ELECTRO-MOTIVE

M.I. 3317-1
*Rev. E

MAINTENANCE INSTRUCTION

AR-TYPE TRACTION ALTERNATORS

DESCRIPTION

The purpose of this maintenance instruction is to supply maintenance information for the AR-type traction alternator portion of a main generator. The main generator consists of an AR-type traction alternator and a D14 or D18 companion alternator. The D14 or D18 companion alternator is physically connected to, but electrically independent of the traction alternator.

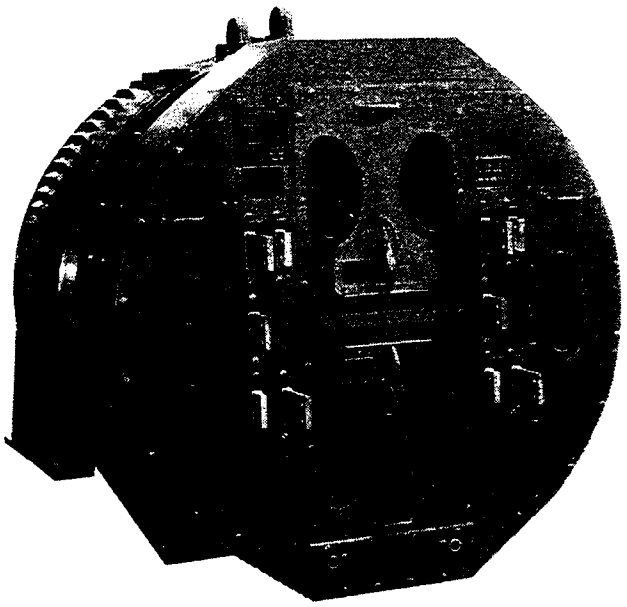
Differences between AR-type traction alternator models will be identified throughout this maintenance instruction, but this instruction will apply to all models unless specifically identified.

The main generator consists of two, three-phase, alternating current generators with a single bearing. The spiders of the two machines are bolted together and the coupling disc of the companion alternator is bolted to the coupling of the engine, the outboard end of the traction alternator rotor is supported by a bearing.

The rotating fields of the traction alternator 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 which is supported by the bearing mounted in the main generator end housing.

The field coils are insulated with class "F" insulation, and are electrically connected to the two inboard collector rings mounted in the air box at the bearing end of the assembly. The D14 or D18 companion alternator 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.

Current production models are 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 or brushes for inspection or replacement of brushes. Another feature is the collector ring cover, Fig. 2, to prevent snow from entering the collector ring area.

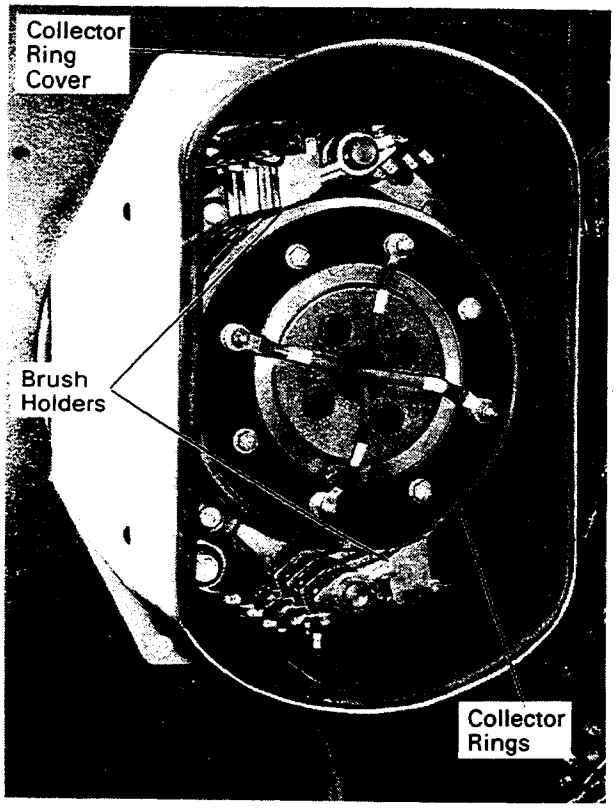


28916

Fig.1 – Typical Main Generator

The traction alternator stator frame and core assembly, utilizing welded construction, provides a rigid structure which houses the stator windings and supports the end housing and D14 or D18 stator assemblies. The class "H" insulated traction alternator stator coils are internally connected at the bearing end of the stator into two sets of three-phase "Y" connected windings.

*Extensively revised and completely retyped. Supersedes previous issues of this number.



NOTE
Model AR11 traction alternator has a two piece collector ring cover.

28576

Fig.2 – Brush Holder Installation

Two rectifier assemblies mounted on the front of the main generator provide means of converting the three-phase AC power to DC power. Each assembly consists of high-current, high-voltage, silicon diodes connected in a three-phase, full wave, rectifier circuit, and mounted on heat sinks capable of providing adequate cooling.

For information on the AR10, AR12, AR15, and AR16-D14 or D18 rectifier banks, refer to M.I. 3317-2. For information on the AR11 rectifier banks, refer to M.I. 3317-3.

For information on the D14 alternator, refer to M.I. 3306. For information on the D18 alternator, refer to M.I. 3307.

MAINTENANCE

The traction alternator is designed and manufactured to provide a long service life and optimum performance with a minimum of maintenance. Like any machine, however, certain maintenance is required, the extent of which is largely determined by the operation and service to which the alternator is subjected. Inspections and maintenance should be performed at the time intervals as specified in the Scheduled Maintenance Program.

CLEANING

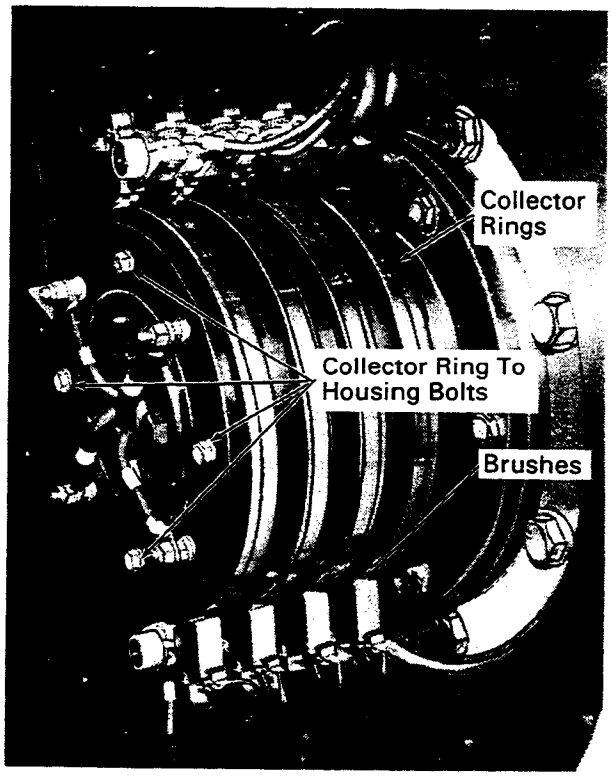
Both the interior and exterior of the traction alternator should be kept clean and free of dust, dirt, oil, and water which are likely to have a detrimental effect on insulation and performance.

As often as conditions warrant, the alternator should be blown out with low pressure air. Avoid excessive air pressure which could cause damage to insulation.

Clean bound-edge, lintless wiping cloths should be used as necessary to remove oil, grease, and accumulations of dirt. It is essential that the rectifier section be kept as clean as possible at all times.

COLLECTOR RINGS AND BRUSHES

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



28577

Fig.3 – Collector Ring And Brush Arrangement

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

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 1.6 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 1.6 mm ± 0.8 mm (1/16″ ± 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 0.8 mm (1/32″).

A collector ring grinder is available (8219264) which must be mounted to the generator with an adapter. Adapter 9506268 is used on large bearing (260 mm) generators and adapter 8364940 is used on small bearing (215 mm) generators.

COLLECTOR RING GRINDING

Use the following procedure to grind the collector ring surface.

CAUTION

Never use emery cloth to polish collector rings or to sand new brushes.

1. Remove the collector ring cover (snow guard), the four 12 o'clock brush holders, and remove diode fuses as required to provide clearance for the grinder and adapter. If brushes are to be reinstalled, label them so that they may be reinstalled in their original positions.

2. Mount applicable adapter assembly at the 2 o'clock position on the bearing housing flange using two of the eight 3/4″-10 bearing housing bolts.

CAUTION

Use care to avoid damage or loss of the insulating washers or insulating strip, and bolt hole insulated tubes surrounding the bearing housing to end housing bolts so that electrical isolation of the bearing is maintained.

3. Mount collector ring grinder to grinder adapter.

4. Position grinder so that there is 3 mm (1/8″) clearance between the grinder and the collector ring to be ground.

5. Install grinding stones in position on grinder. Ensure there is enough travel to grind the rings.

CAUTION

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

6. Make necessary preparations to start engine. Start engine and run it at approximately 600 RPM.

7. 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.

8. 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.

NOTE

Current model generators are equipped with eight constant pressure brush holders, four mounted at the top of the collector ring assembly, and four at the bottom. Earlier model generators had four double arm brush holders mounted at the top of the collector ring assembly. The brushes riding on the two inside collector rings are for the main generator, and the brushes riding on the two outside collector rings are for the companion alternator. The spring pressure is preset and cannot be adjusted. The pressure will remain constant throughout the brush life, regardless of brush wear.

9. 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.

Model AR10 generators manufactured prior to November, 1971, were equipped with a 215.001 mm (8.4646″) bearing with a phenolic lined bearing housing. Model AR10 generators manufactured after November, 1971, and all the other models covered in this maintenance instruction, have a 259.999 mm (10.2362″) bearing.

The large bearing will operate for a longer service period than the smaller bearing and will require maintenance at intervals recommended in the Scheduled Maintenance Program. The small bearing should not require maintenance, but should be replaced with a new bearing and bearing housing at intervals recommended in the Scheduled Maintenance Program.

LARGE BEARING MAINTENANCE

The large (259.999 mm [10.2362″]) bearing requires maintenance at intervals recommended in the Scheduled Maintenance Program. This can be accomplished either by removing the main generator from the installation and following the Generator Disassembly procedure of this instruction or by maintaining the bearing with the generator in place as follows:

1. Remove the two center sections of the air box assembly.

2. Disconnect collector ring brush holder connections and tape leads away from work area.

3. Remove top and bottom brush holders from mounting studs.

4. Disconnect field leads from collector ring studs, Fig. 4 or 5 as applicable.

5. Remove the four bolts securing the retainer plate, Fig. 4 or 5 as applicable, to the end of the shaft and remove retainer plate.

NOTE

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

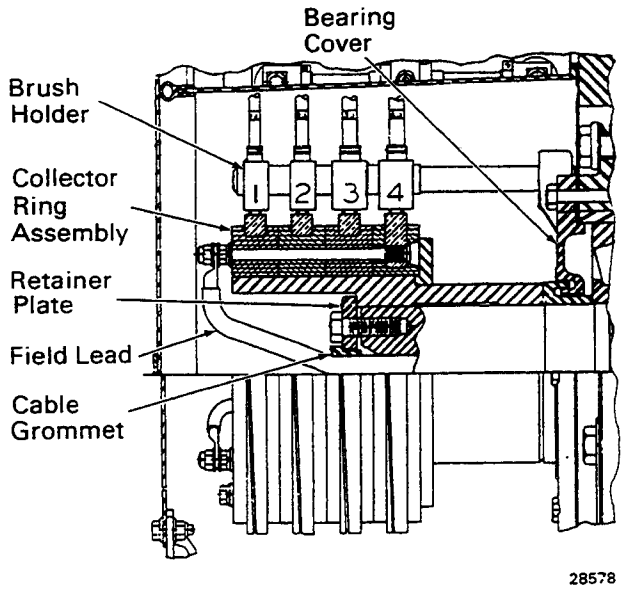


Fig.4 - AR11 And AR16 Collector Ring Assembly

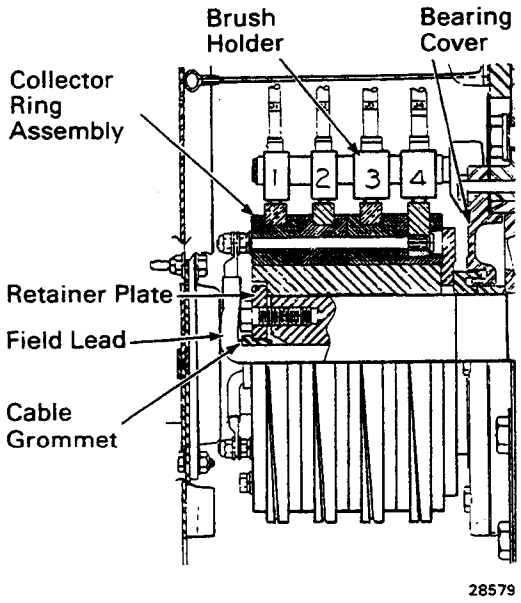


Fig.5 - AR6, AR10, AR12, AR15 Collector Ring Assembly

6. Remove four 3/8"-16 bolts securing the collector rings to the collector ring hub. The bolts are located on the collector ring face between the lead connection terminals, Fig. 3. Place extension cup around field leads and bolt cup to shaft as shown in Fig. 6.

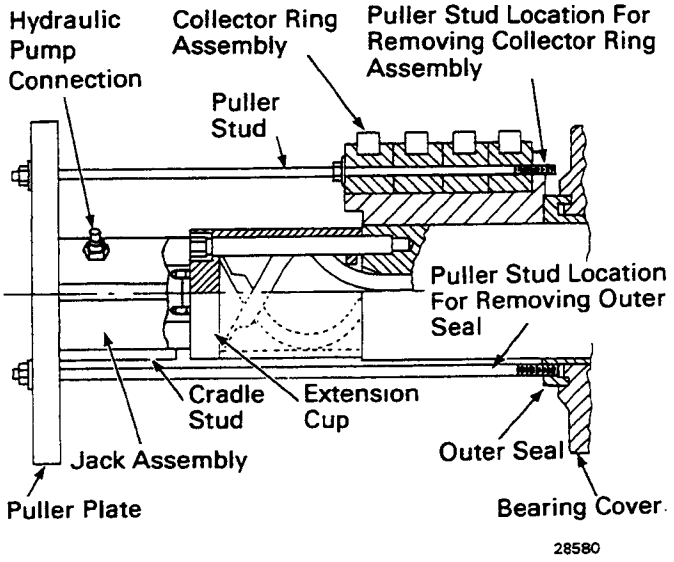


Fig.6 - Collector Ring And Outer Bearing Seal Removal

7. Install puller plate and puller studs to remove collector ring assembly, as shown in Fig. 6. Place jack assembly between the extension cup and the puller plate, supported by cradle studs of the puller plate. Connect hydraulic pump to jack assembly. Ensure puller is pulling equally on all studs to prevent damage to collector ring. Apply hydraulic pressure to jack assembly to remove collector ring assembly.

