M.I. 3328 *REV. A

Maintenance Instruction

Service Department

ELECTRO-MOTIVE

AC SYNCHRONOUS GENERATORS WITH BRUSHLESS EXCITERS - MODELS A33, AB20, AB21 AND AB22

INTRODUCTION

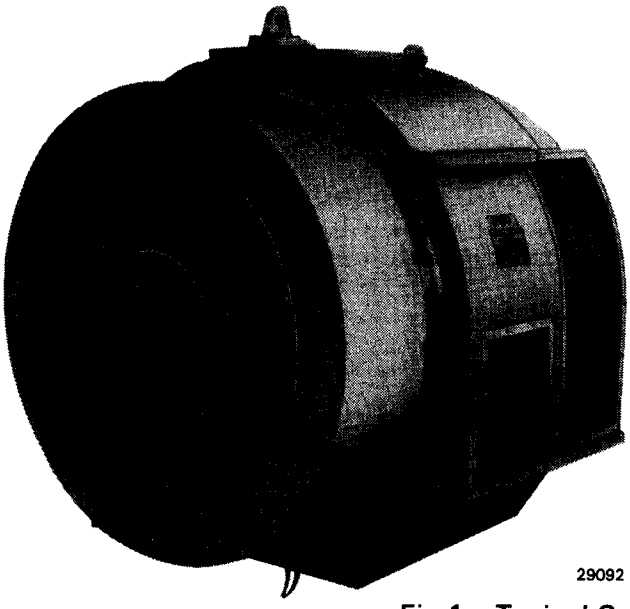
The information contained in this Maintenance Instruction applies to alternating current synchronous generators with brushless exciters, Fig. 1, manufactured by Electro-Motive.

The generators are all single bearing type with the rotor shaft directly connected to the engine crankshaft through a flexible coupling. The shaft is supported at the outboard end by a single, grease lubricated, self-aligning bearing assembled in an end housing which is, in turn, bolted to the main frame of the generator assembly.

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

The stator frame and core assembly, utilizing welded construction, provides a rigid structure which houses the stator windings and supports the end frame housing.

This generator design incorporates an integral brushless exciter and rectifier assembly to provide main field excitation. The exciter armature and the rotating rectifier assembly are on the generator shaft and the exciter field is mounted within the generator end housing.



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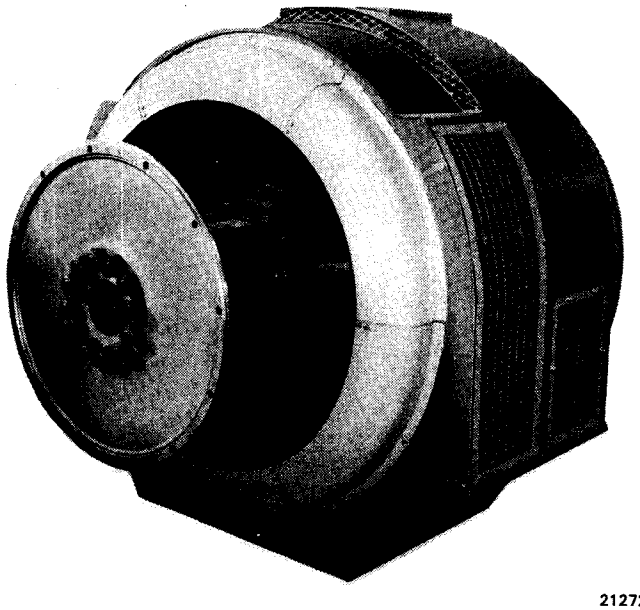

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Fig.1 - Typical Synchronous Generator

*This bulletin is revised and supersedes previous issues of this number. Areas of change are indicated by vertical bars.

The generators are cooled either by fan blades mounted to the rotor spider or by an external blower. In some cases a combination of both is utilized.

BRUSHLESS EXCITER

The main generator is supplied excitation power from a brushless exciter mounted inside the generator housing.

The exciter is an AC generator with its field assembly bolted to the main generator end housing and its armature on the main shaft. The AC output of the exciter is applied to a rectifier assembly that converts it to DC for main generator excitation. The exciter can provide DC power output (after rectification) of 17 kW at 170 volts to the main generator field (rotor).

