

SERVICE DEPARTMENT



Maintenance Instruction

AR6-D14 TRACTION GENERATOR

AR6-D14 traction generator maintenance and overhaul instructions are presented in six sections, each under separate cover. General maintenance instructions are included for the AR6-D14 combination. In addition, detailed instructions to completely disassemble, inspect, recondition, assemble, and test the AR6 traction generator are included. Performance of a specific procedure may require, as a prerequisite, the completion of a procedure contained in another section. In each case this procedure will be referenced.

| <u>Section No.</u> | <u>Title</u> |
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| 3 | Stator Inspection, Reconditioning, And Test |
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| 5 | Rectifier Bank Assemblies And Suppression Circuits |
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SECTION 1

MAINTENANCE AND DISASSEMBLY

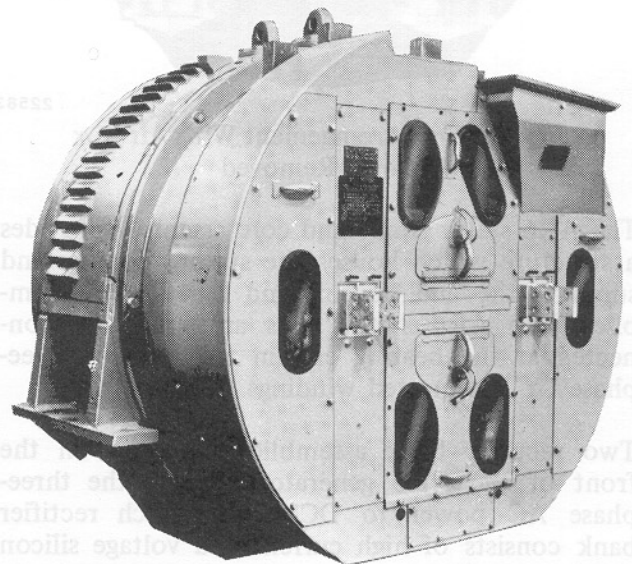
INTRODUCTION

This section contains instructions for general, on the locomotive, generator maintenance. Also included, is a complete generator disassembly procedure broken into two parts. The first part, describing parts removal for bearing maintenance may be performed while the generator is in place. The remainder of the procedure, concerning total generator disassembly, requires that the generator be removed from the installation to complete disassembly.

DESCRIPTION

The AR6-D14 traction generator, Fig. 1, is composed of two three-phase, alternating current synchronous generators of the single bearing type.

The rotors of the two machines are mounted on a single shaft which is directly coupled to the engine crankshaft through a flexible flywheel coupling. The shaft is supported at the outboard end by a single, sealed lubricated, self-aligning bearing assembled in an end housing which is bolted to the main frame of the AR6. The D14 stator is bolted to the coupling end of the AR6 stator.



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Fig. 1 - AR6-D14 Traction Generator

The rotating fields consist of series connected field coils wound on laminated poles, which are bolted to a drum-type spider. The spider is connected to the rotor shaft.

The AR6 field coils are electrically connected to the two inboard collector rings mounted in the

air box at the bearing end of the generator. The D14 field coils are electrically connected to the two outboard collector rings. The collector rings and associated brush holders provide the means of exciting the fields of the two machines.

The AR6 is equipped with an air box cover which includes diode viewing windows and two access doors, Fig. 1. These doors provide easy access to the collector rings and brushes for inspection or replacement of brushes. There is also a collector ring cover, Fig. 2, to prevent contaminants from entering the collector ring area.