8. Remove puller studs from collector ring assembly.

9. Install puller plate and puller studs to remove outer seal, as shown in Fig. 6. Place jack assembly between extension cup and puller plate, supported by cradle studs of the puller plate. Connect hydraulic pump to jack assembly. Ensure puller is pulling equally on all studs to prevent damage to outer seal. Apply hydraulic pressure to jack assembly to remove outer seal. Remove jack assembly, hydraulic pump, puller plate, and puller studs.

10. Remove bolts from bearing cover, Figs. 4 or 5, and remove cover. If cover is stuck to bearing housing, hit outer periphery of cover with a rawhide mallet or similar tool to loosen.

11. Inspect grease in the bearing cover and inspect exposed side of the bearing. Look for metal

particles in the grease, excessive wear in the housing of the bearing, fatigue damage on the rollers or roller path, or evidence of overheating. Replace bearing with a new bearing, if required, and replace any associated parts found in distress.

12. If no distress is found, thoroughly clean the bearing cover.

13. Fill the labyrinth grooves in the bearing cover with Esso Unirex N-2 grease. This grease need not be measured.

14. Weigh the piece of paper that will be used in handling the grease to fill the groove in bearing cover. The weight of the paper must be compensated for when weighing the grease.

15. Carefully weigh the Esso Unirex N-2 grease for the bearing cover groove. Refer to Service Data for proper quantity.

NOTE

Adequate lubrication depends upon precise weight of grease. Too much grease is as detrimental to the service life of the bearing as too little.

16. Pack grease into bearing cover groove. Leave a space free of grease at the top of the bearing cover to limit churning and liquefaction of the grease. Form grease to proper contour as shown in Fig. 7.

17. Remove old grease from exposed side of bearing and as much as possible from between the rollers and cage. Use only a putty knife and fingers. Do not use a solvent. Be careful not to introduce dirt or any other foreign substance into the bearing. Repack all spaces on the exposed side of the bearing with grease. If Shell Cyprina grease is present in the bearing, Esso Unirex N-2 grease may be added.

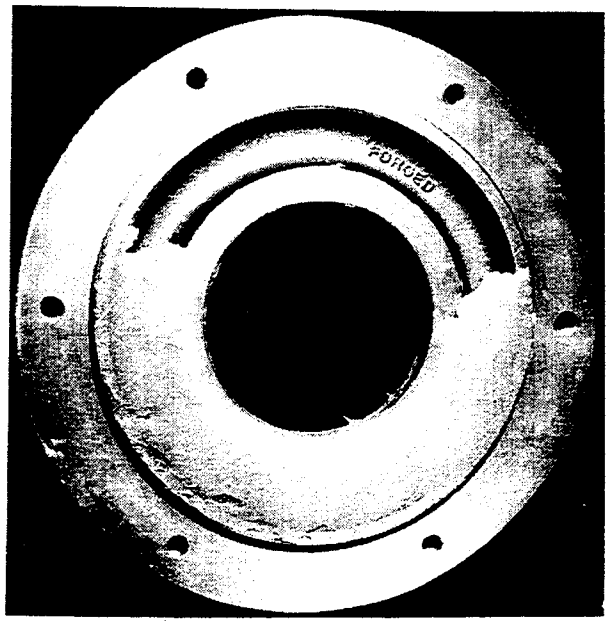
18. Install the greased bearing cover with new gasket. Ensure the space free of grease is at the top of the cover. Tighten bearing cover bolts to 68-75 N·m (50-55 ft-lbs).

CAUTION

In Step 19, do not allow seal to be heated above 105° C (220° F). Overheating may result in warping or damaging the metal.

19. Heat the outer seal in an oil bath, electric oven, or induction heater for half an hour at 105° C (220° F). If an oil bath is used for heating, remove oil from seal with clean, bound-edge cloths prior to shrinking to the shaft. When using an induction heater, pyrometer readings (with current off) should be taken periodically. After heating, shrink the seal to the shaft and allow it to cool to room temperature.

20. Place collector ring on induction heater and heat to 105° C (220° F). Pyrometer readings (with current off) should be taken periodically. After heating, place collector ring against outer



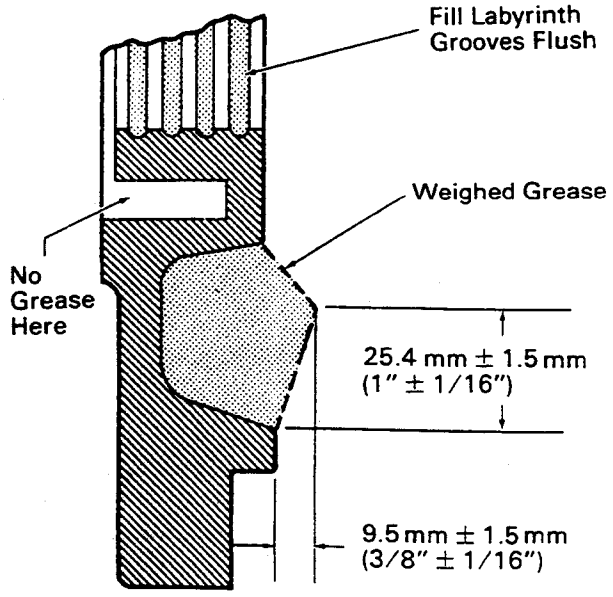


Fig.7 – Application Of Grease To Bearing Cover

seal. Rotate ring assembly on shaft for proper position of lead connections to terminals of ring assembly.

WARNING

If work involving collector ring connections has been performed, use a continuity tester (with all field leads disconnected and all brushes lifted) to check that collector ring terminals marked 1 through 4 on the steel housing adjacent to the terminals are connected to the appropriate collector rings (No. 1 outboard, No. 4 inboard).

21. Place retainer plate over leads and on to the end of the rotor shaft. Tighten 5/8"-11 bolts to 135.5 to 149 N·m (100-110 ft-lbs).

22. Connect the large leads from the traction alternator to collector ring terminals 3 and 4, and the smaller leads from the companion alternator to terminals 1 and 2. Torque to 9.5 to 12.2 N·m (7 to 9 ft-lbs).

23. Install brush holders. Large brush holders (traction alternators) over collector ring positions 3 and 4 and small brush holders (companion alternator) over collector ring positions 1 and 2.

24. Attach jumper leads J1, J2, J3, and J4 between top and bottom brush holders having the same numbers. The jumper leads attach to brush holder locking screws which secure holder to insulated studs.

25. Route leads to the left of the collector ring assembly. Secure leads with the cable clamps bolted to the threaded holes in the bearing housing.

26. Connect external leads 1, 2, 3, and 4 to corresponding lower brush holder terminals.

27. Adjust brush holders to have 3 mm (1/8") clearance over collector rings. In addition, ensure that brush holder is centered over the collector ring. Torque brush holder locking screws to 14-20 N·m (10-15 ft-lbs). Assemble brushes in holders. If used brushes are reinstalled, ensure that the original positions are maintained. Check that each brush is centered within 1.6 mm (1/16") of the mating collector ring.

28. Install collector ring cover and sections of air box covers removed during disassembly.

BEARING CHANGEOUT

NOTE

Early Model AR10 traction alternators having the small bearing, require bearing replacement at intervals recommended in the Scheduled Maintenance Program.

Current traction alternators having the large bearing, require bearing replacement when inspection has determined that the bearing is defective or at intervals recommended in the Scheduled Maintenance Program.

The following procedure is applicable to both, the current large bearing traction alternators and the early Model AR10 traction alternators with the small bearing.

The traction alternator bearing can be changed out either by removing the alternator from the installation and following the Generator Disassembly procedure of this instruction or by changing out the bearing with the generator in place as follows:

BEARING REMOVAL (Generator In Place)

NOTE

All puller tools used to remove the collector rings, outer seal, and bearing may be fabricated as detailed in File Drawings and Work Sketch Drawing listed in Service Data.

1. Perform Steps 1 through 8 of Large Bearing Maintenance procedure.

2. Install support tube as shown in Fig. 8. Support shaft through a "V" block with an adjustable jack.

3. Remove eight 3/4"-10 bolts securing bearing housing to the end housing, Fig. 8. Insert four 3/4"-10 jacking bolts equally spaced around the bearing housing in jacking holes provided. Rotate jacking bolts equally until bearing housing is separated from the end housing.

NOTE

Some early generator bearing housings had 5/8"-18 jacking holes. Ensure proper bolts are used.

4. Lower the adjustable supporting jack until rotor rests on stator. Remove the jack and shaft supporting tube. Slide bearing housing off the shaft. Remove any burrs from end housing which may have been caused by jacking bolts.

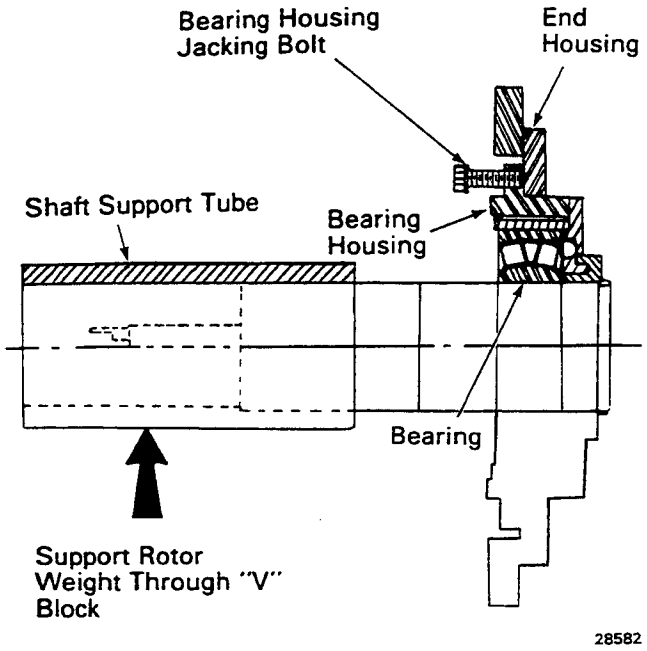


Fig.8 – Bearing Housing Removal

5. Install rotor shaft jacking fixture as shown in Fig. 9. Raise rotor until bearing is approximately centered in the bore of the housing.

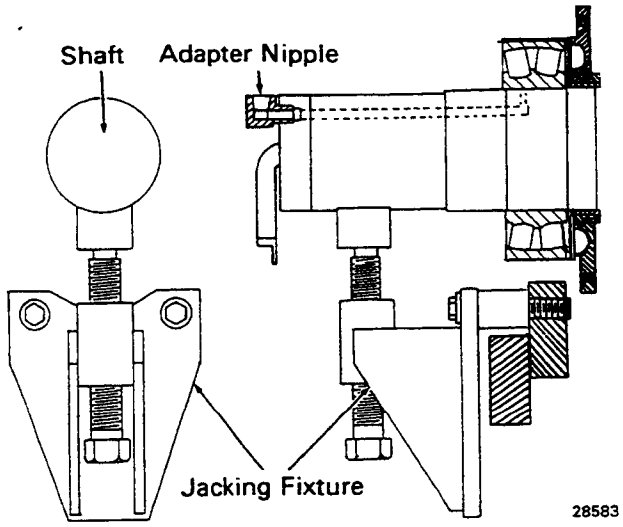


Fig.9 – Rotor Shaft Jacking Fixture

6. If rotor shaft has a tapped hole in the end of the shaft for hydraulic bearing removal. Perform the following procedure. Two hydraulic pumps are required to perform the following procedure.

   a. Ensure threads and pressure fitting seat are cleaned in the drilled passage in the shaft.

   b. Screw a 1/8"-27 adapter nipple, Fig. 9, into tapped hole in shaft and tighten. Refer to Service Data for adapter nipple part number.

   c. Connect hydraulic pump, Fig. 10, to adapter nipple.

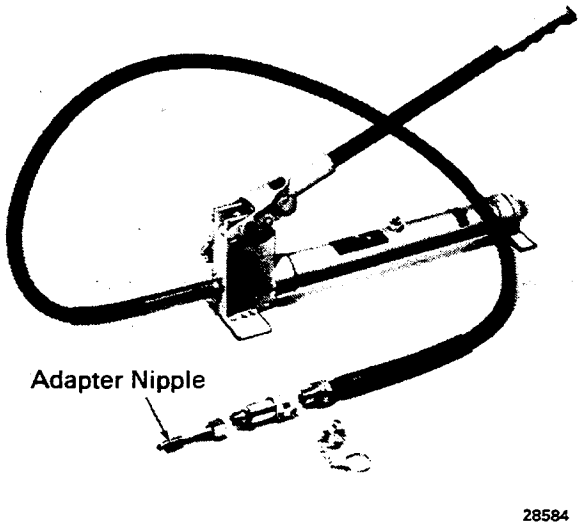


Fig.10 – Hydraulic Pump

7. If shaft is not equipped for hydraulic bearing removal, it is necessary to protect the stator and rotor windings and remove the outer race and cage with a cutting torch.

8. Thread six puller studs into flange of bearing cap. Install six spacer tubes and centering ring as shown in Fig. 11.

9. Place extension yoke around field leads and bolt extension yoke to shaft as shown in Fig. 11.

10. Install puller plate. Place assembly jack between extension yoke and puller plate, supported by cradle studs of puller plate as shown in Fig. 11.

11. If rotor shaft is equipped for hydraulic bearing removal, apply hydraulic pressure to expand inner bearing race. Maintain this pressure while applying hydraulic pressure to the jack assembly until the bearing slides off the shaft seat (approximately 63.5 mm [2-1/2"]). Ensure that puller is pulling equally on all studs to prevent damage to bearing.