The output voltage of the main generator is regulated by a voltage regulator which controls the exciter field voltage.

EXCITER FIELD

The exciter field assembly, Fig. 2, consists of 12 field coils connected in series inside of a laminated steel stack assembly that is mounted in the end housing of the main generator. The exciter field is connected to the voltage regulator which supplies its field voltage.

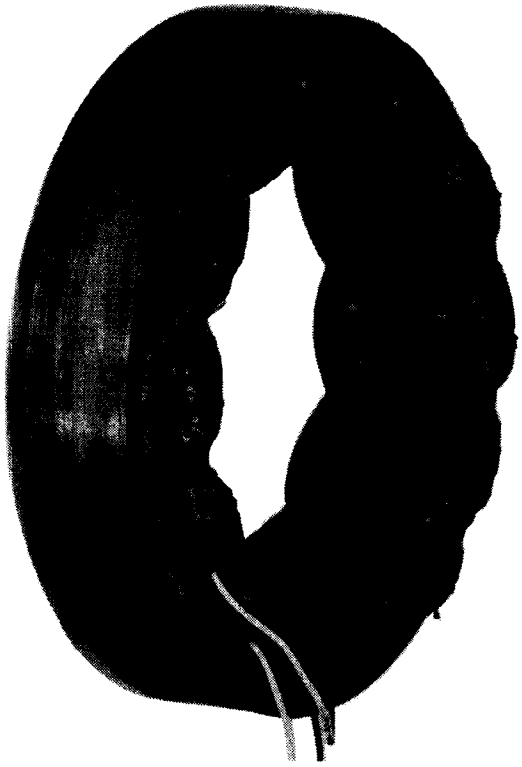

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Fig.2 – Exciter Field

EXCITER ARMATURE

The exciter armature, Fig. 3, is constructed of conventional coil groups mounted on an assembly of stacked steel laminations which is keyed to the main generator shaft. The coils are wye-connected, three-phase, three-wire. The output of the exciter is taken from the armature and rectified by the rotating rectifier assembly.

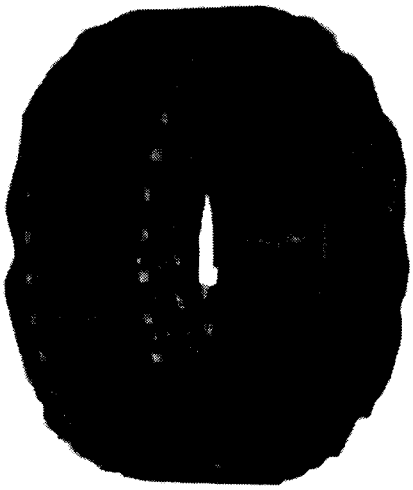

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Fig.3 – Exciter Armature

RECTIFIER ASSEMBLY

The exciter rectifiers, Fig. 4, are installed on a circular printed circuit board assembly (one piece on early models – two piece split ring design on later models or units with service replacement assemblies). The rectifier assembly is mounted on a sleeve which is keyed to the main generator shaft. The rectifier assembly incorporates a surge protection system that functions only when needed.

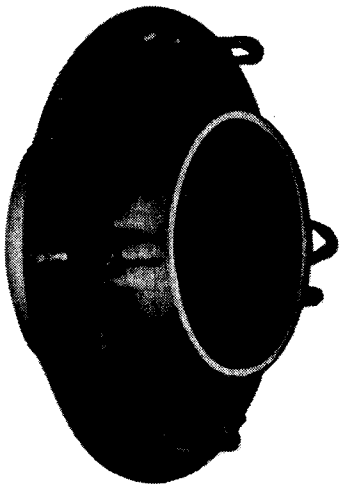

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Fig.4 – Typical Rotating Rectifier Assembly w/Spacer Sleeve (One Piece Early Model Shown)

MAINTENANCE

These generators are 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 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. 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.

RECTIFIER REPLACEMENT

Late model generators are equipped with two-piece split ring design rectifier assemblies, Fig. 5, to facilitate removal for maintenance without major generator disassembly. Early model generators with one-piece rectifiers can be retrofitted with a service replacement two-piece rectifier using existing mounting hub (sleeve) and spacer sleeve.