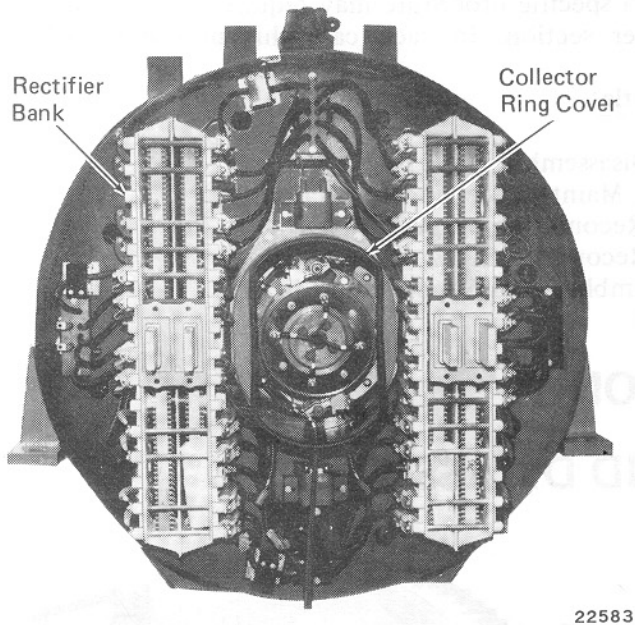


Fig. 2 - End Arrangement With Air Box Cover Removed

The AR6 stator frame and core assembly provides a structure which houses the stator windings and supports the end housing and D14 stator assemblies. The AR6 stator coils are internally connected at the bearing end in two sets of three-phase "Y" connected windings.

Two rectifier bank assemblies mounted on the front of the AR6 generator convert the three-phase AC power to DC power. Each rectifier bank consists of high current and voltage silicon diodes connected in a three-phase, full wave, rectifier circuit mounted on heat sinks for cooling.

MAINTENANCE

This generator is designed and manufactured to provide long service life and optimum performance with minimum maintenance. Like any

machine, however, certain maintenance is required, the extent of which is largely determined by the operation and service to which the generator is subjected. Inspections and maintenance should be performed at time intervals specified in the Scheduled Maintenance Program.

GENERATOR CLEANING

Both the exterior and interior of the generator should be kept clean and free of dust, dirt, oil, and water which are likely to have a detrimental effect on insulation and performance.

When conditions warrant, use high volume, low pressure 207-345 kPa (30-50 psi), clean, dry, compressed air to blow debris from generator parts.

CAUTION: Do not use high pressure air to clean generator. High pressure air may loosen insulation binding and imbed debris into insulation, causing premature failure.

Remove remaining hardened deposits by wiping with a clean cloth dampened with a solvent such as Stoddards Solvent (ASTM-D474-40). This solvent has a flash point of 46° C (115° F).

WARNING: Provide adequate ventilation while working with solvents. Observe usual precautions while handling flammable materials.

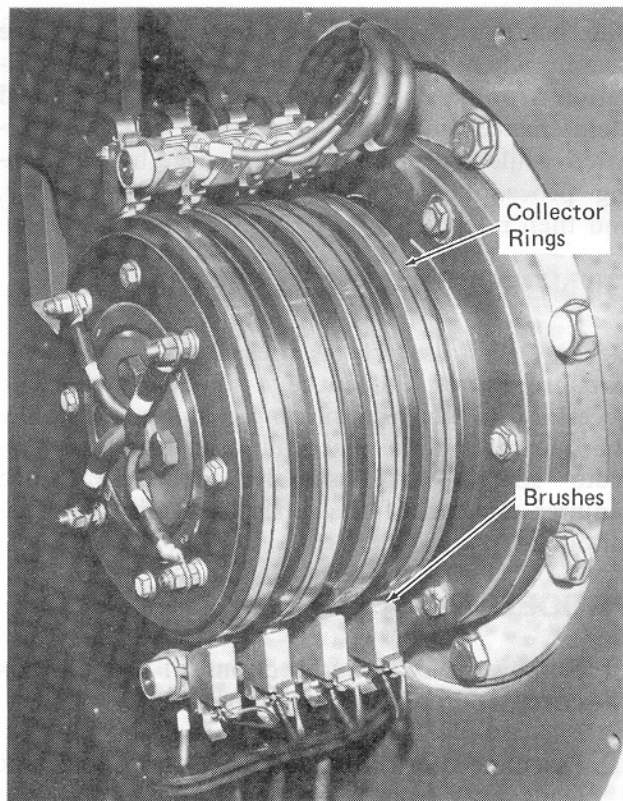
Blow off as much solvent as possible using high volume low pressure air.

Allow parts to stand until all remaining solvent has evaporated.

COLLECTOR RINGS AND BRUSHES

Collector rings and brushes, Fig. 3, should frequently be checked for sparking while the generator is in operation. If collector rings are sparking refer to Collector Ring Sparking section for causes and repairs.

It is normal for the negative collector ring to experience electrical wear more rapidly than the positive ring. The unequal wear can be minimized by reversing polarity of the rings every 6 months. Refer to Service Data for condemning limits of collector rings and brushes.