12. Lower the rotor with the jacking fixture until it contacts the stator. Remove jacking fixture and

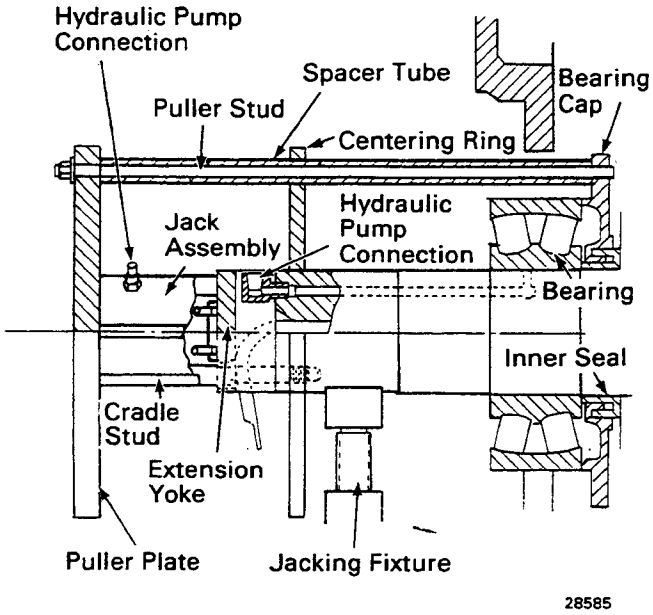


Fig.11 – Bearing Removal

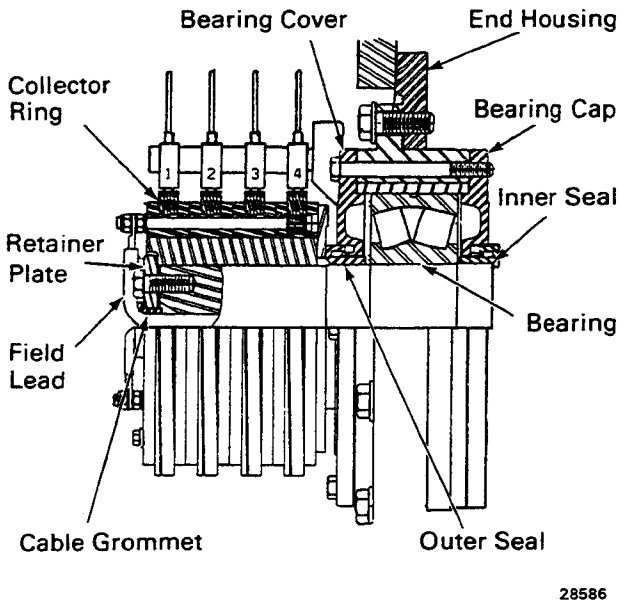


Fig.12 – Bearing And Collector Ring Assembly Cross-Section

pulling equipment. Slide bearing and bearing cap off the rotor shaft.

13. Examine bearing inner seal for evidence of rubbing. If rubbing appears excessive, remove bearing inner seal, using a small heating torch and pry bars.

BEARING INSTALLATION (Generator In Place)

When all associated bearing parts have been cleaned and inspected, the bearing is ready for assembly.

Before shrinking bearing to rotor shaft, it is very important to try the bearing in the housing. Place bearing housing on the floor and slide bearing through the bore of the housing. Ensure bearing enters bearing housing squarely, and is not cocked. Refer to Service Data for bearing dimensions and tolerances.

Use the following procedure to assemble bearing. Refer to Fig. 12 during assembly.

CAUTION

Care should be used when heating bearing parts. Overheating may result in warping or damaging the metal.

1. If bearing inner seal was removed because of rubbing, heat a new inner seal in an oil bath, electric oven, or induction heater for half an hour at 105° C (220° F). If an oil bath is used for heating, remove oil from seal with clean, bound-edge cloths prior to shrinking to the shaft. When using an induction heater, pyrometer readings (with current off) should be taken periodically. After heating, shrink the seal to the shaft and allow to cool to room temperature.

2. Fill labyrinth grooves in the bearing cap with Esso Unirex N-2 grease. This grease need not be measured. The bearing cap can be distinguished from the bearing cover by noting that the bearing cap has tapped holes in the flange while the bearing cover has holes which are not tapped.

3. Weigh the piece of paper that will be used in handling the grease. The weight of the paper must be compensated for when weighing the grease.

NOTE

Esso Unirex N-2 grease must be used exclusively to lubricate a new or cleaned bearing. Adequate lubrication depends upon precise weight of grease. Too much grease is as detrimental to service life of the bearing as too little. Bearing replacement kits include pre-weighed amounts of grease.

4. Carefully weigh the Esso Unirex N-2 grease for the bearing cap groove. Refer to Service Data for proper quantity.

5. Pack the grease into bearing cap groove. Leave a space at the top of the bearing, as shown in Fig. 7 to limit churning and liquefaction of the grease. Form grease to proper contour as shown in Fig. 7.

6. Install greased bearing cap and a new gasket onto shaft.

7. Carefully weigh the Esso Unirex N-2 grease for the new bearing. Refer to Service Data for the proper quantity. Pack the bearing rollers and the space in between the two rows of rollers with grease.

8. Heat roller bearing with an induction heater to 105° C (220° F). Take pyrometer readings (with current off) at outside face of inner race only. Shrink bearing to shaft with the part number toward the outside. Do not cock the bearing when placing it on the shaft. Use a brass pipe to push bearing on shaft and seat firmly against inner seal. Let bearing cool to room temperature.

9. Thread two 1/2"-13 studs, 180° apart, into bearing cap flange to correctly position cap during installation of the bearing housing. Ensure gasket is in place. Slide bearing housing into shaft.

10. Apply Molykote paste 9517921 to inside diameter of bearing housing.

11. Install two 3/4"-10 aligning studs 180° apart into two of the eight bearing housing mounting bolt holes in the end housing. The aligning studs will help prevent the bearing from cocking (damaging insulation material), when assembling bearing housing to end housing.

NOTE

Early Model AR10 traction alternator with the small bearing, has a bearing housing with an inner and outer phenolic sleeve and does not require additional insulation.

12. On traction alternators equipped with the large bearing, position new insulating ring, Fig. 13, over aligning studs so that holes in the ring line up with holes in the end housing.

13. Slide bearing housing over shaft.

14. Install shaft support tube and supporting jack as shown in Fig. 8. Raise rotor until bearing is centered in the bore of the bearing housing.

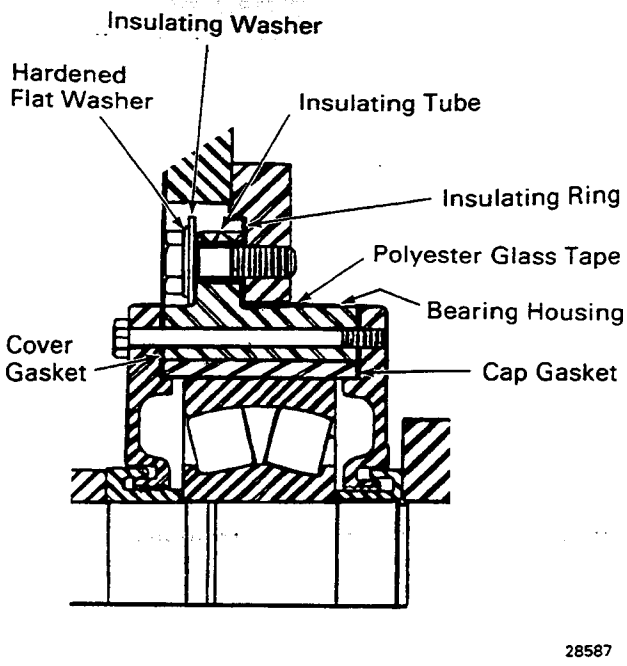


Fig.13 - Large Bearing Insulation

15. Position bearing housing so that bearing housing and bearing cover bolt hole pattern relationship is as shown in Fig. 14. This relationship is important to position brush holder studs at top and bottom positions.

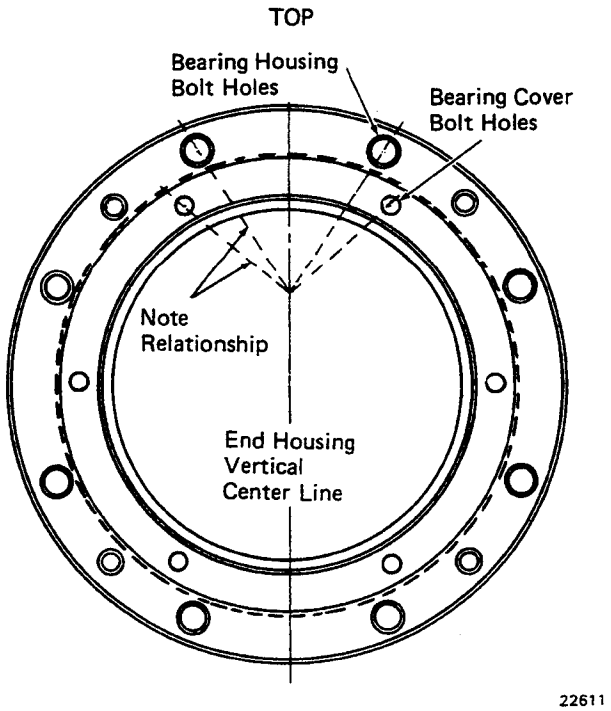


Fig.14 - Installing Bearing Housing

16. Align bearing cap to bearing housing and bearing housing to end housing using the aligning studs. Move bearing housing part way onto bearing. Install special 3/4"-10 x 5" pulling studs through the bearing housing mounting holes and into the end housing. DO NOT ALLOW THE BEARING OUTER RACE TO BECOME TILTED IN THE BEARING HOUSING. Keep the bearing housing parallel to the end housing by tightening the pulling bolts only a partial turn in 180° pairs before proceeding to the next pair. Continue to tighten bolts evenly until the bearing housing is seated. Remove aligning studs and pulling studs.

17. On traction alternator equipped with the large bearing, install eight insulating tubes into bearing housing mounting bolt holes.

18. On traction alternator equipped with the large bearing, apply one insulating washer under each hardened flat washer 9531331 and install bolts to bearing housing. Torque bearing housing bolts to 203 N·m (150 ft-lbs).

19. Check insulation resistance between bearing housing and end housing, using a 1000 volt megohmmeter. Reading must be a minimum 1 megohm. If reading is not satisfactory, remove bearing housing and inspect insulating material for damage and renew if necessary.

20. Carefully weigh the Esso Unirex N-2 grease for the bearing cover groove. Refer to Service Data for proper quantity.

21. Pack the grease into bearing cover groove. Leave a space at the top of the bearing cover to limit churning and liquefaction of the grease. Form grease to proper contour as shown in Fig. 7.

22. Perform Step 18 through 28 of Large Bearing Maintenance procedure.

NOTE

Changing the generator bearing in this manner does not affect engine/generator alignment, however, it is recommended that the alignment is checked before returning the unit to service.

If the stator has been moved or disturbed, realign generator per M.I. 1753.

GENERATOR DISASSEMBLY

NOTE

If equipment for disassembly and assembly is not available, generator should be returned to the Electro-Motive Division for repair either on a rebuild and return, or unit exchange basis.

Before the generator is removed from its location, place strips of fish paper approximately 2 mm x 80 mm x 900 mm (1/16" x 3" x 36") in the bottom air gap between the rotor assembly and stator coils. When removing the generator, be sure to tag shims used under mounting pads so they may be replaced in their original position.

The following steps apply in disassembling the generator. Refer to Figs. 15 through 20 as applicable during disassembly.

1. Mount generator on a sturdy stand at a suitable working height. Remove dust, dirt, oil, and grease from outside of generator. This will prevent dirt from entering during disassembly.

2. Remove all covers from the generator assembly.

3. Disconnect leads to brush holder and filter assemblies.

4. Remove bolts holding air box to end housing, and carefully remove air box.

5. Remove collector ring cover, brush holders and brush holder bracket assembly.

6. Disconnect the phase lead connections and suppression circuit connections at the bus bars of each rectifier bank assembly. Remove the cable cleats securing suppression circuit leads to the slides and ends of each rectifier bank assembly. Remove rectifier banks.