1. Remove rodent screens or louvered access covers from generator end housing and bar engine over to locate field leads (F+ and F–). Mark lead positions on rotor spider hub for reassembly indentification, then disconnect both leads from rectifier.

2. Bar engine over as necessary for access to three exciter armature leads and disconnect each from rectifier assembly.

NOTE

If generator is equipped with two-piece split design rectifier, disregard Steps 3 and 4 following, and proceed with Step 5.

3. On units with old style one-piece rectifier assemblies, bar engine over to a position where cluster of small resistors on rotor side of rectifier is accessible. Using a sharp chisel and an appropriate hammer, cleave inward through rectifier circuit board until it is split through to mounting bolt.

4. At a position 180° from the split made in Step 3, similarly cleave through circuit board to mounting bolt.

5. Remove all four rectifier to hub (sleeve) mounting bolts and separation line attachment bolts, locknuts, and washers to separate halves of rectifier assembly for removal from generator.

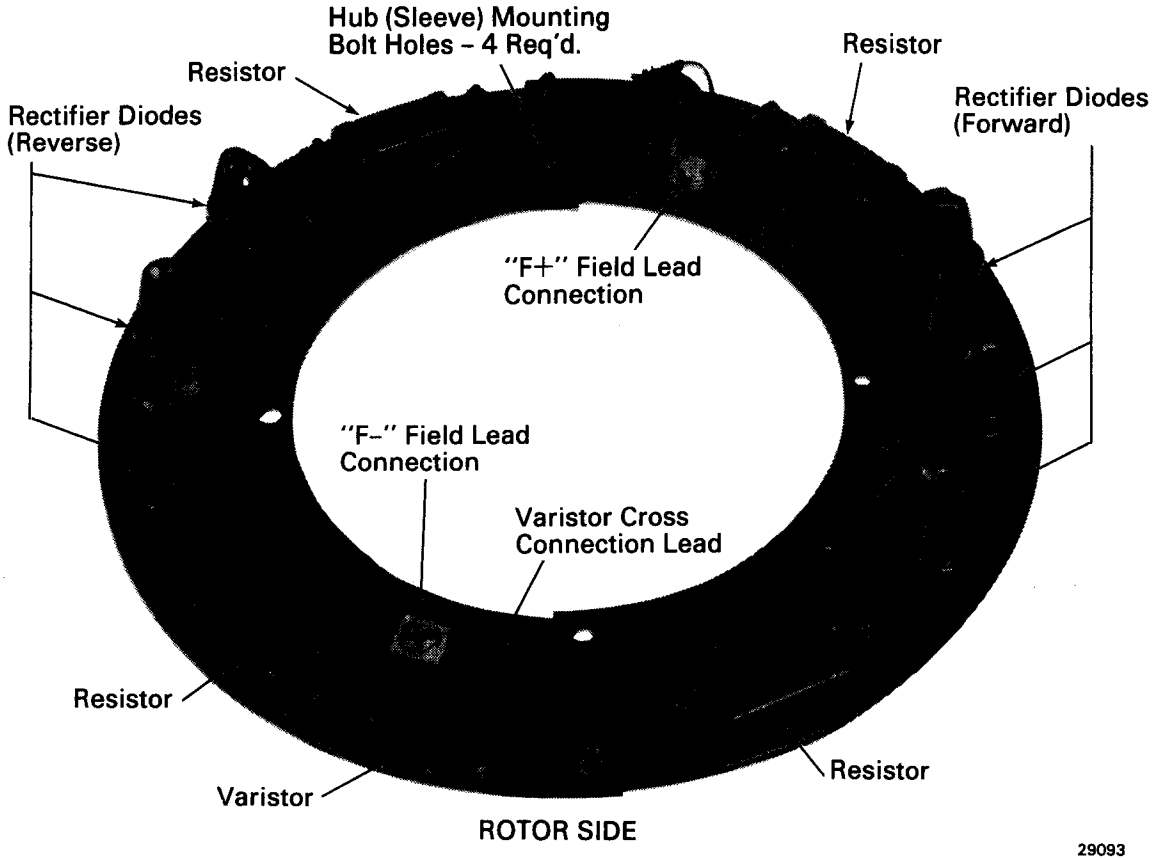
6. To install new rectifier, separate assembly into two halves by removing necessary hardware and cross connecting wires – including three exciter armature connections from the half with the F+ terminal and one varistor suppression lead from the half with the F– terminal.

