of a high resistance or open winding. Use calibrated test leads with the millivoltmeter to ensure accuracy of measurement.

(1) Adjust the compression carbon rheostat (2) for maximum resistance.
(2) Close the switch (3).
(3) Adjust the rheostat until the ammeter (1) reads 100 amperes.
(4) Touch the millivoltmeter (5) test prods to the two terminals of the compensating circuit. The millivoltmeter should then read between 1.75 and 2.00 volts at 25° C (77° F). Disconnect the millivoltmeter.
(5) Open the switch.
(6) If the voltage drop is not within the prescribed limits, replace the complete field coil and pole shoe assembly.

2-23. CONDENSER ASSEMBLY. Using any commercially available condenser-testing equipment, test the condenser assembly (48, figure 2-1) for dielectric breakdown as follows:

a. Apply 110 volts d-c across the two terminals of the condenser, and across each terminal and ground (housing) for one minute.

CAUTION

To safefuard against accidental electric shock, after charging the condenser touch a screwdriver with insulated handle across each terminal and ground to discharge it.

b. Check the condenser rating which should be 4.0 mfd, 150 volts d-c.

2-24. REPAIR OR REPLACEMENT.

2-25. GENERAL. Repair damaged parts as described in the following paragraphs. Replace all parts which do not meet the dimensions in table IV, the inspections in paragraphs 2-12 through 2-17, or the electrical tests in paragraphs 2-19 through 2-23.

ADVANCE REVISION

Serial #1 dated 6 Oct 59
(Sheet 1 of 1)

The sheet of this Advance Revision is to be inserted in the EO as follows:-

Sheet 1 facing page 9

ARMATURE ASSEMBLY

PREFACE

The minimum OD of the commutator has been changed from 2.764" to 2.700".

INSTRUCTIONS

(a) Delete 2.764" from para. 2.26d and insert 2.700".

(b) Delete 2.764" from para. 2-27a, line 12, and insert 2.700".

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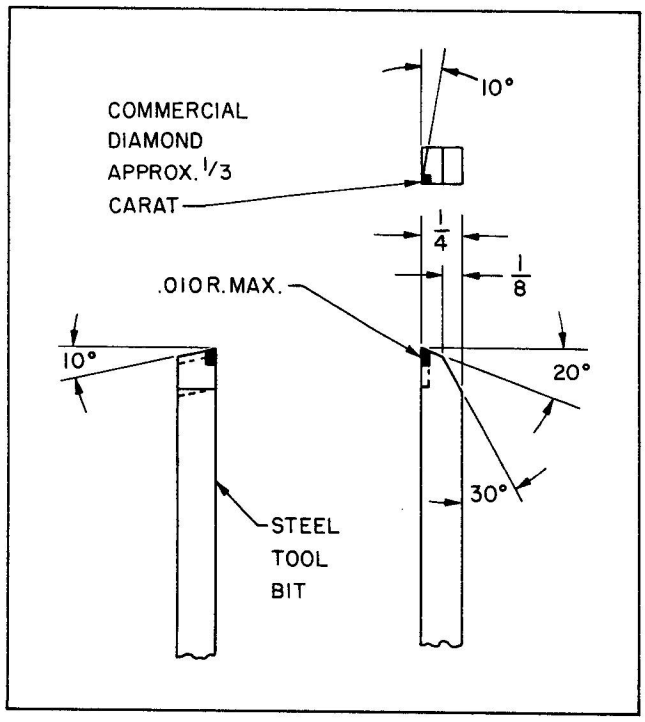


Figure 2-4. Diamond-Tipped Cutting Tool

2-26. ARMATURE ASSEMBLY. Replace the armature assembly (67, figure 2-1) if any of the following conditions exist:

a. if the diameters of the shaft or of the shaft splines are not as specified in table IV;

b. if the commutator has badly burned bars, because such a condition is usually the result of open-circuited armature coils;

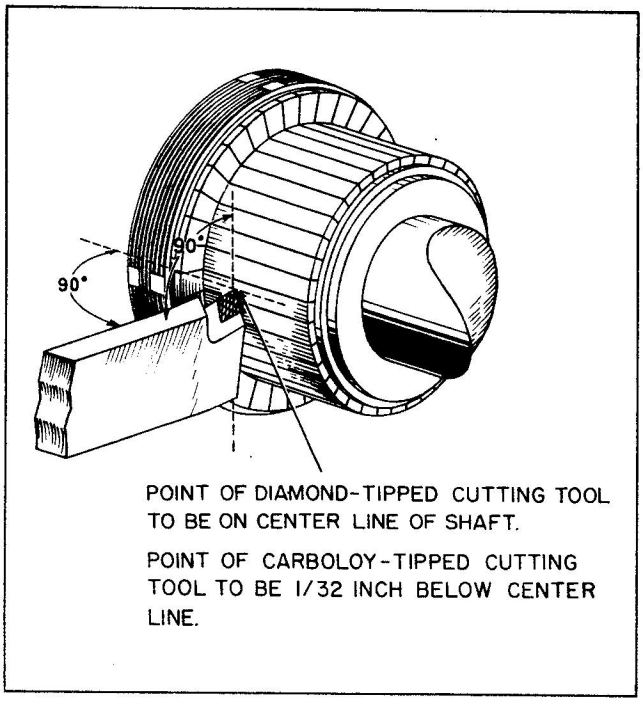


Figure 2-5. Mounting of Commutator Cutting Tool

c. if the commutator bars are loose or out of alignment;