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Fig. 3 - Collector Ring And Brush Arrangement

COLLECTOR RING SPARKING

Sparking on collector rings should be corrected immediately to prevent failure of the generator.

The various causes of sparking and their remedies follow.

OIL ON SURFACE OF COLLECTOR RING

If collector ring surfaces are oily, wipe off the surface of the rings and brushes with a clean, dry, lintless cloth.

BRUSH HOLDER LOOSE

The generator is equipped with eight constant pressure brush holders, four mounted at the top of the collector ring assembly, and four at the bottom. If a brush holder is not mounted securely to the brush holder stud or the stud itself is loose, it will allow the brushes to bounce on and off the collector ring, resulting in sparking. Tighten all mounting bolts.

DAMAGED BRUSH HOLDER

Make certain that brushes are free to move up and down in their slots. The spring pressure, on constant pressure brush holders, is preset and cannot be adjusted. The pressure will remain constant throughout the brush life, regardless of brush wear. Refer to Service Data for spring pressure value.

Check that each brush is centered to within 1.59 mm (1/16") of the mating collector ring, when facing the brush holders. The right-hand side of all brush holders is set closer to the collector rings than the left side. Check that the right-hand side is 1.59 mm \pm 0.79 mm (1/16" \pm 1/32") closer.

ECCENTRIC OR PITTED COLLECTOR RINGS

If collector ring eccentricity exceeds 0.15 mm (0.006") total indicator reading (ring assembly installed) the ring will have to be machined to bring it into tolerance. A rough or pitted collector ring surface should also be cleaned up by machining.

The above conditions can usually be corrected by grinding. However, the minimum acceptable diameter of collector rings is 260 mm (10-1/4"). If rings cannot be cleaned up without going below minimum diameter, they should be renewed. Rings should also be renewed if lateral runout exceeds 0.79 mm (1/32").

Use the following procedure to machine collector ring surface:

CAUTION: Never use emery to polish collector rings, or sand new brushes.

1. Remove brush holder assemblies. If brushes are to be reinstalled, label them so that they may be reinstalled in their original positions.
2. Mount collector ring grinder to bearing cover.
3. Position grinder so that there is 3.2 mm (1/8") clearance between it and the ring to be ground.
4. Install grinding stones in position on grinder. Make certain there will be enough travel to grind rings.

CAUTION: Make certain that grinding stones do not contact collector ring surface until generator begins rotating.

5. Make necessary preparations to start engine. Start engine and run it at approximately 600 RPM.
6. Gradually bring stones in contact with ring surface. Grind ring surface until it is smooth. After grinding, stop engine and recheck eccentricity with a dial indicator.
7. When grinding operation is complete, stop engine and remove grinding equipment. Blow all grinding dust from stator and rotor assemblies. Use high volume low pressure air.
8. Reassemble brush holder assemblies in their proper positions. Renew brushes if necessary, refer to Brush Renewal.

BRUSH RENEWAL

When installing new brushes, they should be sanded to fit the curvature of the collector ring. This can be done by placing a piece of sandpaper on surface of ring with rough side against brush. Then with the brush held down by brush holder spring tension, move sandpaper in direction of normal rotation of rotor shaft until brush conforms to ring surface.

BEARING

A sealed, grease lubricated, self-aligning bearing is assembled into an insulated housing. The bearing housing is insulated to prevent damage from electrical arcing. No additional lubrication, other than recommendations in the Scheduled Maintenance Program, is required. Occasional checks of bearing temperature during operation will give an indication of bearing condition. Obtain temperature readings by applying a pyrometer to the outside surface of the bearing cover. Bearing temperature should not exceed a 25° C (45° F) rise. High bearing temperature may be caused by:

1. Contamination of grease.
2. Excessive thrust due to misalignment.
3. Pounding caused by worn rollers of bearing being loose on shaft.
4. Actual bearing failure caused by bearing fatigue or wear.

The bearing cover and exposed portions of the bearing when the cover is removed, require lubrication at intervals recommended in the Scheduled Maintenance Program. These parts can be lubricated while the generator is in place by performing procedure A under Generator Disassembly, and then referring to M.I. 3323-2.

GENERATOR DISASSEMBLY

Generator disassembly is presented in two separate procedures. Procedure A may be used when necessary to perform bearing maintenance while the generator is in place. Procedure B is a complete generator disassembly procedure which requires removal of the generator from the installation.