7. Mount the rectifier half with the F+ terminal oriented to the F+ lead position marked on the rotor hub in Step 1 above, with semiconductors facing the rotor.

8. Mount remaining half with F– terminal similarly, making sure pieces properly overlap at separations.

9. Apply four rectifier to hub mounting bolts and separation line attachment bolts, locknuts and washers removed in Step 5, and remaining hardware and cross connecting wires removed in Step 6. Tighten mounting bolts and screws securely.

10. Connect the three exciter armature leads to the terminals marked "A" on the bearing side of the rectifier. If necessary, re-form leads to press against rectifier mounting hub and replace



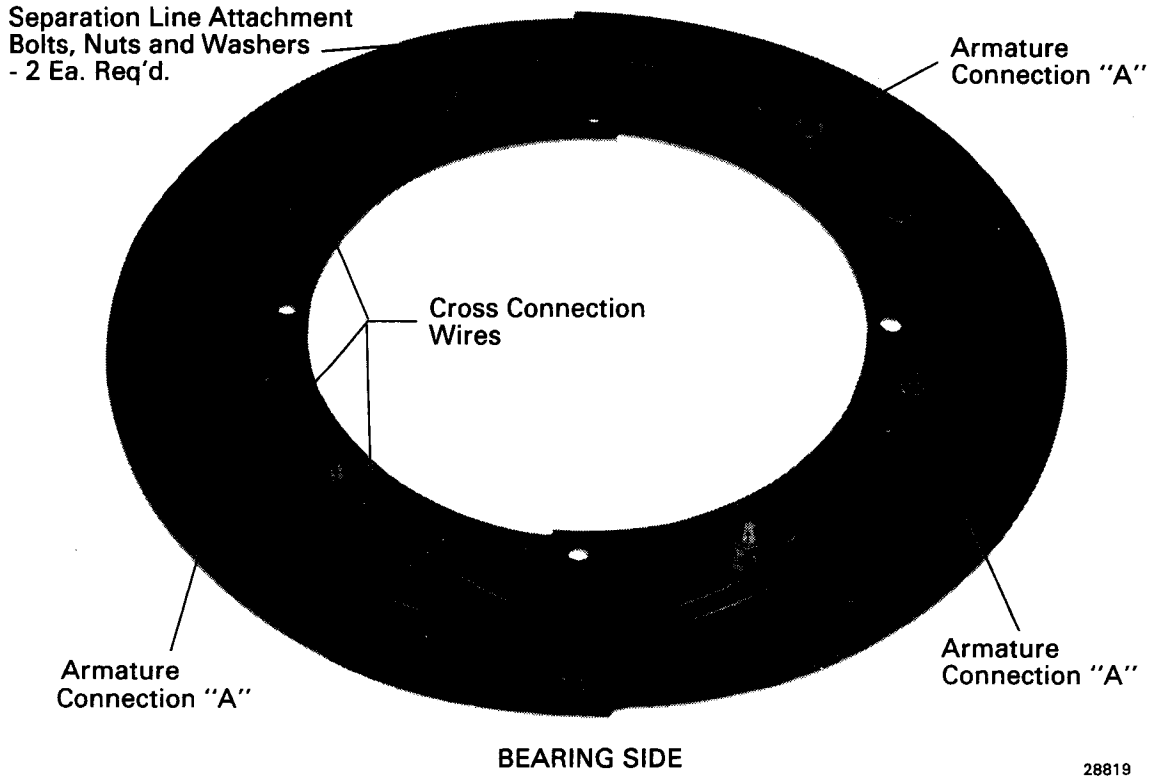


Fig.5 – Two Piece (Split Ring) Rotating Rectifier Assembly

cable tie 8428101, if removed. Tighten terminal lug bolts to a torque of 2.8 to 4.5 N·m (25 to 40 in.-lbs).