d. if turning down the commutator would reduce the OD below the allowable minimum of 2.764 inches.

2-27. RESURFACING THE COMMUTATOR.

a. To remove oil or carbon film, take a single light cut at approximately 600 surface feet per minute. If scored or pitted, take a series of light cuts at approximately 200 surface feet per minute. A diamond-tipped cutting tool is recommended (see figure 2-4). The point of the diamond-tipped cutting tool must be held on the center line of the armature shaft (see figure 2-5). If a Carboloy-tipped cutting tool is used (see figure 2-6), the point of the cutting tool must be held 1/32 inch below the center line of the armature shaft. The minimum diameter to which the commutator can be turned down is 2.764 inches. The limit is indicated by a stop cut into the commutator for this purpose. However, as metal is removed, the stop will become less evident, therefore, measurements should always be taken.

b. After the commutator has been turned down, measure the depth of the undercutting between the commutator bars. If the depth is less than 0.021 inch, undercut to a depth of 0.021 inch minimum, 0.036 inch maximum, and a width of 0.025 inch.

NOTE

If the commutator does not need resurfacing, it will still be necessary to check the undercutting.

c. After the commutator has been undercut, take a final cut of not more than 0.001 inch across the face of the commutator to remove burrs. If a diamond-tipped cutting tool is not available, make the final cut with a freshly-honed Carboloy-tipped tool. Cutting speed should be approximately 600 surface feet per minute with either type tool. Do not use polishing abrasives. After the final cut, remove burrs between commutator bars with a strip of fiber.

d. The commutator must be concentric with the bearing surface of the armature shaft within 0.0005 inch, full indicator reading.

e. After resurfacing, clean the commutator to remove all traces of oil, grease, or other substances as specified in paragraph 2-9.

f. Repeat the electrical tests described in paragraph 2-19.

2-28. BALANCING THE ARMATURE ASSEMBLY.

a. After finishing, check the armature assembly for dynamic balance. The assembly must not be out of balance by more than 0.020 inch-ounce. Rebalance, if necessary, by soldering at each end on the banding wire (step b).

b. Use Eclipsaloy No. 9, grade 6 (obtainable from Red Bank Division, Bendix Aviation Corporation, Eatontown, N.J.), having a composition of 5 percent tin and 95 percent lead and a melting range of 277°C to 313°C (530°F to 596°F). Solder conforming to Federal Specification ASTM B32-49 (Gr 5A), having a similar composition and melting range, may be used as an emergency alternate. Use a flux composed of 50 percent rosin (water white) and 50 percent ethyl

block adapter QB80028-1 to support the housing (79) and seat pole shoes firmly with pole shoe expander QB80008-4. Using screwdriver press QB80000-1 and screwdriver bit QB80027-1, tighten the pole shoe screws. Tighten the pole shoe expander only enough to seat pole shoes properly as tightening the expander too much will cause distortion of the yoke. Stake the pole shoe screws after tightening. Check the alignment and seating of the pole shoes with plug gage QB80005-34. In the case of a grounded complete field coil and pole assembly, replace the complete field coil and pole assembly as described in paragraphs 2-6 and 2-38.

2-33. DRIVE SHAFT ASSEMBLY. If the splines or taper of the drive shaft assembly (20, figure 2-1) are burred or scored, stone gently; replace if stoning deforms the splines or taper in any way or if the splines fail to meet the dimensions specified in table IV.

2-34. BRUSH ASSEMBLIES. Replace the brush assemblies (13, figure 2-1). The new brushes must be run-in before testing (refer to paragraph 3-12).

2-35. LUBRICATION.

2-36. During reassembly, lubricate the splines of the drive shaft assembly (20, figure 2-1), the armature assembly (67) shaft end taper, and the vibration dampener front plate (25) taper with Pioneer No. 31 spline lubricant (obtainable from Red Bank Division, Bendix Aviation Corporation, Eatontown, N.J.). If this lubricant is not available, a lubricant conforming to Federal Specification MIL-L-3545 may be used.

2-37. REASSEMBLY.