7. Remove cleat assemblies securing stator leads to end housing.

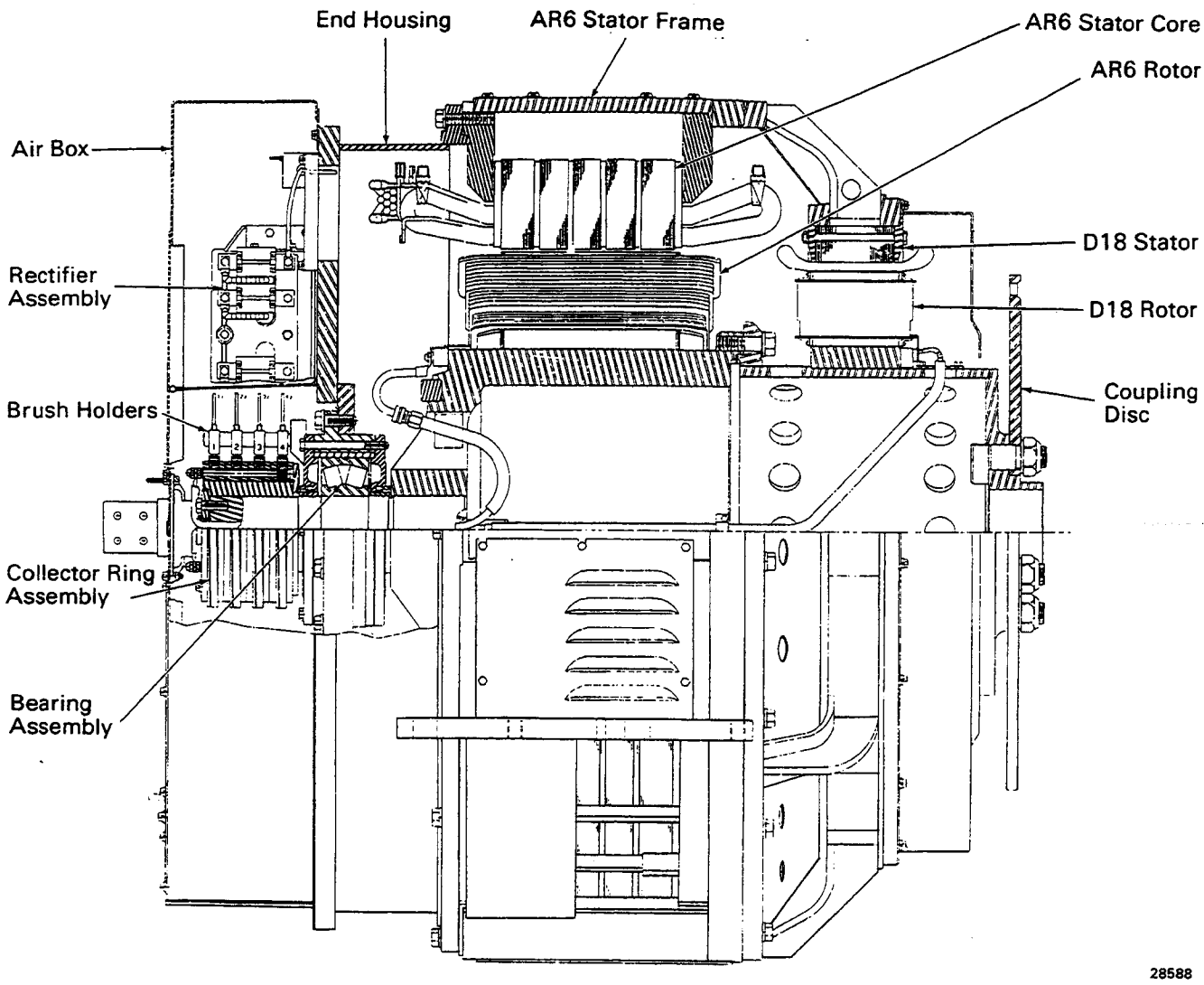


Fig.15 – AR6-D18 Main Generator Cross-Section

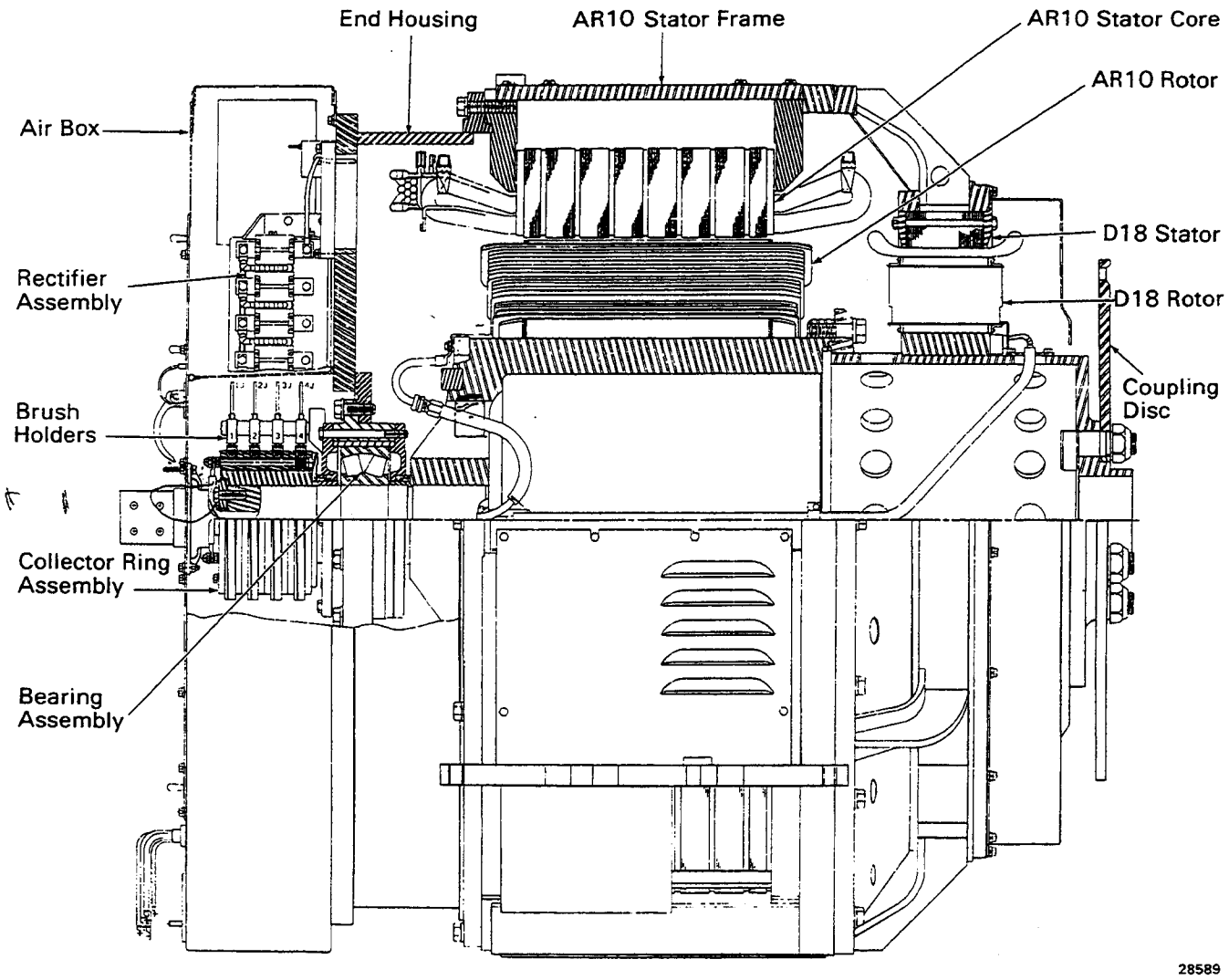


Fig.16 – AR10-D18 Main Generator Cross-Section

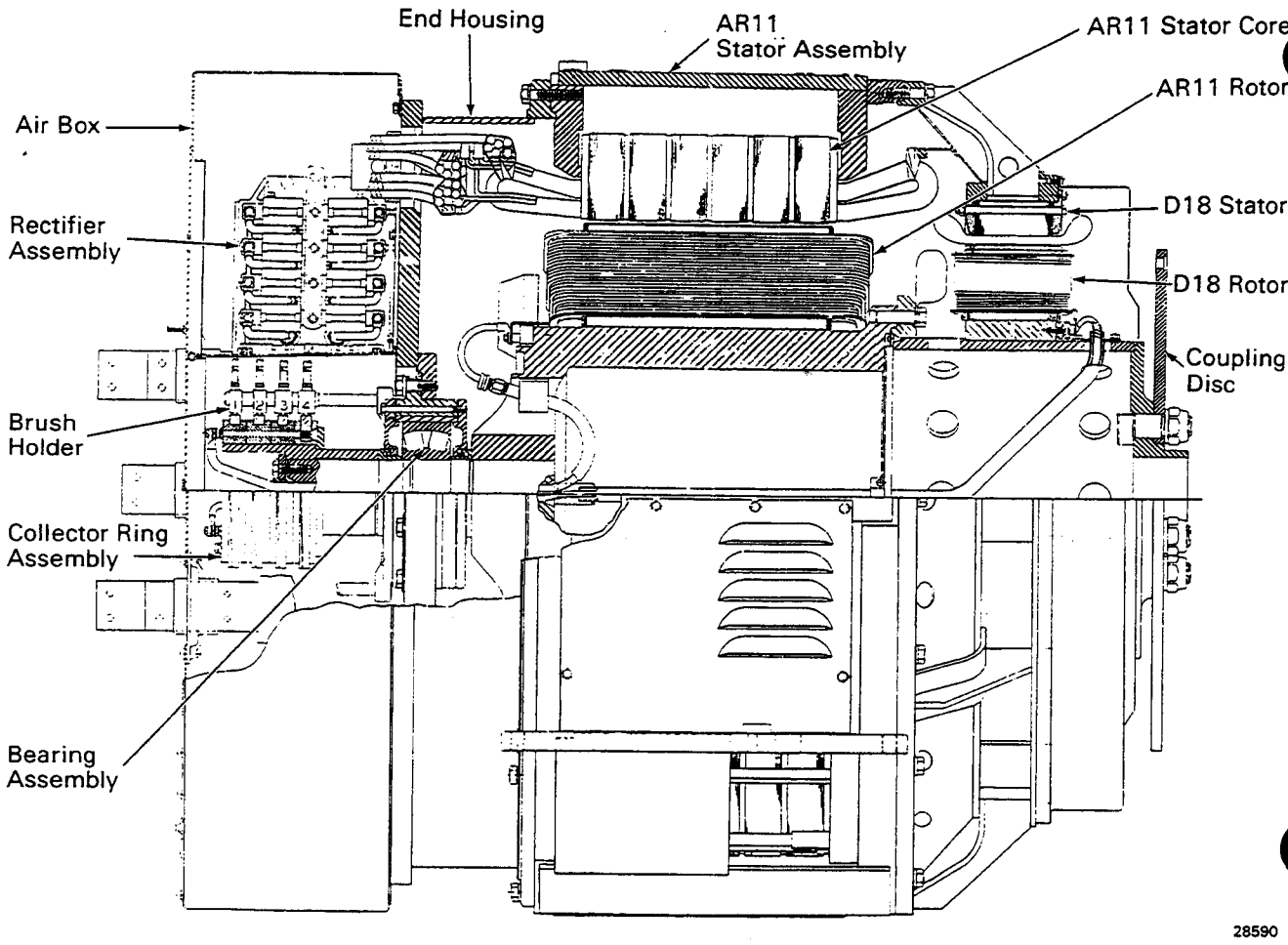


Fig.17 – AR11-D18 Main Generator Cross-Section

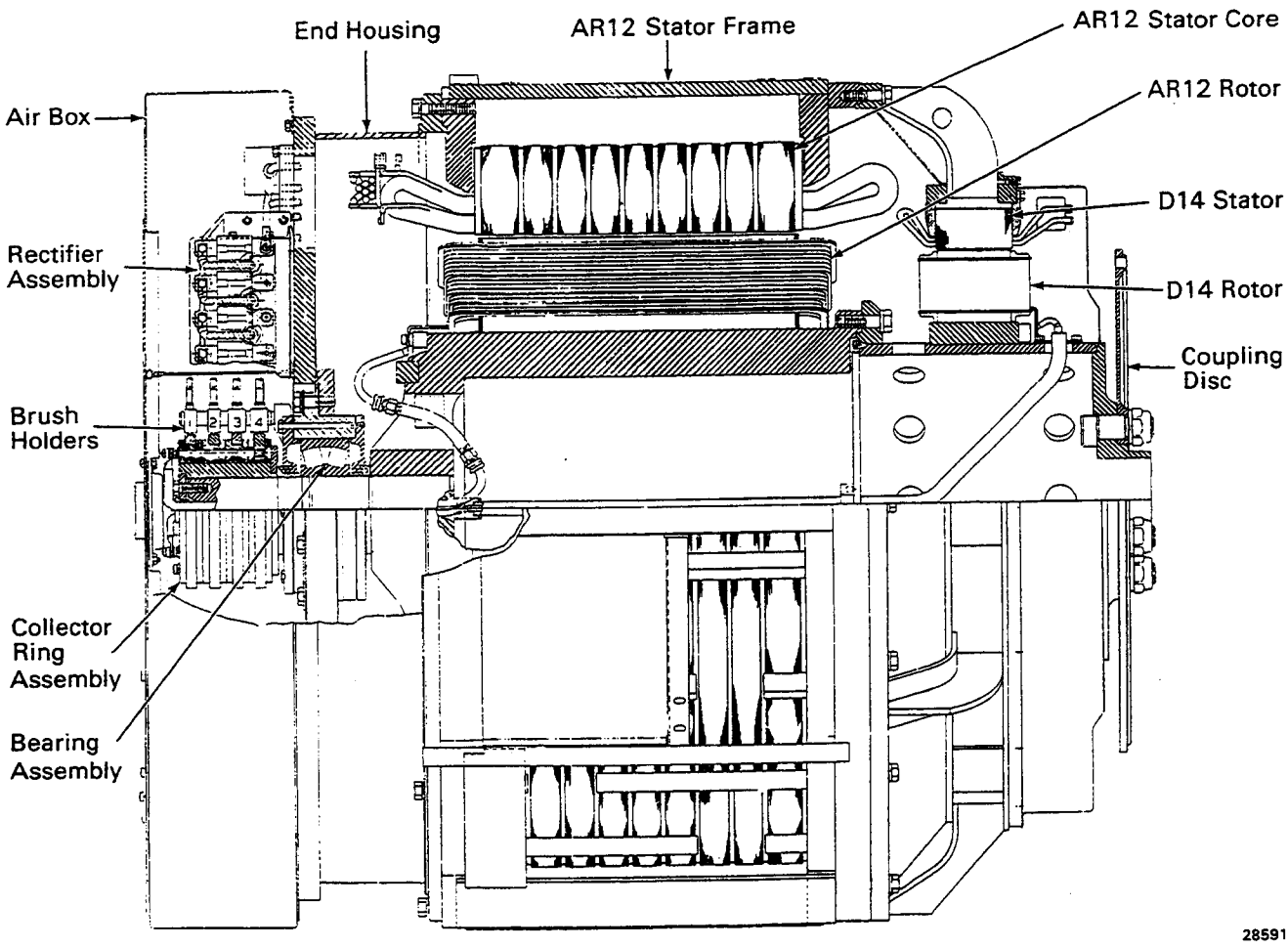


Fig.18 – AR12-D14 Main Generator Cross-Section

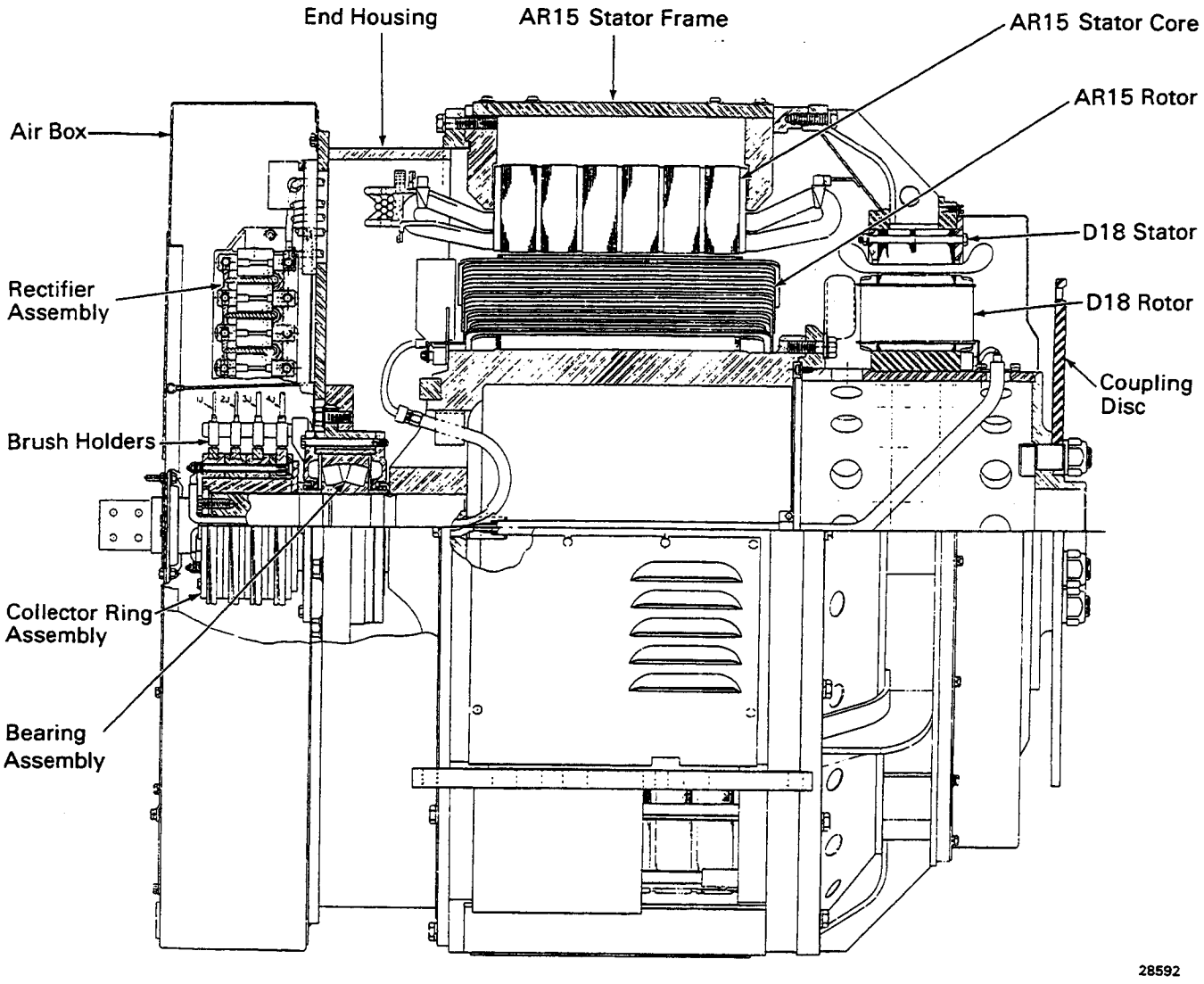


Fig.19 – AR15-D18 Main Generator Cross-Section

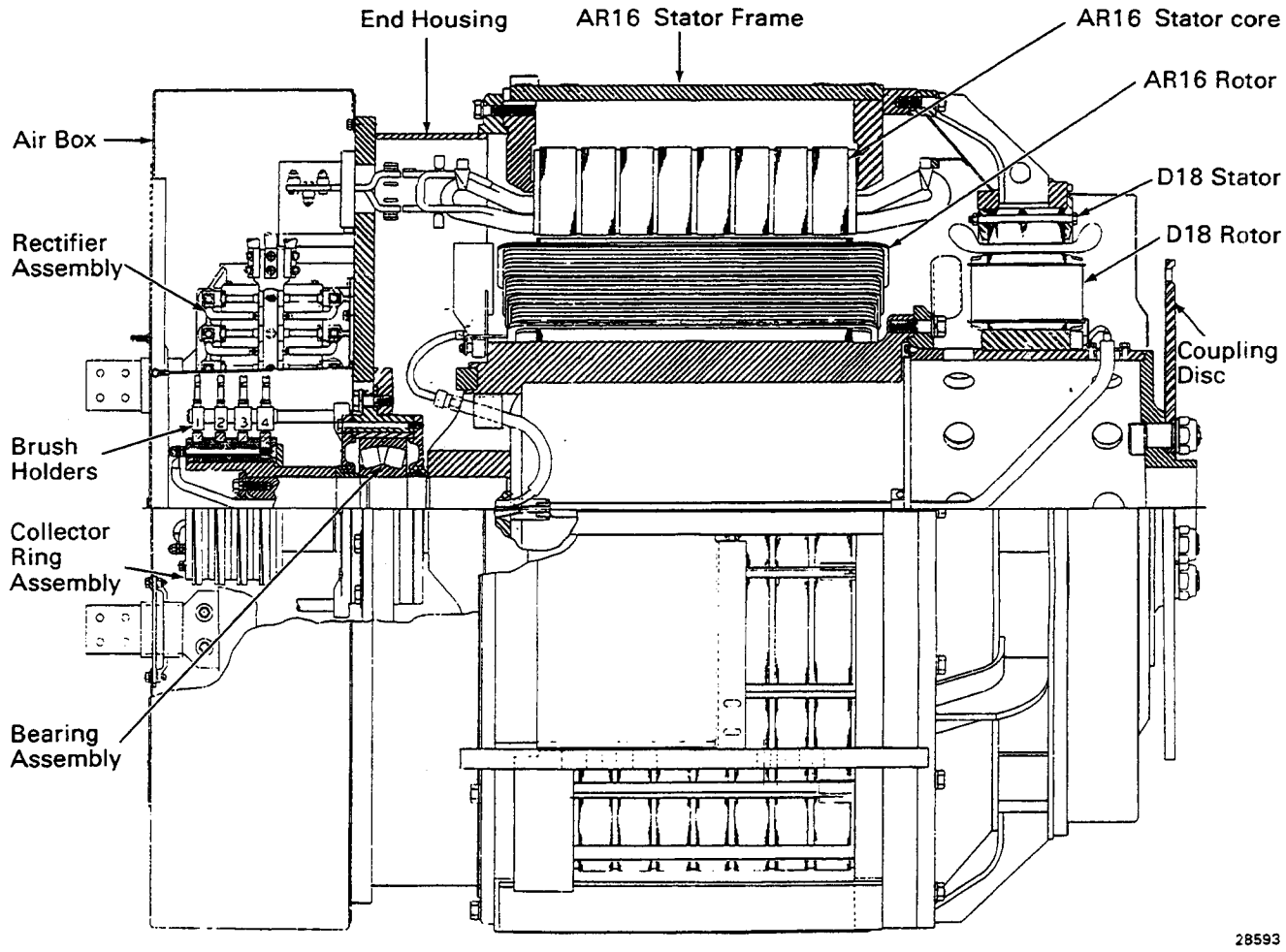


Fig.20 – AR16-D18 Main Generator Cross-Section

8. Apply an arbor fixture to spider bore of companion alternator rotor, Fig. 21. Attach crane cable to end of fixture.

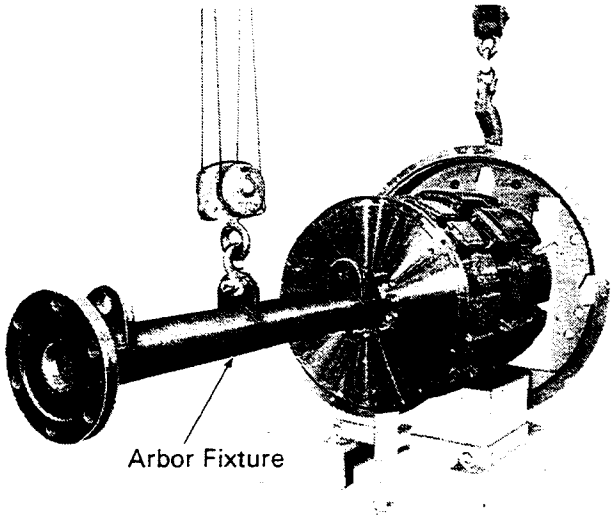


Fig.21 - Application Of Arbor Fixture

9. Support end housing with another crane cable and end housing holding fixture, Fig. 22. Remove eight 3/4"-10 bolts securing end housing to stator frame.

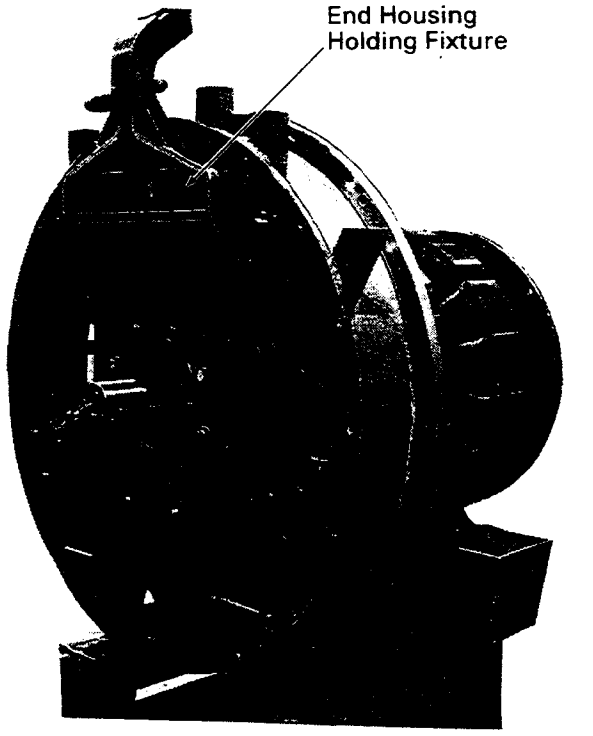


Fig.22 - Attaching Crane Cable To End Housing

NOTE

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

10. Insert three 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.

11. 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.

12. Carefully remove rotor and end housing assembly from stator, moving it towards bearing end of assembly until it clears stator, Fig. 23.

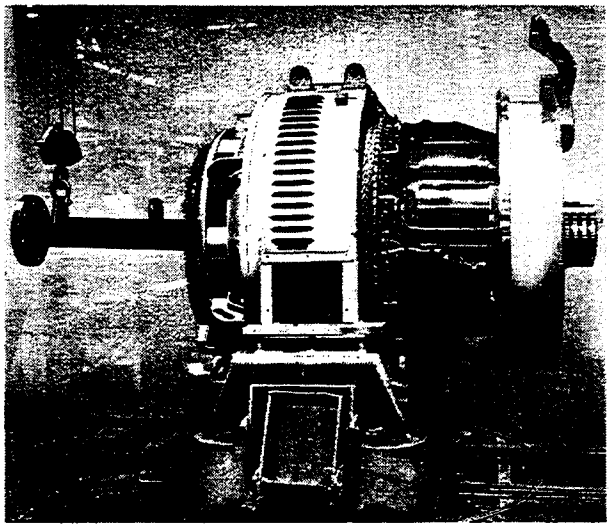


Fig.23 - Removing Rotor And End Housing From Stator

NOTE

If necessary, the coupling disc and the companion alternator rotor can be removed from the traction alternator rotor.

13. Place rotor assembly on a cradle stand, Fig. 24 with strips of fish paper between rotor and cradle.

14. Disconnect field leads from collector ring studs, Fig. 4 or 5 as applicable.

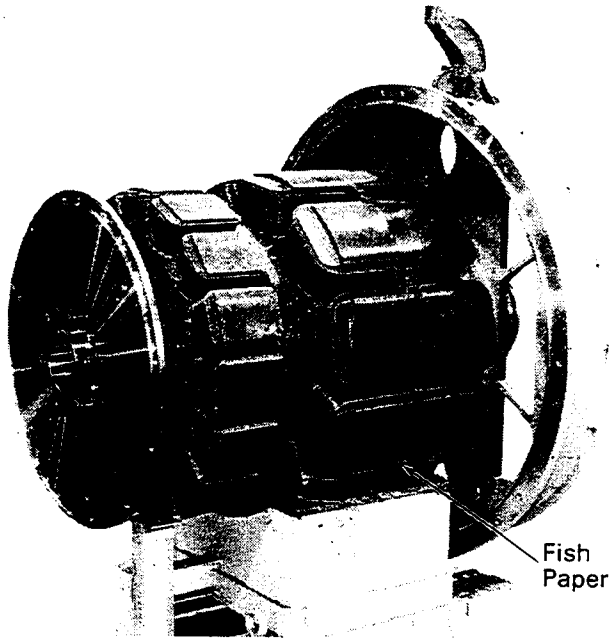


Fig.24 – Rotor Assembly Removed From Stator

15. Remove the four bolts securing the retainer plate to the end of the shaft, and remove the retainer plate.