CAUTION

Make sure the lead terminals are not contacting any of the components mounted on the rectifier assembly.

11. Connect field leads (F+ and F–) to terminals similarly marked on rotor side of rectifier. If necessary, re-form leads to press against spacer sleeve and replace cable tie 8428101, if removed. Check to be sure leads are not applying stress to the rectifier, then tighten terminal lug bolts to a torque of 2.8 to 4.5 N·m (25 to 40 in.-lbs).

12. Bar engine over several times and check to be sure no conductors are dragging or otherwise making contact with metal parts. Replace rodent screens or louvered access covers.

REPACKING BEARING

A grease lubricated, self-aligning bearing is assembled into an insulated bearing 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 or bearing being loose on shaft.
4. Actual bearing failure caused by bearing fatigue or wear.

The bearing requires lubrication at intervals recommended in the Scheduled Maintenance Program. If generator is removed from installation, follow lubrication instructions in the Disassembly Of Generator section. Use the following procedure to lubricate bearing while generator is in place.

1. Remove 1/2"–20 bolts that secure bearing outer cover to end housing assembly, Fig. 6. Remove cover and gasket by tapping with a rawhide mallet or similar tool.

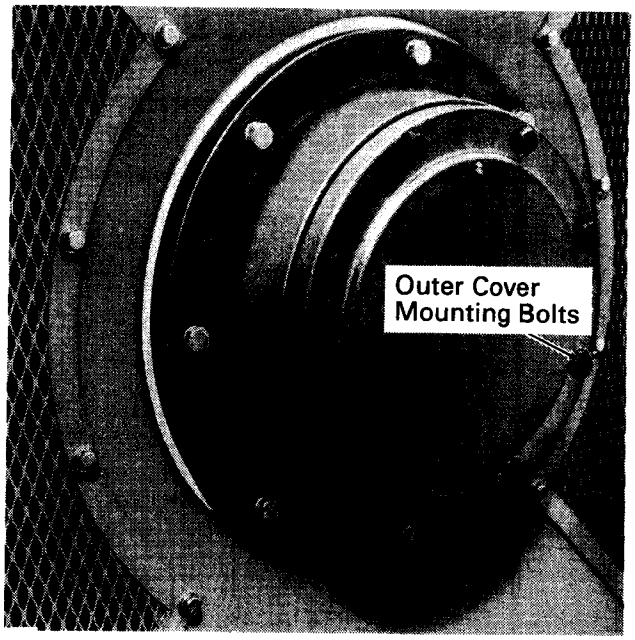


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Fig.6 – Bearing Outer Cover

2. Inspect grease in bearing cover and inspect exposed side of bearing. Look for metal particles in grease, excessive wear in the housing of the bearing, fatigue damage on rollers or roller path, or evidence of overheating. Replace bearing with a new bearing, if required, and replace any associated parts found in distress. Refer to Disassembly Of Generator section to replace bearing parts.

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

4. Weigh the piece of paper that will be used in handling grease to fill bearing cover. Weight of the paper must be compensated for when weighing grease.

5. Carefully weigh amount of grease needed to fill bearing cover. Refer to Service Data for proper quantity.

CAUTION

Esso Unirex N-2 grease must be used exclusively, not mixed with other lubricants. Adequate lubrication depends upon precise weight of grease. Too much grease is as detrimental to bearing life as too little.

6. Pack grease into bearing cover, Fig. 7. To limit churning and liquefaction, the arc of the grease should include the lower 240° to 270° of the