2-38. REASSEMBLY OF COMPLETE HOUSING AND FIELD COIL ASSEMBLY. If disassembled, reassemble the parts of the complete housing and field coil assembly (73, figure 2-1) in the reverse order of disassembly (paragraph 2-6). Observe the following special procedures:

a. Reassemble the terminals (76 and 77) and "E" post connector (78) of the complete field coil and pole assembly (74), using the solder described in paragraph 2-29, steps a and c.

b. Place the complete field coil and pole assembly (74) in the housing (79) and assemble loosely with the pole shoe screws (75). Make certain that the insulating strips on the field coil connections are in the same position noted at disassembly (paragraph 2-6b) and then tighten the pole shoe screws sufficiently to hold the coil in place.

c. Repeat the ground check described in paragraph 2-22, step a.

d. Dip the complete housing and field coil assembly for one-half hour in Sterling Varnish M-830, manufactured by the Sterling Varnish Co., Hayesville, Pennsylvania (specific gravity 0.850 to 0.860).

CAUTION

Do not dip the leads. Protect them from the varnish to prevent hardening after baking.

e. Drain the assembly for 30 minutes. Wipe the excess varnish from the housing, using a naphtha-moistened cloth.

f. Bake the entire assembly from 10 to 12 hours at approximately 121°C (250°F).

g. Remove the unit from the oven and allow it to cool from 1 to 2 hours.

h. Repeat step d above.

i. Repeat step e above.

j. Invert the position of the unit in the oven and repeat step f above to ensure uniformity of baking.

k. While the unit is still hot from baking, use pole shoe expander QB80008-4 to expand opposite pole shoes and coils or interpoles against the housing. With the expander in place, tighten the pole shoe screws. Repeat this operation for the remaining pole shoes and coils and interpoles.

l. Remove the expander and check with plug gage QB80005-34 to ensure proper armature clearance.

NOTE

The inside diameter between faces of opposite pole shoes must be between 3.863 and 3.865 inches.

m. Repeat the continuity and ground tests described in paragraph 2-22 to make sure that the new complete housing and field coil assembly has not been opened or grounded during assembly.

n. Stake each pole shoe screw to the housing in two places.

2-39. REASSEMBLY OF ANTI-DRIVE END HEAD ASSEMBLY AND JUMPER ASSEMBLIES. If disassembled, reassemble the parts of the anti-drive end head assembly (28, figure 2-1) and jumper assemblies (8) in the reverse order of disassembly (paragraph 2-5). Observe the following special procedures:

a. Using brush spring pilot QB80078-2 and brush spring assembly anvil QB80079-1, assemble the springs (44), adjusting sleeves (42), and cotter pins (43) into the brush box and post assemblies (32 and 33).

b. Coat the brush box insulators (39) and bushings (40) with AN-TT-V-116 or AN-TT-V-118 (or General Electric No. 1201) red glyptal lacquer before assembly. Assemble the brush box and post assemblies (32 and 33) onto the anti-drive end head (45), using the bolts (34), insulators, bushings, plates (41), washers (37), clamps (38), lock washers (36), and nuts (35). (See figure 2-9.) Use brush box aligner QB80513-1 to align the brush boxes. Coat the screw heads and washers, as well as the insulating parts, with AN-TT-V-116 or AN-TT-V-118 (or General Electric No. 1201) red glyptal lacquer, as shown in figure 2-9. Repeat the ground check described in paragraph 2-20.

c. Using spring scale QB80004-1, adjust the springs so that each spring has a tension of 28 to 32 ounces when its arm is lifted 7/32 inch above the top of the brush box as described in paragraph 2-14, step a.

d. Assemble the two jumper assemblies (8) in the position shown in figure 2-9. Secure the jumpers in place with the clamps (38). The terminals will be connected when the brush assemblies are installed.