16. Remove four 3/8″-16 bolts securing the collector rings to the collector ring hub. The bolts are located on the collector ring face between the lead connection terminals, Fig. 3. Place extension cup around field leads and bolt cup to shaft as shown in Fig. 6.

NOTE

All puller tools used to remove collector ring, bearing outer seal, bearing, and bearing inner seal may be fabricated as detailed in File Drawings and Work Sketch Drawing listed in Service Data.

17. Install puller plate and puller studs to remove collector ring assembly, as shown in Fig. 6. Place jack assembly between the extension cup and the puller plate, supported by cradle studs of the puller plate. Connect hydraulic pump to jack assembly to remove collector ring assembly. Ensure puller is pulling equally on all studs to prevent damage to collector ring. Apply hydraulic pressure to jack assembly to remove collector ring.

18. Remove puller studs from collector ring assembly and install original bolts.

19. Install puller plate and puller studs to remove outer seal as shown in Fig. 6. Place jack assembly between extension cup and puller plate supported by cradle studs of the puller plate. Connect hydraulic pump to jack assembly. Ensure puller is pulling equally on all studs to prevent damage to outer seal. Apply hydraulic pressure to jack assembly to remove outer seal. Remove jack assembly, hydraulic pump, puller plate, and puller studs.

20. Remove bolts from bearing cover, Fig. 4 or 5 as applicable, and remove bearing cover. If cover is stuck to bearing housing, hit outer periphery of cover with a rawhide mallet or similar tool to remove cover and gasket.

CAUTION

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

21. Remove eight 3/4-10″ bolts securing bearing housing to end housing, Fig. 25. Insert four 3/4″-10 jacking bolts equally spaced around the bearing housing in special holes provided. Turn jacking bolts equally until bearing housing is separated from the end housing.

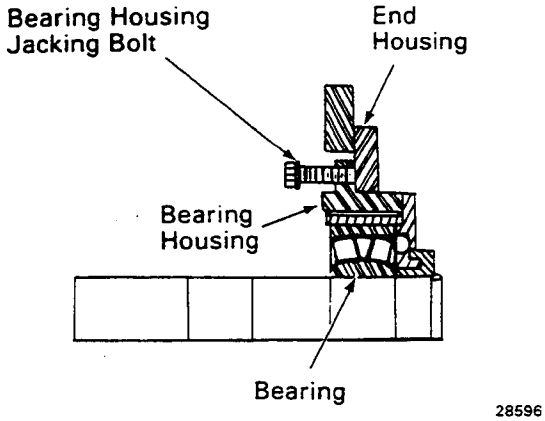


Fig.25 – Bearing Housing Removal

CAUTION

Do not wash bearing housing in caustic solution or cob blast the housing bore. The bearing housing and housing bore dimensions are extremely critical and may be damaged.