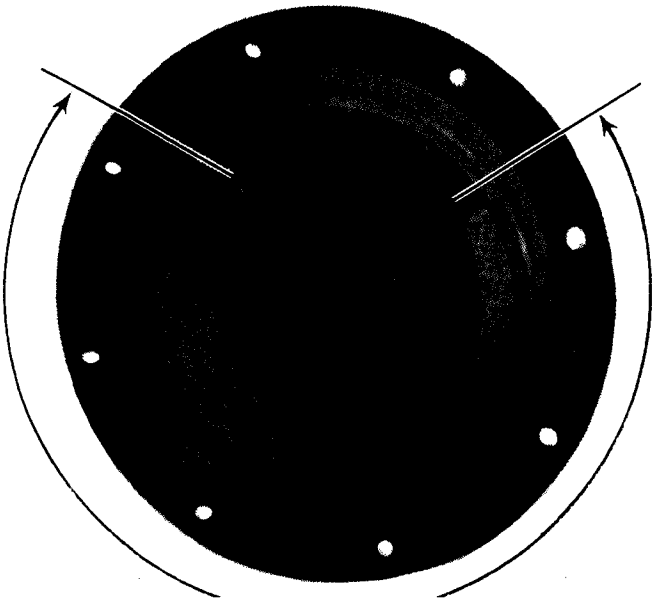

Fig.7 – Position Of Grease

cover. Keep the ungreased portion at top of cover when assembling to end housing. Form grease to proper contour as shown in Fig. 8.

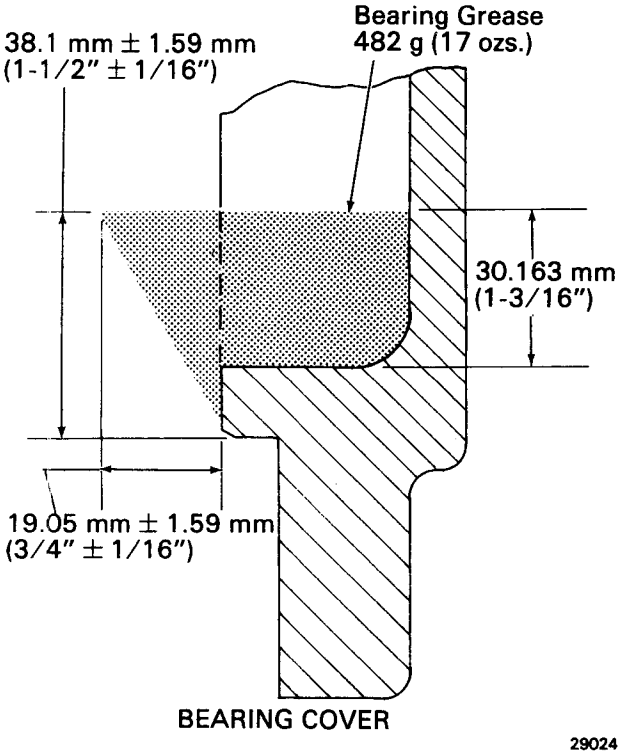

Fig.8 – Grease Contour

7. Remove old grease from exposed side of bearing and as much as possible from between rollers and cage. Use a putty knife and fingers only. Do not use solvent to remove grease.

8. Repack all spaces on exposed side of bearing with fresh grease, Fig.9.

CAUTION

Take extreme care to ensure that no foreign material gets into grease or bearing parts while disassembled.

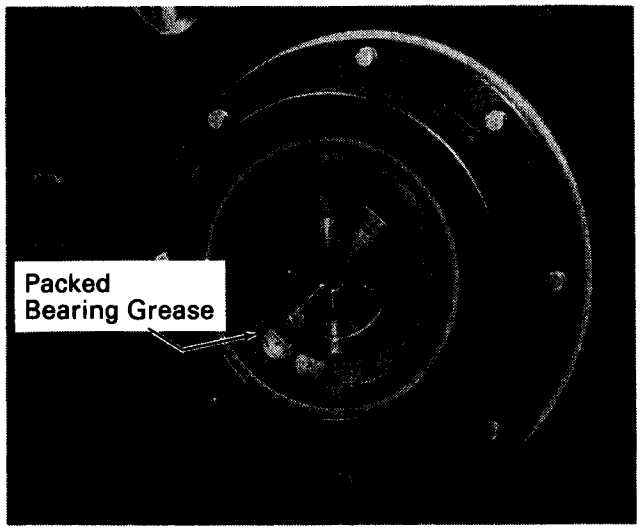

Fig.9 – Repacking Bearing

9. Install greased bearing cover with a new gasket. Position cover so that ungreased portion is at the top of cover, Fig. 10. Tighten bearing cover bolts to 68 to 75 N·m (50 to 55 ft-lbs).