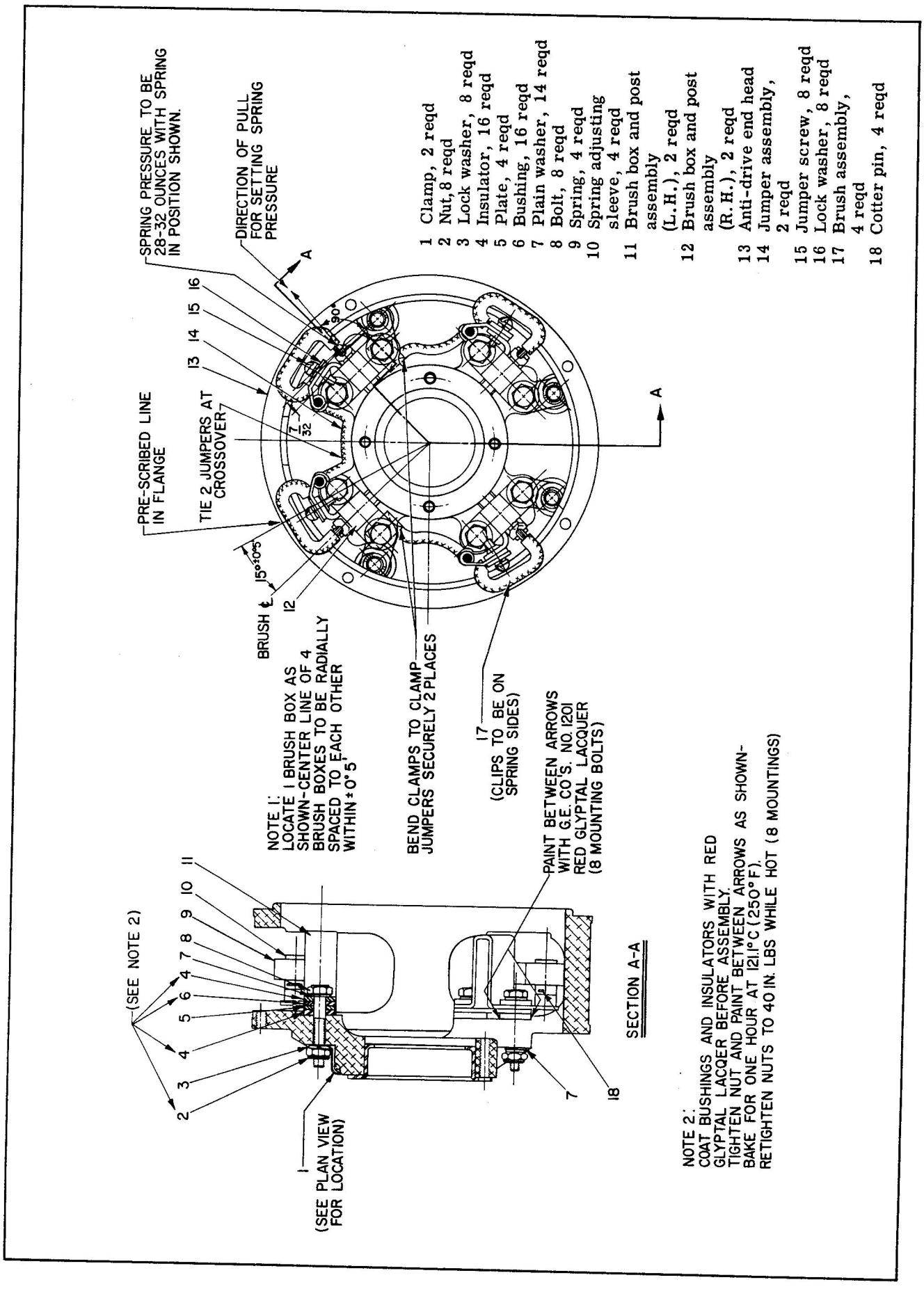


Figure 2-9. Anti-Drive End Head Assembly with Jumpers and Brushes Assembled

2-40. REASSEMBLY OF GENERATOR BASIC COMPONENTS. Reassemble the generator basic components in the reverse order of disassembly (paragraph 2-4). See the internal wiring diagram, figure 2-2, for correct wiring. Observe the following special procedures:

a. Heat the drive end ball bearing (68) to an oven temperature of 93.3°C (200°F) to expand the inner race. Using screwdriver press QB80000-1, swivel adapter QB80110-1, and piloted bearing pusher QB80009-5, assemble the ball bearing and slingers (70) on the drive end of the armature assembly (67) shaft. Using lock ring pilot QB80097-1 and bearing pusher QB80001-7, secure the ball bearing in place with the lock ring (69).

b. Using screwdriver press QB80000-1, swivel adapter QB80110-1, and piloted bearing pusher QB80009-6, press the anti-drive end ball bearing (27) and slingers (26) into the anti-drive end head assembly (28). Heat the assembled bearing and head to a temperature of 93.3°C (200°F) and then, using screwdriver press QB80000-1, swivel adapter QB80110-1, and piloted bearing pusher QB80009-6, insert the commutator end of the armature assembly (67) into the ball bearing.

c. Slip the tab lock (19) on the shaft of the armature assembly (67) and lightly screw on the bearing nut (18).

d. Insert the drive end of the armature shaft into the complete housing and field coil assembly (73). Position the anti-drive end head assembly (28) against the housing (79) and lightly secure it to the housing with screws (29), washers (30), and washer plates (31).

e. Using screwdriver press QB80000-1, swivel adapter QB80110-1, and piloted bearing pusher QB80009-5, press the back head (71) onto the ball bearing (68). Secure the back head to the housing (79) with screws (72). Tighten the screws (29) to a torque of 89 to 96 inch-pounds.

f. Position the "E" post interpole connector (78) over the condenser terminal (52) and secure it to the terminal block (63) with one bolt (49) and lock washer (50).