PROCEDURE A

1. Remove two center sections of the air box cover, and collector ring cover.
2. Disconnect brush holder connections and tape leads away from work area.
3. Disconnect brush leads and remove brushes. If brushes are to be reinstalled, label them so that they may be reinstalled in their original positions.
4. Remove top and bottom brush holders from mounting studs.
5. Disconnect field leads from collector ring studs, Fig. 4.

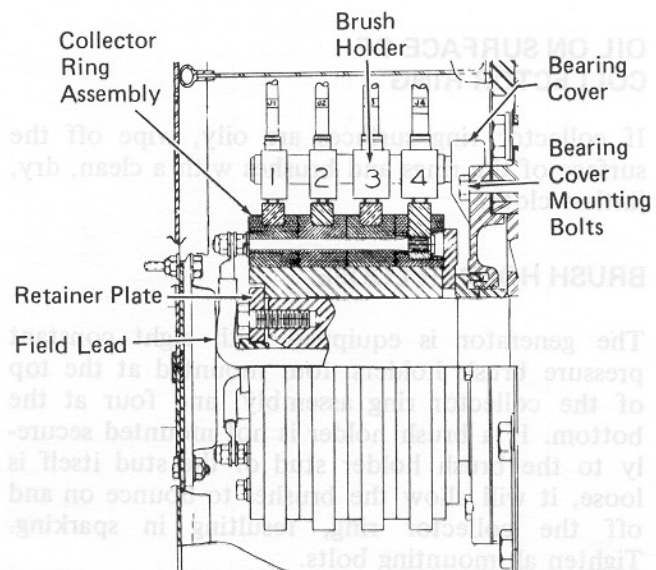


Fig. 4 - Collector Ring And Brush Removal

- Remove bolts securing retainer plate to end of rotor shaft, remove plate.

NOTE: All puller tools used to remove the collector ring assembly and outer seal may be fabricated as detailed in File Drawing listed in Service Data.

- Remove four 3/8"-16 bolts securing collector rings to collector ring housing. These bolts are located on the collector ring face between the lead connection terminals. Place extension cup around field leads and bolt extension cup to rotor shaft as shown in Fig. 5.

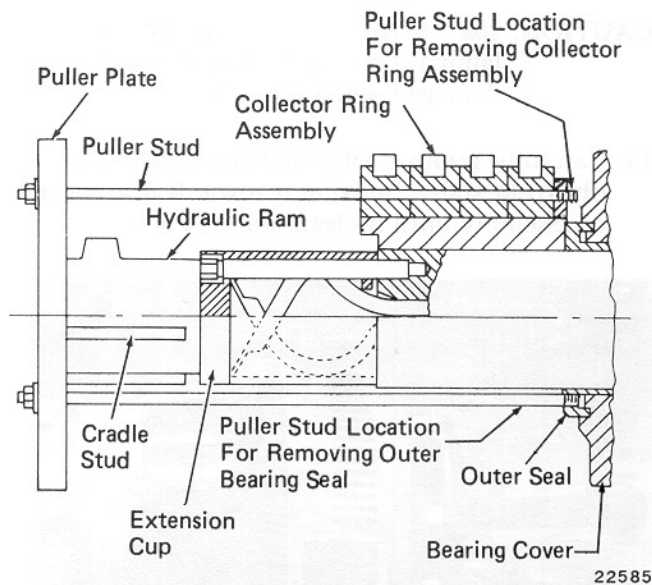


Fig. 5 - Collector Ring And Bearing Outer Seal Removal

- Install puller plate and puller studs to remove collector ring assembly, as shown in Fig. 5. Place hydraulic ram between extension cup and puller plate, supported by cradle studs of puller plate. Remove collector ring by applying hydraulic pressure to the ram. Make certain that puller is pulling equally on all studs to prevent damage to parts.
- Remove puller studs from collector ring assembly and install original bolts. Torque bolts to between 9.5 and 11 N·m (7 and 8 ft-lbs).
- Install puller plate and puller studs to remove outer bearing seal, as shown in Fig. 5. Place hydraulic ram between extension cup and puller plate, supported by cradle studs of puller plate. Remove outer bearing seal by applying hydraulic pressure to the ram. Make certain that puller is pulling equally on all studs to prevent damage to parts.