22. If rotor shaft has a tapped hole in the end of the shaft for hydraulic bearing removal. Two hydraulic pumps are required to perform the following procedure.

    a. Ensure threads and pressure fitting seat are cleaned in the drilled passage in the shaft.

    b. Screw a 1/8″-27 adapter nipple, Fig. 9 into tapped hole in shaft and tighten. Refer to Service Data for adapter nipple part number.

    c. Connect hydraulic pump, Fig. 10, to adapter nipple.

23. If shaft is not equipped for hydraulic bearing removal, it is necessary to protect the stator and rotor windings and remove the outer bearing race and cage with a cutting torch.

24. Thread six puller studs into flange of bearing cap. Install six spacer tubes and centering ring as shown in Fig. 11.

25. Place extension yoke around field leads and bolt extension yoke to shaft as shown in Fig. 11.

26. Install puller plate. Place hydraulic jack between extension yoke and puller plate, supported by cradle studs of puller plate as shown in Fig. 11.

27. If rotor shaft is equipped for hydraulic bearing removal, apply hydraulic pressure to expand inner bearing race. Maintain this pressure while applying hydraulic pressure to the jack assembly until bearing slides off the shaft seat (approximately 63.5 mm [2-1/2″]). Ensure puller is pulling equally on all studs to prevent damage to bearing.

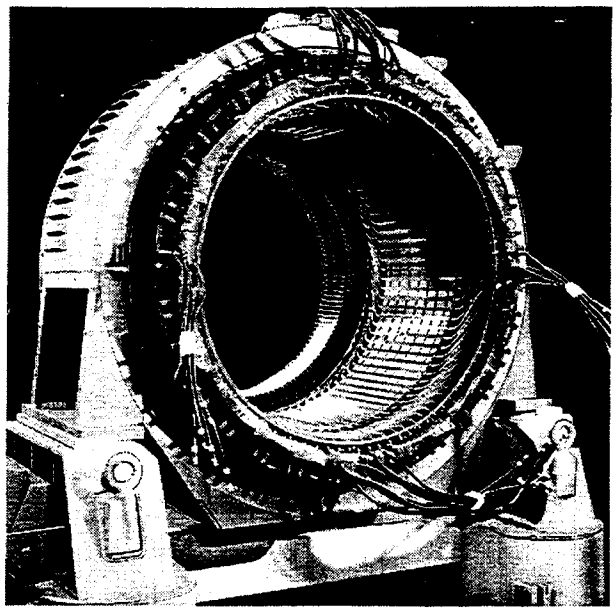
28. Remove bearing inner seal using small heating torch and pry bars.

29. Remove companion alternator stator closure assembly, if necessary.

30. Ensure the companion alternator stator assembly is properly supported and remove bolts securing the companion alternator stator assembly to the traction alternator stator assembly. Install 3/4″-10 jack bolts and remove the companion alternator stator assembly.

ELECTRICAL INSULATION TEST

Before the generator is assembled, it is advisable to electrically qualify the stator, Fig. 26, and rotor. The following qualifications should be met before any attempt to give the stator or rotor a high potential test. This applies to any stator or rotor that has had an occasion for windings to accumulate moisture or dirt.



13235

Fig.26 – Typical AR10 Stator Assembly

1. Stator and rotor must be clean.

2. Stator and rotor must show a steady insulation resistance reading for at least three hours at any given temperature from 75° C to 90° C (167° F to 194° F).

3. The ratio of insulation resistance taken 5 minutes after starting the megger check should not be less than 1-1/2 times the reading taken 10 seconds after starting the check. The check should be taken with a stator temperature reading of 50° C (122° F).

4. The insulation resistance of the rotor must be not less than one megohm at any temperature up to 75° C (167° F).

Any stator or rotor which, although clean, shows low or erratic insulation resistance readings, should

be dried at 90° C (194° F) until a stabilized insulation resistance reading is obtained for a period of twenty-four hours. Before applying high potential test, all the other qualifications outlined must be met.

NOTE

Generators which have been stored for a considerable period of time should be given an insulation resistance check before being put into service.

HIGH POTENTIAL TEST

If the stator and rotor meet the listed qualifications, test should be taken at 50° ± 5° C (122° ± 9° F) in the following manner:

1. For stators, short all positive and negative bus bars. DO NOT PERFORM HIGH POTENTIAL TESTS BEFORE CONSULTING M.I. 3317-2.

2. Apply 1050 volts RMS to stator for one minute.

3. Apply 300 volts to rotor for one minute.

If the stator or rotor fails to qualify either the resistance check or the high potential test, the generator should be returned to the Electro-Motive Division due to the special tooling and facilities needed to make corrections.

BEARING INSPECTION

GENERAL

On all bearings with appreciable service, some dents, nicks, pits, and craters will be found. If these are small and scattered, they should not be cause for rejection; however, they should be evaluated with good judgement and with reference to the overall condition of the bearing. All doubtful parts should be discarded. Failed parts should be replaced with either new or acceptable reconditioned parts. If one part of an assembly has been subjected to excessive stress which results in a visible defect severe enough to reject the part, the rest of the assembly requires a detailed inspection and evaluation before reuse.

The roller bearing should be thoroughly inspected for possible evidence of impending failure. The following inspections are to be used when qualifying bearing components for reuse.

CLEANING

Before attempting to make any inspection, a bearing must be thoroughly cleaned. Stoddards solvent or similar noncorrosive solvent having a flash point of 46° C (115° F) or higher may be used.

A clean brush or lintless cloth can be used to facilitate cleaning. Gasket surfaces should be given special attention to remove all traces of remaining gasket material.

NOTE

If bearing components are not to be used immediately after inspection they should be coated with Esso Unirex N-2 grease to prevent corrosion while in storage.

OPERATING SURFACES

All exposed operating surfaces must be inspected visually to ensure that they contain none of the following defects which will be cause for rejection:

1. Wear - A properly lubricated bearing not subjected to misalignment, dirt, or distortion will show no evidence of wear. The internal radial clearance of the bearing may be checked by passing a feeler gauge between the rollers and race of the unloaded side of the bearing. Do not roll a feeler through a bearing. For limits, see Service Data.

2. Fatigue Failure - Signs of fatigue failure will most usually appear on the bearing surface. Fatigue failure is usually evidenced as ragged craters, and may be of any size. Any bearing showing any sign of cracks or craters of any size, regardless of how small they may be, should be replaced. This type of failure is more likely to occur on either the rollers or inner race.

3. Protrusions above the normal surface.

NOTE

Protrusions should be reduced to the normal surface by light circumferential honing with Arkansas stone (novaculite) or grade 240 abrasive cloth. Likewise, the sharp edges should be smoothed. Care must be taken to work down to the normal surface only, to prevent reduction of contact area, and to work circumferentially so as to prevent the formation of flats.

4. Cracks and flats.

5. Ruptures, tears or seams (2.4 mm [3/32"] or more in length, or more than hairline width).

6. Scores, or deep scratches which extend more than 3/4 the length of the operating surface and are inclined at less than 10° to the axis.

7. Corrosion pits. (0.8 mm [1/32] or more in diameter.)

8. Craters or pits from electrical arcing. (0.8 mm [1/32] or more in diameter.)

9. Profuse denting.

10. Overheating.

11. Circumferential pattern of pits or dents at the ends of the roller path.

12. Fatigue pits, flaking, shelling or galling.

GENERATOR ASSEMBLY

NOTE

The main generator consists of an AR-type traction alternator and a companion alternator.

After the generator stator and rotor have been cleaned and checked, the inside of the stator and the outside of the rotor should be painted with red air drying enamel.

When all the component parts have been cleaned, checked inspected, and painted, the generator is ready for assembly.

Before shrinking bearing to rotor shaft, it is very important that the bearing be tried in its housing. Place bearing housing on floor and slide bearing through bore of housing. Ensure bearing enters the housing bore squarely, and is not cocked. See Service Data for bearing dimensions and tolerances.

Refer to Figs. 15 through 20 as applicable during assembly.

BEARING AND END HOUSING ASSEMBLY

1. Fill labyrinth grooves in the bearing cap and cover with Esso Unirex N-2 grease. This grease need not be measured.

2. Weigh the piece of paper that will be used in handling the grease. The weight of the paper must be compensated for when weighing the grease.

NOTE

Esso Unirex N-2 grease must be exclusively to lubricate a new or cleaned bearing. Adequate lubrication depends upon precise weight of grease. Too much grease is as detrimental to service life of the bearing as too little. Bearing replacement kits include preweighed amounts of grease.

3. Carefully weigh the Esso Unirex N-2 grease for the bearing cap and cover groove. Refer to Service Data for proper quantity.

4. Pack the grease into bearing cap and cover groove. Leave a space at the top of the bearing, as shown in Fig. 7, to limit churning and liquefaction of the grease. Form grease to proper contour as shown in Fig. 7.

5. Clean armature shaft and remove burrs or gall marks.

CAUTION

Care should be used when heating bearing parts. Overheating may result in warping or damaging the metal.

6. Heat the inner seal in an oil bath, electric oven, or induction heater for half an hour at 104° C (220° F). If an oil bath is used for heating, remove the oil from the seal with clean, bound-edge cloths prior to shrinking to the shaft. When using an induction heater, pyrometer readings (when current off) should be taken periodically. After heating, shrink the seal to the shaft and let it cool to room temperature.

7. Install greased bearing cap with gasket onto shaft.

8. Pack the bearing rollers and the space between the two rows of rollers with the quantity and type of grease specified in Service Data. On large bearings, fill groove in outer race with additional grease.

NOTE

If Shell Cyprina grease is present in the bearing, Esso Unirex N-2 may be added.

9. Heat roller bearing with an induction heater to 105° C (220° F). Take pyrometer readings (with current off) at outside face of inner race only. Also see Caution before Step 6. Shrink bearing to shaft with the bearing part number toward the outside. Do not cock the bearing when placing it on shaft. Use a brass pipe to push bearing on shaft up to and against inner seal. Let bearing cool to room temperature.

10. Place end housing in a horizontal position with mounting flange down, and install two 3/4"-10 aligning studs 180° apart into two of the eight tapped bearing housing bolt holes in the end housing. The aligning studs will help prevent the bearing from cocking (damaging insulation material) when assembling bearing housing to end housing.

NOTE

Small bearing Model AR10 traction alternator has a bearing housing with an inner and outer phenolic sleeve and does not require additional insulation.

11. On traction alternator equipped with large bearing, position new insulating ring, Fig. 13, over aligning studs so that holes in the ring line up with the holes in the end housing.

12. Apply Molykote paste to inside diameter of bearing housing prior to assembling bearing housing to bearing.

13. Position bearing housing so that bearing housing and bearing cover bolt hole pattern relationship is as shown in Fig. 14. This relationship is important to position brush holder studs at top and bottom position.

14. Carefully lower bearing housing into position guided by aligning studs. Gently tap bearing housing until bearing housing bottoms out on the end housing. Remove aligning studs.

15. On traction alternator equipped with large bearing, install eight insulating tubes into bearing housing mounting bolt holes.

16. On traction alternator equipped with the large bearing, apply one insulating washer under each hardened flat washer 9531331 and install bolts to bearing housing. Torque bearing housing bolts to 203 N·m (150 ft-lbs).

17. Check insulation resistance between bearing housing and end housing, using a 1000 volt megohmmeter. Reading must be a minimum of 1 megohm. If reading is not satisfactory, remove bearing housing and inspect insulating material for damage and renew if necessary.

18. Insert two 1/2"-13 aligning studs, Fig. 27, 180° apart in the threaded holes in the bearing cap. The purpose of the studs is to guide the bearing housing to the bearing cap. A bearing alignment disc, Fig. 27, may also be used in installing the end housing.

NOTE

Bearing alignment disc may be fabricated as detailed in the File Drawing referenced in Service Data.

19. Lift end housing and place over rotor shaft. Align bearing housing to bearing cap using the aligning studs. Being careful not to cock bearing housing on bearing, gently push end housing onto bearing until housing is snug against bearing cap. Remove aligning disc.

20. Apply new gasket to bearing cover, Fig. 13. Mount bearing cover to bearing housing with brush holder studs located at top and bottom positions. Remove aligning studs and secure cover with 1/2"-13 cover mounting bolts hand tightened. When all bolts are installed hand tight and the cover is not cocked, torque bolts to 68-75 N·m (50-55 ft-lbs) using a minimum of three passes.

CAUTION

Do not heat seal above 104° C (220° F). Overheating may result in warpage or other damage to seal.

21. Heat outer seal in an oil bath or electric oven, for half an hour at 104° C (220° F). If oil bath method is used, remove oil from seal with clean bound edge cloths prior to shrinking to rotor shaft. When using an induction heater, pyrometer readings (with current off) should be taken periodically. After heating, shrink outer seal to rotor shaft by letting it cool to room temperature.

22. Place collector ring assembly on induction heater and heat to 104° C (220° F). Pyrometer readings (with current off) should be taken periodically. After heating, place collector ring assembly on rotor shaft, against outer seal. Rotate ring assembly on shaft for proper position of lead connection to terminals of ring assembly.