g. Secure the "B" post connector (54) to the positive brush terminal of the anti-drive end head assembly (28) with screws (9) and lock washers (10). Position the "B" post connector over the condenser terminal (53) and secure it to the terminal block (63) with the bolt (49) and lock washer (50).

h. Secure the lead assembly (57) terminal (61) to the terminal block (63) "D" post with the one bolt (58) and lock washer (59). Secure the terminal (62) to the negative brush terminal of the anti-drive end head assembly (28).

i. Secure the field terminal (77) of the complete field coil and pole assembly (74) to the terminal block (63) "A" pole with the other bolt (58) and lock washer (59). Secure the interpole terminal (76) to the negative brush terminal of the anti-drive end head assembly (28).

j. Tighten the bearing nut (18) on the commutator end of the armature assembly (67) shaft, while preventing the armature from turning. Secure the nut with the tab lock (19).

k. Before assembling the drive shaft assembly (20), assemble the lining (24) on the inner surface of the back plate of the drive shaft assembly (20) and slip the front plate (25) onto the drive shaft so that both plates fit snugly against the lining. Lubricate the splines of the drive shaft and armature shaft as described in paragraph 2-36.

l. Mount the generator in the spline shaft holder QB80063-2. Assemble the spring (23), washer (22), and nut (21) on the commutator end of the drive shaft assembly (20) and tighten the nut to 75 inch-pounds.

m. Rotate the armature assembly (67) by hand and check for rubbing, binding, and noise. The armature should rotate quietly and with a very slight and uniform drag caused by the grease in the ball bearings. If the armature does not rotate freely, disassemble the generator and recheck the dimensions specified in table IV.

n. Secure the brush assemblies (13) and jumper assemblies (8) to the brush boxes (32 and 33) with the screws (9) and lock washers (10). Using hook QB80277-1, lift up the brush spring (44) arms and insert the brushes into the brush boxes. Do not twist the brush leads. (See figure 2-9.) **Make certain that the side of the brush that has the metal strip faces the brush spring and that the brush leads are not twisted.**

o. Safety wire all drilled-head screws in accordance with Specification MS 33540 (ASG).

SECTION III

TEST PROCEDURE

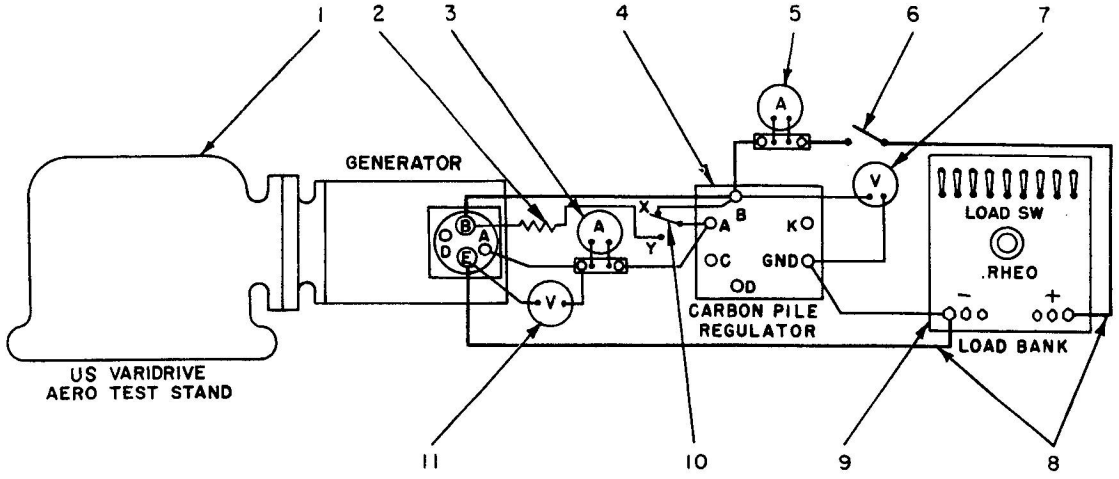
3-1. TEST EQUIPMENT.

3-2. The test equipment required and test set-up is shown in figure 3-1. The recommended air-blast cooling test set-up is shown in figure 3-2. If a model OTB Type 30-600 aircraft generator testometer is available, substitute the equipment on the testometer for the similar equipment shown in figures 3-1 and 3-2.

3-3. CONTROL EQUIPMENT. (See figure 3-1.) Adjust the carbon pile voltage regulator (4) to produce a regulated 27.0 to 28.4 volt d-c output voltage. For all tests except the minimum speed check described in paragraph 3-16, the pile shorting switch (10) must be in the "X" position to insure voltage control by the carbon pile voltage regulator.

3-4. LOAD BANK. Use a load bank (9, figure 3-1) having graduated load steps and a continuous rating of at least 100 amperes at 30 volts.

3-5. INSTRUMENTS. Refer to figure 3-1 for required instruments.