- Remove bearing cover mounting bolts, Fig. 4, and remove bearing cover. Use a rawhide mallet or similar tool to remove cover and gasket.

NOTE: Disassembly for bearing maintenance is complete. Refer to M.I. 3323-2 for bearing lubrication procedure. If further disassembly is required, refer to Procedure B.

PROCEDURE B

NOTE: If equipment for disassembly and assembly is not available, generator should be returned to Electro-Motive Division for repair either on a Rebuild and Return, or Unit Exchange basis.

Before generator is moved from its location, place strips of fish paper 1.6 mm x 76 mm x 914 mm (1/16" x 3" x 36") in bottom air gap between rotor and stator.

When removing generator, be sure to tag any shims used under mounting pads so they may be reinstalled in their original positions.

- Mount generator on a sturdy stand at a suitable working height. Remove dirt, oil, and grease from outside of generator. This will prevent dirt from entering generator during disassembly.
- Remove all covers.
- Disconnect leads to brush holder and filter assemblies. If brushes are to be reinstalled, label them so that they may be reinstalled in their original position. Remove brush holders.
- Remove bolts securing air box to end housing, and carefully remove air box.
- Disconnect the 15 phase lead cable connections and 6 suppression circuit connections at the paralleling bus bars of each rectifier bank assembly. Remove cable clamps securing suppression circuit leads to the sides and ends of each rectifier bank assembly. Remove rectifier banks. Refer to M.I. 3323-5 for information concerning rectifier bank assemblies.
- Remove cleat assemblies securing stator leads to end housing.

7. Apply an arbor fixture to spider bore of D14 rotor, Fig. 6. Attach crane cable to end of fixture.

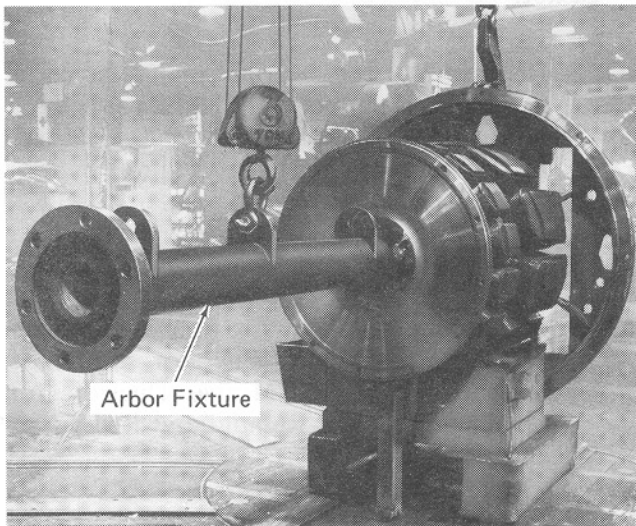


Fig. 6 - Application Of Arbor Fixture

NOTE: Arbor fixture may be fabricated as detailed in File Drawing referenced in Service Data.

8. Support end housing with another crane cable and end housing holding fixture, Fig. 7. Remove eight 3/4"-10 bolts securing end housing to stator frame.

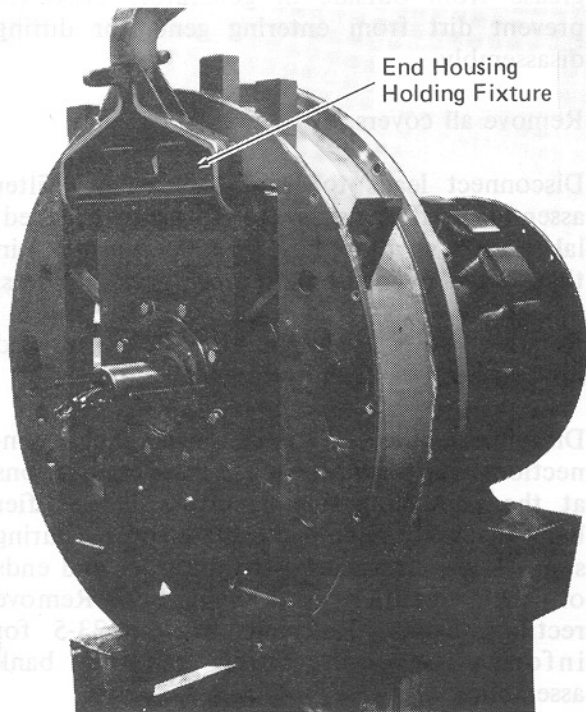


Fig. 7 - Attaching Crane Cable To End Housing

NOTE: End housing holding fixture may be fabricated as detailed in File Drawing referenced in Service Data.