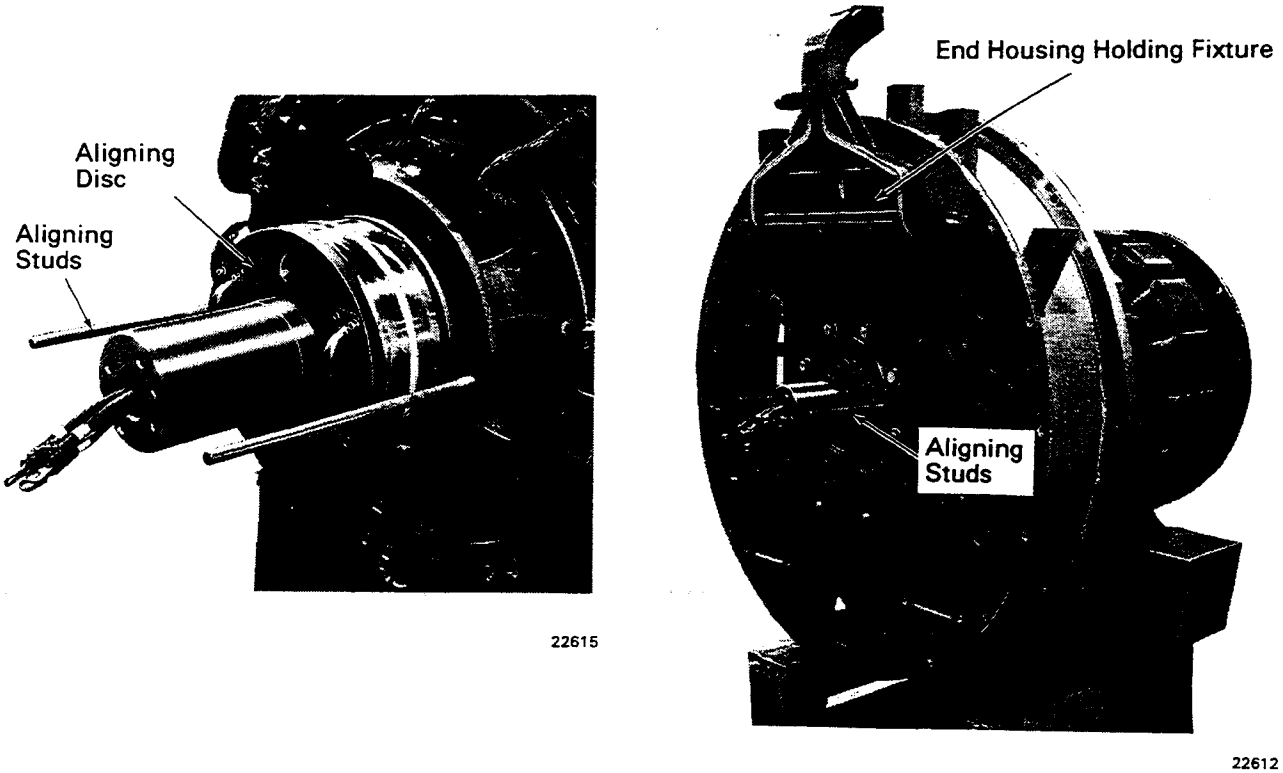


Fig.27 – Applying End Housing To Rotor Assembly

WARNING

If work involving collector ring connections has been performed, use a continuity tester (with all field leads disconnected and all brushes lifted) to check that collector ring terminals marked 1 through 4 on the steel hub adjacent to the terminals are connected to the appropriate collector rings (No. 1 outboard, No. 4 inboard).

23. Place retainer plate over leads and on to the end of rotor shaft. Torque the 5/8"-11 retainer plate mounting bolts to 149-163 N·m (110-120 ft-lbs).

24. Install cable grommet over four field leads and insert grommet into retainer plate.

25. Connect large field leads (traction alternator) to collector ring terminals 3 and 4, and smaller field leads (companion alternator) to terminals 1 and 2. Secure leads by torquing mounting bolts to 10-12 N·m (7-9 ft-lbs).

ROTOR AND STATOR ASSEMBLIES

1. If companion alternator rotor assembly was removed from main generator rotor, align mating bolt holes and bolt rotors together using 7/8"-9 bolts removed during disassembly. Be sure companion alternator cable leads are threaded through the traction alternator rotor shaft. Torque bolts to 508-542 N·m (375-400 ft-lbs) using a minimum of three passes.

2. Bolt companion alternator stator assembly to traction alternator stator frame assembly. Torque mounting bolts to 271 N·m (200 ft-lbs).

NOTE

A new generator/engine coupling arrangement designed to reduce vibration levels has been applied since January 1983.

The new coupling arrangement applies and engine coupling with a thin cross-section and a generator coupling disc with a thick cross-section, rather than the thick engine coupling/thin generator coupling disc arrangement. The mating surfaces of the new arrangement are designed to prevent misapplication. Refer to Fig. 28.

3. Apply coupling disc to companion alternator rotor hub. Lubricate threads, washer and washer face of self locking nut with Molykote. Torque mounting nuts to 1898-2034 N·m (1400-1500 ft-lbs).

4. Place stator assembly and rotor assembly on their stands close enough to each other so that when the arbor fixture is placed in the flange bore of the companion alternator rotor, the end

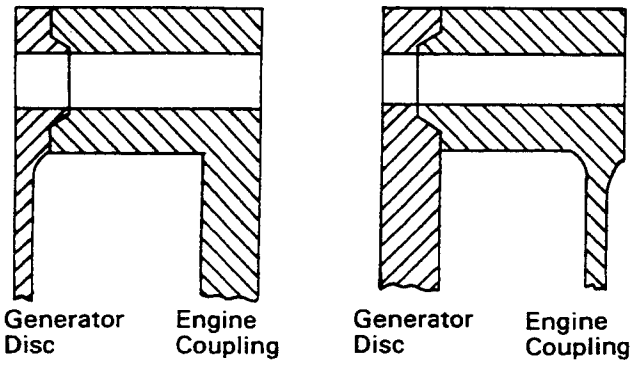


Fig.28 - Engine/Generator Coupling Arrangement

of the fixture protrudes through the stator assembly, as shown in Fig. 29.

NOTE

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

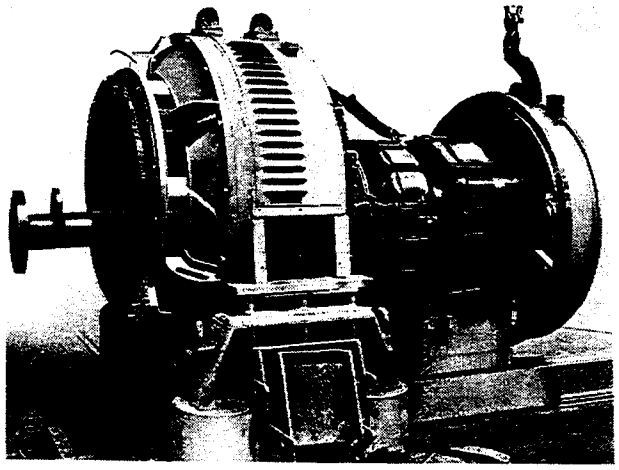


Fig.29 - Preparation To Install Rotor In Stator

5. Support end housing with a crane cable and end housing holding fixture, Fig. 30. Support end of arbor fixture with another crane cable. Carefully lift and guide rotor assembly into stator. Avoid damaging insulation. When end housing is flush against stator frame, install 3/4"-10 bolts, and lockwashers, to hold end housing to stator frame. Torque bolts to 271 N·m (200 ft-lbs) using a minimum of three passes.

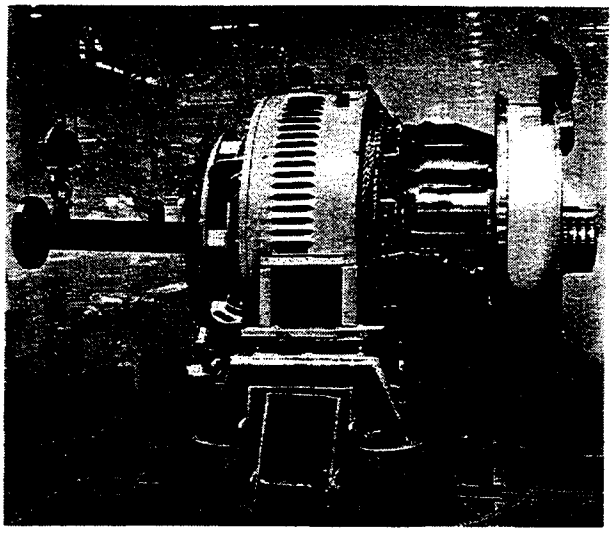


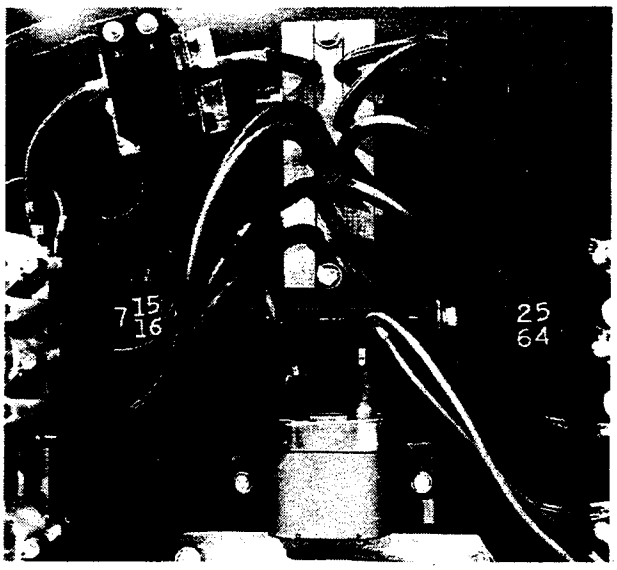
Fig.30 - Installing Rotor In Stator

NOTE

At the time of manufacture, the total end movement measurement of the bearing within the bearing housing is stamped on the generator end housing. On current generators, this dimension is 9.5 mm ± 0.4 (3/8" ± 1/64"). A few early generators had a total end movement less than 9.5 mm, which can be verified by the figure stamped on the generator end housing. This dimension is required to determine that the bearing has the necessary clearance.

During manufacture, measurement is also taken to determine bearing thrust clearance (called the "X" dimension) and is stamped on the generator end housing. This dimension is used to position the generator when being connected to the engine to provide bearing thrust clearance to prevent bearing damage.

6. Center the rotor assembly in the stator and check the total end movement of the bearing outer race in the bearing housing. A few early generators had a total end movement of less then 9.5 mm ± 0.4 mm (3/8" ± 1/64") which can be verified by the figure stamped on the generator housing. All current generators and most earlier models have a total end movement of 9.5 mm ± 0.4 mm (3/8" ± 1/64"). If the original parts are reused, this figure may be the same as the original figure which was stamped on the face of the generator end housing. If the total end movement measurement differs from the number stamped on the generator end housing, Fig. 31, remove the original number and stamp the new number adjacent to it.



22614

Fig.31 – Stamped Dimensions On Generator End Housing

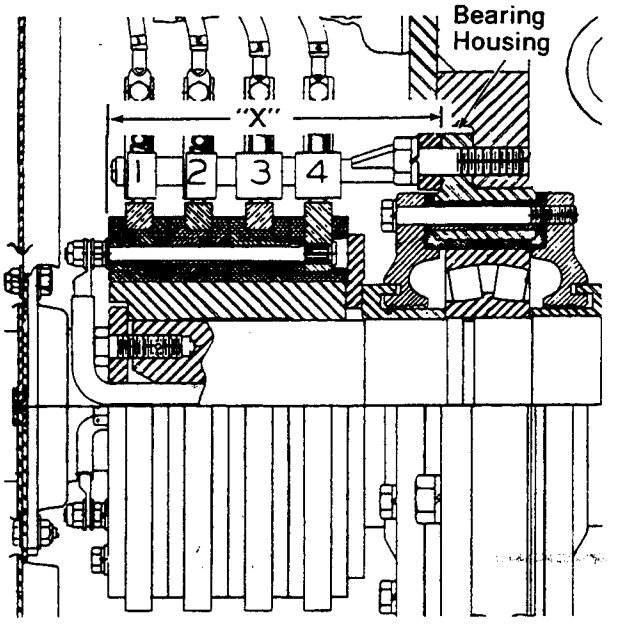
7. Position the rotor so that all the end movement is taken up in the direction of the coupling disc.

   On early model AR10 generators with the small bearing application, measure the distance from the machined surface of the bearing housing between the mounting bolts to the outer surface of the collector ring assembly, Fig. 32. This measurement is the "X" (protrusion) dimension. Stamp this measurement, to the nearest 0.40 mm (1/64″), on the generator end housing, Fig. 31. This dimension should be approximately 224.6 mm (8-7/8″).

   On the other model generators with the large bearing application, measure the distance from the bearing housing bolt head at the 1 o'clock position to the outer surface of the collector ring assembly, Fig. 33. This measurement is the "X" (protrusion) dimension. Stamp this measurement, to the nearest 0.40 mm (1/64″), on the generator end housing, Fig. 31.

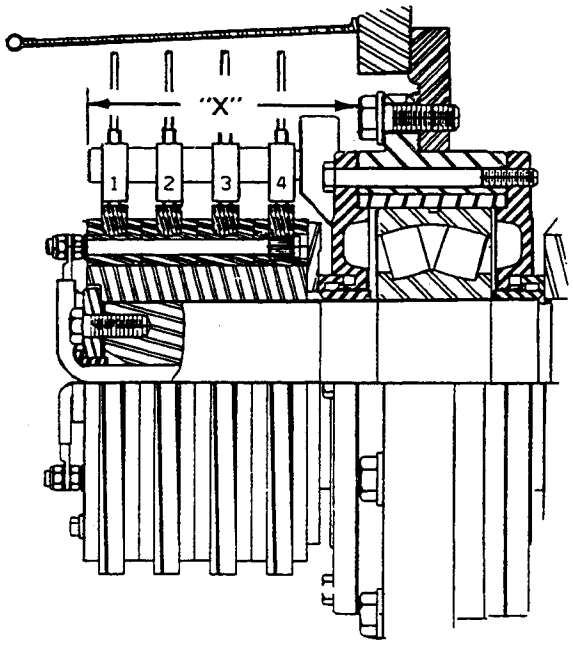
   On AR6, 10, 12, and 15 generators, this dimension should be approximately 203 mm (8″), and on the AR11 and 16 generators, approximately 300 mm (11-13/16″).

8. Place fish paper strips 2 mm x 80 mm x 900 mm (1/16″ x 3″ x 36″) in air gap between rotor assembly and stator. Remove crane cables and end housing holding fixture.



18893

Fig.32 – Model AR10 Small Bearing "X" (Protrusion) Measurement



28598

Fig.33 – Large Bearing "X" (Protrusion) Measurement

9. Install brush holders, Fig. 4 or 5 as applicable. Large brush holders (traction alternator) over collector ring positions 3 and 4, and small brush holders (companion alternator) over collector ring positions 1 and 2.

10. Mount jumper leads J1, J2, J3, and J4 between top and bottom brush holders having the same position numbers. The jumper leads attach to brush holder locking screws, which secure holder to insulated stud.

11. Route leads to left of collector ring assembly. Secure leads with three cable clamps bolted into threaded holes in bearing housing.

12. Connect external leads 1, 2, 3, and 4 to corresponding lower brush holder terminals.

13. Adjust brush holders to have 3.2 mm (1/8") clearance over collector rings. In addition ensure that holder is centered over collector ring. Torque holder locking screws to 14-20 N·m (10-15 ft-lbs). Assemble brushes in holders; if used brushes are reinstalled ensure that their original positions are maintained. Check that each brush is centered within 1.59 mm (1/16") in relation to mating collector ring.