NOTE

Use AWG No. 12 cable for all circuits except those designated (8), for which use No. 00.

1 US Varidrive Aero Test Stand, US Electrical Motors Inc., New York, N.Y., 25 hp (min), speed 2200 to 7000 rpm (min)
2 Fixed resistor, 3/4-ohm, 75-watt
3 D-c field ammeter, with 15-amp external shunt, Weston Electrical Instrument Corp., Newark, N.J., Model 45, range 0-15 amp (or equivalent)
4 Carbon pile voltage regulator, Red Bank Division, Bendix Aviation Corp., Eatontown, N.J., Type 1042-217, for 30-volt operation
5 D-c load ammeter, with 100-amp external shunt, Weston Electrical Instrument Corp., Newark, N.J., Model 45, range 0-100 amp (or equivalent)
6 Load switch, knife, spst, 100-amp capacity
7 D-c line voltmeter, Weston Electrical Instrument Corp., Newark, N.J., Model 45, range 0-30 V (or equivalent)
8 AWG No. 00 cable
9 Load bank, having graduated load steps and a continuous rating of at least 100 amperes at 30 volts d-c
10 Pile shorting switch, knife, spst, 15-amp capacity
11 D-c field voltmeter, Weston Electrical Instrument Corp., Newark, N.J., Model 45, range 0-30 V (or equivalent)

Figure 3-1. Test Set-Up

a. All ammeters should be procured without internal shunts in order that they may be used with suitable external shunts for a wide range of applications. External shunts used on d-c ammeters must be of the same millivolt rating as the ammeters. Use calibrated shunt leads.

b. The varidrive test stand must include speed ranges between 2200 and 7000 rpm, and be equipped with a tachometer to indicate speed.

3-6. TEST PREPARATION.

3-7. FLASHING THE FIELD. Prior to connecting the generator into the test set-up, flash the shunt field to make certain that the generator retains sufficient residual magnetism to build up voltage properly. Connect the negative terminal of a 12-volt battery to the "E" generator terminal post. Connect the positive battery terminal through a single-pole, single-throw knife switch to the "A" generator terminal post. Apply battery current to the field with the knife switch for approximately five seconds. Repeat the operation several times to make sure that the field is properly flashed.

CAUTION

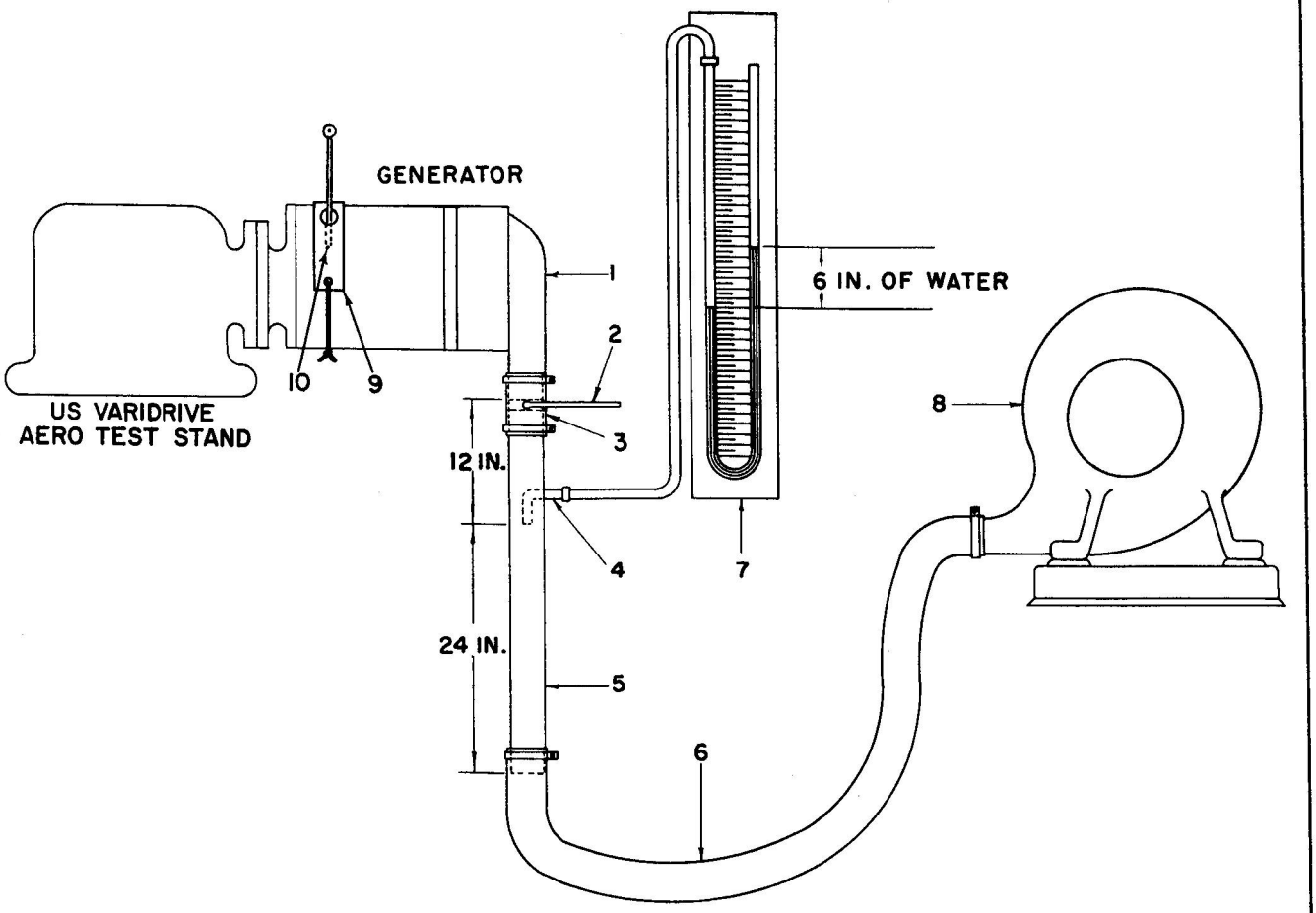
Always apply battery current through a knife switch when flashing the field. Opening the circuit at the generator or battery may cause severe damage to the terminals.