9. Insert three special 3/4"-10 jacking bolts equally spaced around end housing in bolt holes from which end housing mounting bolts were removed. Turn jacking bolts equally until end housing is separated from stator frame.
10. Raise arbor fixture until air gap is equal around circumference of rotor. Raise cable at end housing until taut.

CAUTION: Use extreme care to ensure that laminations and windings are not damaged when removing rotor.

11. Carefully remove rotor and end housing assembly from stator, moving it towards bearing end of assembly until it clears stator, Fig. 8.

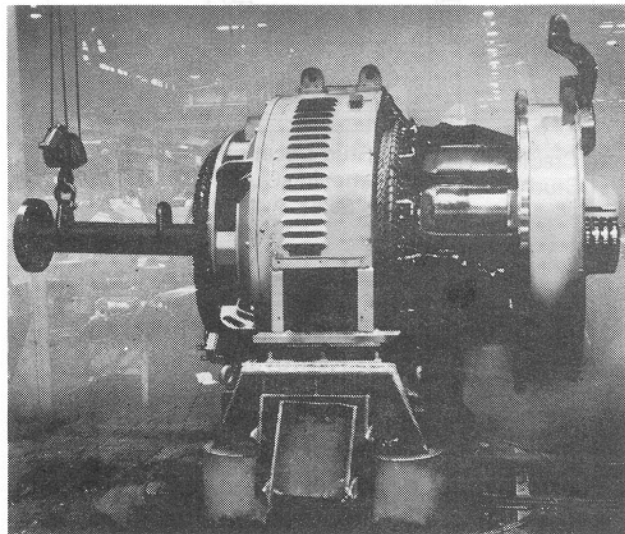
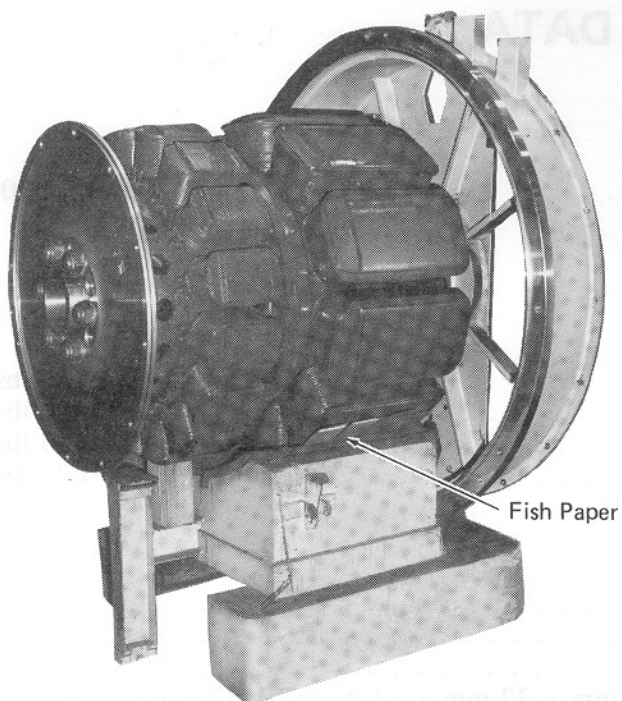


Fig. 8 - Removing Rotor And End Housing From Stator

NOTE: If necessary, the coupling disc and D14 rotor can be removed from the AR6 rotor.

12. Place rotor assembly on a cradle stand, Fig. 9, with strips of fish paper between rotor and cradle.
13. Perform Steps 5 through 11 under disassembly Procedure A.

CAUTION: Use extreme care to ensure that bearing housing bore is not damaged when removing end housing.



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Fig. 9 - Rotor Assembly Removed From Stator

14. Slide end housing off bearing.

NOTE: The bearing housing cannot be removed from the end housing without destroying the insulating ring separating the two housings. If necessary to remove bearing housing perform Step 15 otherwise proceed to Step 16.