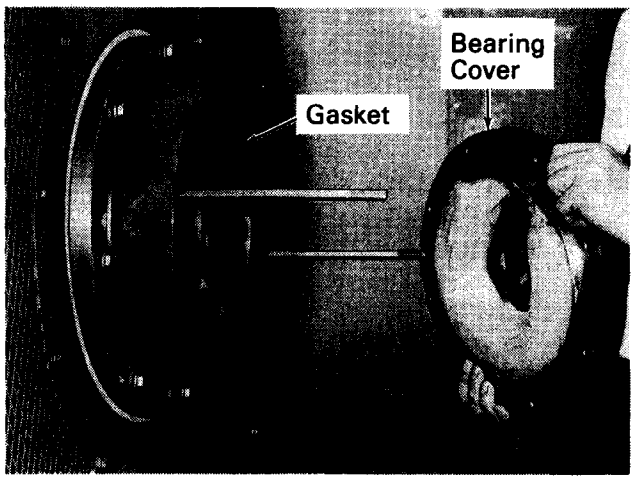

Fig.10 – Applying Outer Bearing Cover

DISASSEMBLY OF GENERATOR

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 removed 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 assembly and stator coils.

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

The following procedure should be used when disassembling the generator:

1. Mount generator on a sturdy stand at a suitable working height from the floor.
2. Remove all rodent screens or louvered access covers from generator assembly.
3. Remove cleat assemblies that secure stator leads to end housing.
4. Apply an arbor fixture (File Drawing 754) to the rotor spider coupling, Fig. 11. Attach crane cable to end of fixture.

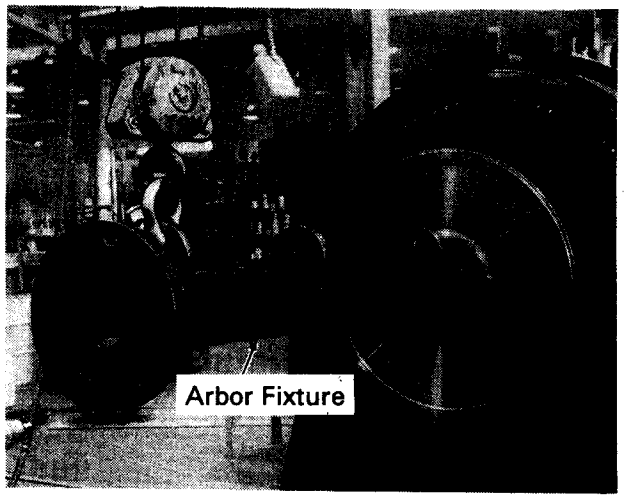

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Fig.11 – Application Of Arbor Fixture

5. Support end housing with another crane cable and remove eight 3/4″–10 bolts securing end housing to stator frame, Fig. 12.

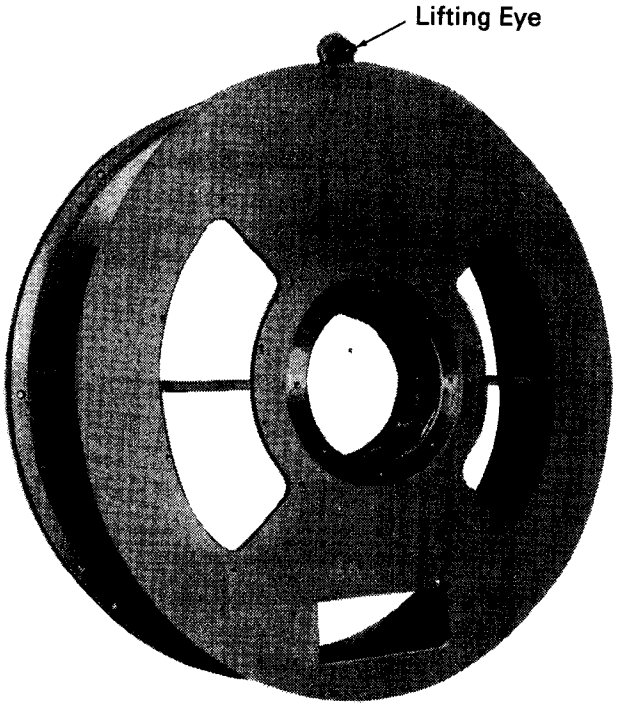

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Fig.12 – Attaching Crane Cable To End Housing

6. 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.
7. Raise arbor fixture until air gap is equal around circumference of rotor.
8. Using a second crane, raise front end until cable is taut.