14. Install rectifier banks on end housing.

15. Install stator lead cleat assemblies to face of end housing and connect stator leads to rectifier bank assemblies.

16. Install collector ring cover and air box cover assembly removed during disassembly.

17. Connect all loose leads to proper connections and secure with tape to prevent movement. Route remaining external leads through hole on lower face of air box.

Generator is now ready to be tested, refer to Generator Testing. When tests are complete, refer to Installation Of Main Generator Into Locomotive Unit.

GENERATOR TESTING

1. Prepare generator for testing by performing the following preliminary steps:

   a. Clean out and inspect generator for stray material, steel cuttings, etc.

   b. Disconnect suppression circuitry from rectifier bridges and AC paralleling bars.

   c. Generators equipped with current transformers should have the current transformers short circuited by securely bolting together leads CTA, CTB, and CTC on outside of the air box.

2. Take cold, 75° C (167° F), resistance readings. Refer to Service Data for limits.

HIGH POTENTIAL TEST

The insulation used in these generators is designed to withstand somewhat higher voltages than those experienced during normal operation.

High potential tests are normally used when it is necessary to qualify new equipment installations or to determine the location of an insulation breakdown on older equipment. High potential tests can be destructive to equipment being tested and, therefore, are not recommended as a normal routine maintenance item.

In some cases, such as; national or local code requirements, company policy, or a suspected insulation breakdown, high potential tests are required. In these instances adhere to all cautions, listed below in the Safety Precautions section, while performing test.

If the rotor or stator fail the high potential test it is recommended that it be returned to Electro-Motive Division because of special tooling and facilities required to make repairs.

SAFETY PRECAUTIONS

- Whenever possible, high potential tests should be performed by one man. All others should be kept away from the test area.

- A thorough knowledge and understanding of equipment, and procedures involved is essential.

- To prevent dangerous overvoltage surges, test electrodes must be firmly connected to item under test before voltage is applied. In addition, the voltage should be removed before the electrodes are removed.

- Discharge residual voltage to ground after removing tester.

Before high potential tests are made, it is highly desirable to check first with a megohmmeter. A megohmmeter reading of 1 megohm, when tested with a 1000 V megger, is satisfactory for hi-pot test. An accumulation of dirt and moisture sometimes is sufficient to cause leakage and, if high potential is applied, it will cause an actual breakdown of the

insulation. The condition may be aggravated by sudden temperature changes. If the equipment has been standing outside during cold weather before being brought inside a warm building, the equipment will tend to sweat and the condensed moisture will aid the leakage effect.

The normal voltage of EMD main generators is 600 volts. Therefore, the minimum test voltage should be:

Generator	950 volts
High voltage wiring and high voltage equipment	1050 volts

In making high potential tests, the following precautions should be taken.

WARNING

Make sure that all personnel are in the clear before applying voltages.

1. All high potential tests must be made by placing electrodes on the circuit under test before closing switch, and opening switch before removing electrodes. Dangerous over-voltage surges may result from making or breaking the high voltage circuit with the electrodes.

2. It is of utmost importance, that a reliable high potential tester be used to ensure that an adequate test is made, and that unnecessary overstressing of insulation does not take place. In regard to the features which should be incorporated in a high potential tester, the following points are pertinent:

   a. Wave form
   b. Surges
   c. Voltage regulation

INSTALLATION OF MAIN GENERATOR INTO LOCOMOTIVE UNIT

The installation of the main generator is similar to removal, with the exception that it requires more time, care and skill.

Before a main generator is installed, check and clean the mounting plates. Be sure these plates are smooth, free of burrs and high spots.

Before lifting the generator into the unit, check and clean the mounting pads on the locomotive bed frame. Be sure these pads are clean and free of burrs.

Check the surface on the engine and generator coupling discs, both must be smooth and clean. Add a little oil or mounting compound to the fitting surfaces. Check that bolt holes in couplings are clean and smooth.

Apply 2-3/8" socket wrench to the engine and generator coupling bolt nuts to make sure they are tightened to the proper torque as specified in Service Data.

Inspect and clean shims. Shims must be smooth, free from burrs and kinks. Shims should have been tagged after removal of generator so they may be installed in their original position at this time.

Lift generator and guide slowly and carefully into engineroom. Set generator on mounting pads as close to engine coupling disc as possible.

Line up hole patterns in the engine and generator coupling discs by barring or jacking engine over. Push generator toward engine until engine coupling fits into the beveled groove in the generator coupling disc.

Check all coupling bolts to see that they are smooth and clean. Place a little oil or mounting compound on 3/4" coupling bolts and install all bolts through the generator and engine coupling discs from the engine side. Check to be sure the generator coupling is not cocked and is properly mated to the engine coupling disc.

Once the generator is attached to the engine, do not bar or jack engine over until all fish paper strips are removed from between the rotor assembly and the stator coils.

Line up dowel holes and base bolt holes. Do not insert dowels or base bolts until generator is aligned with engine. See M.I. 1753 for alignment of generator to engine. Install dowels and base bolts. Use Texaco Threadtex as a lubricant on the bolts and washers.

SERVICE DATA

REFERENCES

AR10, AR12, AR15, AR16-D14 or D18 Traction Generator Rectifier Bank Assemblies And Suppression Circuits . . . . . M.I. 3317-2

AR11 Traction Generator Rectifier Bank Assemblies And Suppression Circuit . . . . . M.I. 3317-3

D14 Alternator . . . . . M.I. 3306

D18 Alternator . . . . . M.I. 3307

Alignment Of Locomotive Rotating Equipment . . . . . M.I. 1753

SPECIFICATIONS

Weights

AR6	6 030 kg (13,300 lbs)
AR10	7 120 kg (15,700 lbs)
AR11	7 440 kg (16,400 lbs)
AR12	8 225 kg (18,130 lbs)
AR15	6 985 kg (15,400 lbs)
AR16	8 330 kg (18,360 lbs)

Brushes

Number of Brushes	4
Grade	255
Brush Part Number	
Used With Single Brush Holder 8413189 (Current Model)	8413191
Used With Double Brush Holder 8283003	8329691
Used With Double Brush Holder 8455030	8456279
Brush Size	
8413191 (Current Model)	54 mm x 32 mm x 13 mm (2-1/8″ x 1-1/3″ x 1/2″)
8329691, 8456279	51 mm x 32 mm x 13 mm (2″ x 1-1/4″ x 1/2)
Wear Limit	19 mm (3/4″)
Brush Holder 8413189 (Current Model)	
Number	4
Spring Pressure	1.50 kg ± 0.15 kg (3.3 ± 0.33 lbs)
Brush Holder 8283003	
Number	2
Spring Pressure	1.49 kg ± 0.11 kg (3.29 ± 0.25 lbs)
Brush Holder 8455030	
Number	2
Spring Pressure	1.50 kg ± 0.15 kg (3.3 ± 0.33 lbs)

(For D14 brushes and brush holders, see M.I. 3306)
(For D18 brushes and brush holders, see M.I. 3307)

Collector Rings

Maximum Ring Eccentricity	0.15 mm (0.006″)
Maximum Lateral Ring Runout	0.8 mm (1/32″)
Condemning Limit On Ring Outside Diameter	260 mm (10-1/4″)

	Current Generators	AR10 Generators Built Prior to Nov., 1971
Roller Bearing		
Outer Diameter	259.999 mm +0.000 mm −0.036 mm	215.001 mm +0.000 mm −0.030 mm
	(10.2362″ +0.0000″ −0.0014″)	(8.4646″ +0.0000″ −0.0012″)
Bearing Bore	120.000 mm +0.000 mm −0.020 mm	120.000 mm +0.000 mm −0.020 mm
	(4.7244″ +0.0000″ −0.0008″)	(4.7244″ +0.0000″ −0.0008″)
Width	86.000 mm +0.00 mm −0.13 mm	58.001 mm +0.00 mm −0.13 mm
	(3.3858″ +0.000″ −0.005″)	(2.2835″ +0.000″ −0.005″)
Internal Clearance (before assembly)	0.104 mm to 0.150 mm (0.0041″ to 0.0059″)	0.114 mm to 0.155 mm (0.0045″ to 0.0061″)
Internal Clearance (after assembly)	0.064 mm min. (0.0025″ min.)	0.08 mm min. (0.003″ min.)
Bearing Housing Bore Inside Diameter	260.152 mm +0.102 mm −0.000 mm	215.151 mm +0.025 mm −0.000 mm
	(10.2422″ +0.0040″ −0.0000″)	(8.4705″ +0.0010″ −0.0000″)
Lubricant Capacity		
Bearing Cap	284 g (10 ozs.)	170 g (6 ozs.)
Bearing	369 g (13 ozs.)	113 g (4 ozs.)
Outer Bearing Cover	284 g (10 ozs.)	170 g (6 ozs.)
	Total 937 g (33 ozs.)	453 g (16 ozs.)

COLD RESISTANCE LIMITS (In Ohms At 75° C)

MODEL AR6	Nominal	+4%	-4%
Rotor Collector Ring To Collector Ring	1.020	1.061	0.979
	Nominal	+2%	-2%
Stator Line-To-Neutral Per 5 Phase Group	0.00476	0.00485	0.00466
Stator Line-To-Line Per 5 Phase Group	0.00903	0.00921	0.00885
	Nominal	+8%	-8%
Stator Line-To-Neutral Per Paralleled 10 Phase Group	0.00272	0.00294	0.00250
	Nominal	+5%	-5%
Stator Line-To-Line Per Paralleled 10 Phase Group	0.00497	0.00537	0.00457

MODEL AR10	Nominal	+4%	-4%
Rotor Collector Ring To Collector Ring	1.238	1.288	1.188
	Nominal	+2%	-2%
Stator Line-To-Neutral Per 5 Phase Group	0.00308	0.00314	0.00302
Stator Line-To-Line Per 5 Phase Group	0.00568	0.00579	0.00557
	Nominal	+8%	-8%
Stator Line-To-Neutral Per Paralleled 10 Phase Group	0.00176	0.00190	0.00162
	Nominal	+5%	-5%
Stator Line-To-Line Per Paralleled 10 Phase Group	0.00312	0.00328	0.00296

COLD RESISTANCE LIMITS (CONTINUED)

MODEL AR11			
Rotor Collector Ring To Collector Ring	Nominal 1.238	+4% 1.288	-4% 1.188
	Nominal	+2%	-2%
Stator Line-To-Neutral Per 5 Phase Group	0.000876	0.000890	0.000866
Stator Line-To-Line Per 5 Phase Group	0.00142	0.00145	0.00139
	Nominal	+8%	-8%
Stator Line-To-Neutral Per Paralleled 10 Phase Group	0.000500	0.000545	0.000465
	Nominal	+5%	-5%
Stator Line-To-Line Per Paralleled 10 Phase Group	0.00078	0.00082	0.00074

MODEL AR12			
Rotor Collector Ring To Collector Ring	Nominal 1.48	+2-1/2% 1.52	-2-1/2% 1.44
	Nominal	+2%	-2%
Stator Line-To-Neutral Per 5 Phase Group	0.00242	0.00247	0.00237
Stator Line-To-Line Per 5 Phase Group	0.00444	0.00453	0.00435
	Nominal	+5%	-5%
Stator Line-To-Neutral Per Paralleled 10 Phase Group	0.001380	0.001450	0.001310
Stator Line-To-Line Per Paralleled 10 Phase Group	0.00253	0.00266	0.00240

COLD RESISTANCE LIMITS (CONTINUED)

MODEL AR15	Nominal	+4%	-4%
Rotor Collector Ring To Collector Ring	1.238	1.288	1.188
	Nominal	+2%	-2%
Stator Line-To-Neutral Per 5 Phase Group	0.00300	0.00306	0.00294
Stator Line-To-Line Per 5 Phase Group	0.00555	0.00566	0.00544

MODEL AR16	Nominal	+4%	-4%
Rotor Collector Ring To Collector Ring	1.635	1.701	1.570
	Nominal	+2%	-2%
Stator Line-To-Neutral Per 5 Phase Group	0.001455	0.001484	0.001426
Stator Line-To-Line Per 5 Phase Group	0.002729	0.002784	0.002674

Coupling Disc Torque (Lubricated with Texaco Threadtex)	
Six Bolt Application	2440 N·m (1800 ft-lbs)
Twelve Bolt Application	1830 N·m (1350 ft-lbs)
Engine To Generator Coupling Bolt Nut Torque	400 N·m (295 ft-lbs)

EQUIPMENT LIST

Pyrometer	8364533
Induction Heater	8041446
Stone (1" x 1-1/2" x 5") – 2 required	8204167
Collector Ring Grinder	8219264
Collector Ring Grinder Adapter:	
Small Bearing (215 mm) Generator	8364940
Large Bearing (260 mm) Generator	9506268

NOTE

Two hydraulic pumps are required for bearing removal if rotor shaft has tapped hole for hydraulic bearing removal.

Hydraulic Pump	8174285
Hydraulic Pump Hose Assembly	8152395
Hydraulic Pump Oil, 1 gal.	8246430
Adapter Nipple, 1/8"-27	8458505
Megohmmeter Tester	9548311
High Potential Tester	8324253, 8212404
Aligning Stud (3/4"-10 x 8-1/4")	8458481
Jacking Bolt (3/4"-10 x 5")	8458523
Generator Lifting Shackle – Includes Pin – 2 required	8249739
Shackle Base – 2 required	8072352
Shackle Base Bolts – 8 required	272563
Rotor Shaft Jacking Fixture	*Work Sketch 16288
Grease Contour Mask, Bearing Cap And Cover	*File Drawing 919
End Housing Holding Fixture	*File Drawing 753
Arbor Fixture	*File Drawing 754
Collector Ring, Seals, and Bearing Puller Assembly	*File Drawing 755
Bearing Alignment Disc	*File Drawing 920

* File and work sketch numbers represent facility drawings that are available (at no charge) from EMD Service Publication Department. These drawings include construction details of tooling that can be manufactured by the customer.

MATERIAL LIST

Texaco Threadtex 18.93 liters (5 gallons)	8307731
Red Air Drying Enamel (Water Based)	
.95 liters (1 quart)	8061130
18.93 liters (5 gallons)	8084876
Molykote Lubricant .473 liters (1 pint) paste	9517921
Bearing Lubricant	Esso Unirex N-2
13.61 kg (35 lb)	9507146
54.43 kg (120 lb)	9507147