3-8. CONNECTING GENERATOR INTO TEST SET-UP. Connect the generator into the test set-up shown in figure 3-1. Use flexible, insulated cables of sizes not less than those specified for the particular circuit. Keep connections as short as possible.

3-9. ATTACHMENT OF THERMOMETER. Use a laboratory-type thermometer to measure the temperature rise of the generator during the heat run (paragraph 3-15). Insert the bulb end of the thermometer (10, figure 3-2) through a slotted felt strip (9). Set the bulb end of the thermometer against the housing of the generator at a pole shoe screw. Tie the strip firmly in place against the housing.

NOTE

Do not attach the thermometer to the same side of the generator as the air spout.



1 Air spout
2 Laboratory-type thermometer
3 Flexible hose with suitable reducers
4 Pitot tube
5 Air-blast tube, smooth inside, 1.91 inch ID
6 Flexible hose with suitable reducers
7 Manometer
8 Blower, American Blower Corp., Detroit, Mich., Size D, type P (or equivalent). Must provide 75 cfm of cooling air at a maximum temperature of 30°C (86°F) and a pressure of 6 in. H_2O (static plus velocity head)
9 Felt strip
10 Mercury column laboratory-type thermometer

Figure 3-2. Test Set-Up - Air-Blast Cooling

3-10. AIR-BLAST COOLING. (See figure 3-2.) Make certain all air duct connections are securely clamped. Make sure the window strap assembly is in place. Turn on the blower (8) and adjust the air intake to the blower until the outlet pressure measures 6 inches of water (static plus velocity head) on the manometer (7). The maximum permissible temperature of the cooling air is 30°C (86°F). When the pressure has been adjusted properly, turn off the blower until ready to proceed with testing.

CAUTION

Do not operate the generator without proper air-blast cooling or with the window strap assembly removed, or excessive heating will result.

3-11. PRELIMINARY RUNNING CHECK. (See figure 3-1.) Make a brief running check to be certain the generator is in safe operating condition. Refer to table VI for the proper voltage, current, and speed conditions. If load can be applied as described below, the generator may be considered in safe condition for further testing. With all load switches open, proceed as follows:

CAUTION

If, at any time during this or any other test, smoking or excessive sparking is observed, undue noises are heard, or if the generator fails to meet any of the specified performance values, immediately open all switches and shut down the driving motor and blower. Do

TABLE VI. PRELIMINARY RUNNING CHECK PERFORMANCE VALUES

GENERATOR SPEED RPM	TEST VALUES (SEE FIGURE 3-1.)		
	FIELD AMMETER (3) AMPERES (max)	LOAD AMMETER (5) AMPERES (max)	LINE VOLTMETER (7) REGULATED VOLTS
2500 to 4500	8.00	100	30

not proceed with the test until the cause of the trouble has been located and corrected. If visual inspection fails to disclose the cause of the trouble, disassemble the generator and repeat the inspection and testing described in Section II. Repeat the test procedure from the start after reassembling.