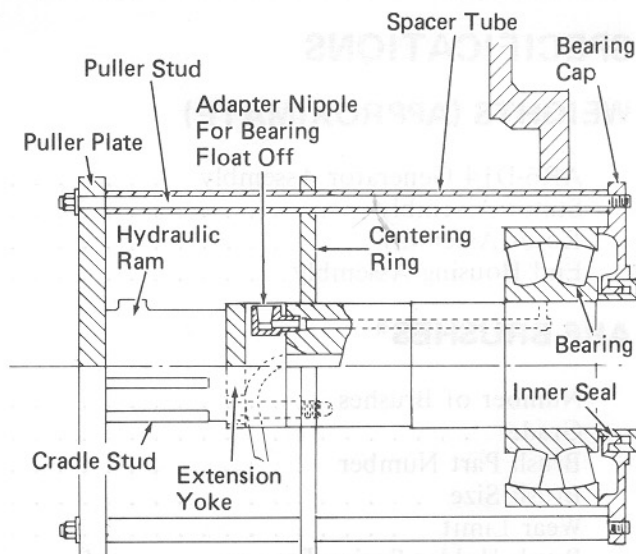
15. Remove eight 3/4"-10 bolts securing bearing housing to end housing. Insert four special 3/4"-10 jacking bolts equally spaced around bearing housing in special holes provided. Turn jacking bolts equally until bearing housing is separated from the end housing. Remove any burrs from end housing caused by jacking bolts.

16. A tapped hole is provided in the bearing end of the rotor shaft. This hole provides a means of applying hydraulic pressure to the inner race of the bearing, thus aiding in removal of the bearing. Perform following procedure as a preparation for bearing removal.

- a. Clean threads and pressure fitting seat in tapped hole.
- b. Thread 1/8"-27 NPT adapter nipple into tapped hole and tighten, Fig. 10. Refer to

Service Data for information concerning tools.

- c. Connect hydraulic pump to adapter nipple.



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Fig. 10 - Bearing Removal

17. Thread six puller studs into flange of bearing cap. Install six spacer tubes and centering ring as shown in Fig. 10.

18. Place extension yoke around field leads and bolt extension yoke to shaft.

19. Install puller plate. Place hydraulic ram between extension yoke and puller plate, supported by cradle studs of puller plate.

20. Pump up hydraulic pressure to expand inner race of bearing. Maintain this pressure while applying hydraulic pressure to the removal ram until bearing slides off rotor shaft seat (approximately 63.5 mm [2-1/2"]). Make certain that puller is pulling equally on all studs to prevent damage to parts.

21. Remove bearing inner seal using small heating torch and pry bars.

22. Remove D14 stator closure assembly, if necessary.

23. With D14 stator assembly properly supported, remove bolts securing D14 stator assembly to AR6 stator assembly. Install 3/4"-10 jack bolts and remove the D14 stator assembly.

SERVICE DATA

REFERENCES

D14 Alternator M.I. 3306

SPECIFICATIONS

WEIGHTS (APPROXIMATE)

| | |
|--------------------------------------|----------------------|
| AR6-D14 Generator Assembly | 6033 kg (13,300 lbs) |
| Stator Assembly | 2404 kg (5300 lbs) |
| Rotor Assembly | 2472 kg (5450 lbs) |
| End Housing Assembly | 487 kg (1075 lbs) |

AR6 BRUSHES*

| | |
|--|--|
| Number of Brushes | 4 |
| Grade | 255 |
| Brush Part Number | 8413191 |
| Brush Size | 54 mm x 32 mm x 13 mm (2-1/8" x 1-1/4" x 1/2") |
| Wear Limit | 19 mm (3/4") |
| Brush Holder Spring Pressure | 1.50 kg ± 0.15 kg (3.3 ± 0.33 lbs) |

*Refer to M.I. 3306 for information concerning D14 brushes and brush holders.

COLLECTOR RINGS

| | |
|---|------------------|
| Maximum Eccentricity | 0.15 mm (0.006") |
| Maximum Lateral Runout | 0.8 mm (1/32") |
| Outside Diameter Condensing Limit | 260 mm (10-1/4") |

EQUIPMENT LIST

| | |
|--|------------------|
| Pyrometer | 8027937 |
| Hydraulic Pump (2 required) | 8309742 |
| End Housing Holding Fixture | File Drawing 753 |
| Arbor Fixture | File Drawing 754 |
| Collector Ring, Seals, And Bearing Puller Assembly | File Drawing 755 |
| Adapter Nipple | 1/8"-27 NPT |