NOTE

Generator rotation is counterclockwise as viewed from the generator drive end. Do not drive in a clockwise direction.

a. Turn on the air-blast cooling blower (8, figure 3-2).
b. Close the pile shorting switch (10, figure 3-1) to the "X" position, which will connect the generator for automatic voltage regulation through the carbon pile voltage regulator (4).
c. Start the varidrive test stand (1) and gradually increase generator speed until the desired speed, as specified in table VI, has been reached.
d. The regulated line voltage, as read on the line voltmeter (7), should read approximately 30 volts as the generator speed nears the minimum rpm.
e. Close the load switch (6) and apply approximately a 10-ampere load by closing load bank (9) switches, as required. The regulated line voltage, as read on the line voltmeter (7), should remain at approximately 30 volts. The load ammeter (5) should read approximately 10 amperes.
f. If the generator operates satisfactorily, gradually increase the applied load to not more than 100 amperes by closing as many additional load bank (9) switches as necessary. The regulated line voltage, as read on the line voltmeter (7) should remain at 30 volts. The shunt field current, as read on the field ammeter (3), should not exceed 8.00 amperes.
g. When the test has been completed, open all load switches and shut down the driving motor and the blower.

3-12. SEATING BRUSHES. (See figures 3-1 and 3-3.) The new brushes installed in the generator must be run-in before proceeding with the tests. Refer to table VII for the proper voltage, current, speed, and temperature values. With all switches open, proceed as follows:

CAUTION

Do not exceed the voltage, load, and speed values specified in table VII during brush run-in. Do not use abrasives to aid in seating the brushes.

a. Turn on the air-blast cooling blower (8, figure 3-2).
b. Close the pile shorting switch (10, figure 3-1) to the "X" position for automatic voltage regulation.
c. Start the varidrive test stand (1) and gradually increase the generator speed to 2500 rpm.
d. Maintain the regulated line voltage, as read on the line voltmeter (7), at approximately 30 volts.
e. Close the load switch (6) and apply not more than 50 amperes of load, as indicated on the load ammeter (5), by closing load bank (9) switches, as required.
f. Operate the generator at this load for about 30 minutes; then increase the applied load to not more than 100 amperes. Turn off the driving motor and blower at 15-minute intervals, remove the window strap assembly, and examine the brush seats. Continue operation at full load until each brush is satisfactorily seated, as shown in figure 3-3. There shall be no evidence of grooving or other damage to the brush faces.
g. When the brush seating has been completed, open

TABLE VII. BRUSH SEATING RUN PERFORMANCE VALUES

GENERATOR SPEED RPM	TEST VALUES (SEE FIGURE 3-1.)				
	FIELD AMMETER (3) AMPERES (max)	LOAD AMMETER (5) AMPERES (max)		LINE VOLTMETER (7) REGULATED VOLTS	*MAXIMUM HOUSING TEMPERATURE
		First 30 Minutes	Balance of Run		
2500	8.00	50	100	30	110°C (230°F)

*Maximum housing temperature should not be confused with normal rise in temperature. Operation of the generator at temperatures exceeding the value specified may result in damage to its windings.

3-21. VISUAL INSPECTION AFTER TEST RUNS. After tests are completed, remove the window strap assembly (4, figure 2-1) and the brush assemblies (13).

a. Closely examine the interior of the anti-drive end head assembly (28) and the complete field coil and pole assembly (74) for thrown particles of solder or copper.

b. Closely inspect the armature assembly (67) for armature rubbing, bearing roughness, commutation brush tracking, and any evidence of improper brush seating. Check the armature assembly for high commutator bars.

c. Check the brushes for improper seating.

d. If the generator fails the above inspection in any respect, refer to the Caution in paragraph 3-11.

NOTE

In the event that either the complete field coil and pole assembly or the armature assembly are replaced, repeat the entire test procedure outlined in this Section.

e. Reassemble the generator and repeat the ground tests described in paragraph 3-20.

CAUTION

Each brush must be returned to the same brush box from which it was removed, and in the same position.

3-22. POLARITY CHECK. After satisfactory completion of the test procedure and visual inspection, remount the generator on the test stand and connect the air-blast cooling system. Reconnect the electrical test connections from the carbon pile voltage regulator (4, figure 3-1) to the "A" and "B" terminal posts of the generator. Then, connect the positive and negative terminals of the line voltmeter (7) to the "B" and "E" terminal posts, respectively. Drive the generator at any speed within the rated speed range (2500 to 4500 rpm). The voltmeter should indicate in the proper direction. If it is necessary to reverse the voltmeter connections to obtain a reading, the polarity of the generator has been reversed. In this event, refer to paragraph 3-7 and flash the field in the proper direction as outlined. Upon completion of the polarity check, remove all test connections and dismount the generator from the test stand.

SECTION IV

DIFFERENCE DATA SHEETS

Overhaul instructions and test procedure for the types included in this section are the same as those for the type 30E16-1-A, Engine-Driven D-C Generator, except for the differences noted in the applicable Difference Data Sheet. Sections II and III contain complete overhaul instructions and test procedure for the type 30E16-1-A, Engine-Driven D-C Generator.

INDEX OF ENGINE-DRIVEN D-C GENERATORS