CAUTION

Use extreme care to ensure that laminations or windings are not damaged when removing rotor.

9. Carefully remove rotor and end housing assembly from stator, moving it towards bearing end of assembly until it clears stator, Fig. 13.
10. Place rotor assembly on a cradle stand, Fig. 14, with strips of fish paper between rotor and cradle.
11. Remove 1/2″–20 bolts that secure bearing cover to end housing assembly, Fig. 15. Remove cover and gasket by tapping with a rawhide mallet or similar tool.

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Fig.13 – Removing Rotor From Stator

CAUTION

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

12. Slide end housing off bearing.

13. Remove four 5/8″–11 bolts that secure bearing retainer plate to rotor shaft, Fig. 15. Remove retainer plate.

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

    a. Clean threads and pressure fitting seat in tapped hole.

    b. Thread a 1/8″–27 NPT adapter nipple into tapped hole and tighten.

    c. Connect hydraulic pump, Fig. 16, to adapter nipple. Refer to Service Data for information concerning tools.

15. Pump up hydraulic pressure to expand inner race. Maintain pressure while performing Step 16.

16. Using a locally fabricated bearing puller, Fig. 17, remove bearing. Make certain that puller is pulling equally on all studs to prevent damage to bearing cap or bearing.

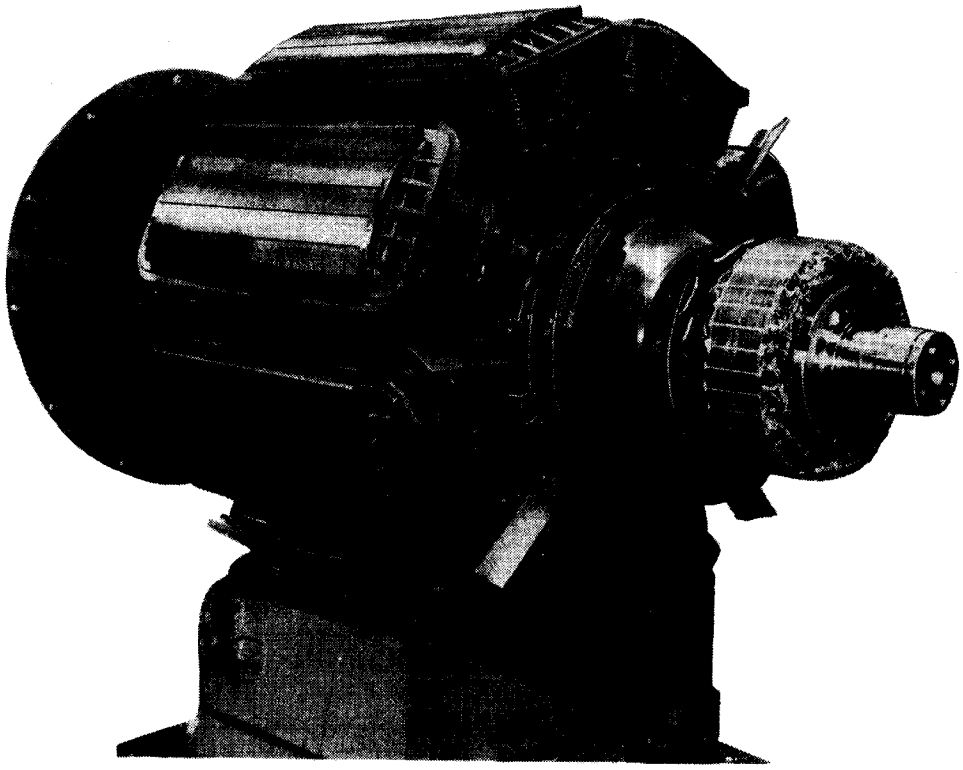

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Fig.14 – Typical Rotor Assembly Removed From Stator

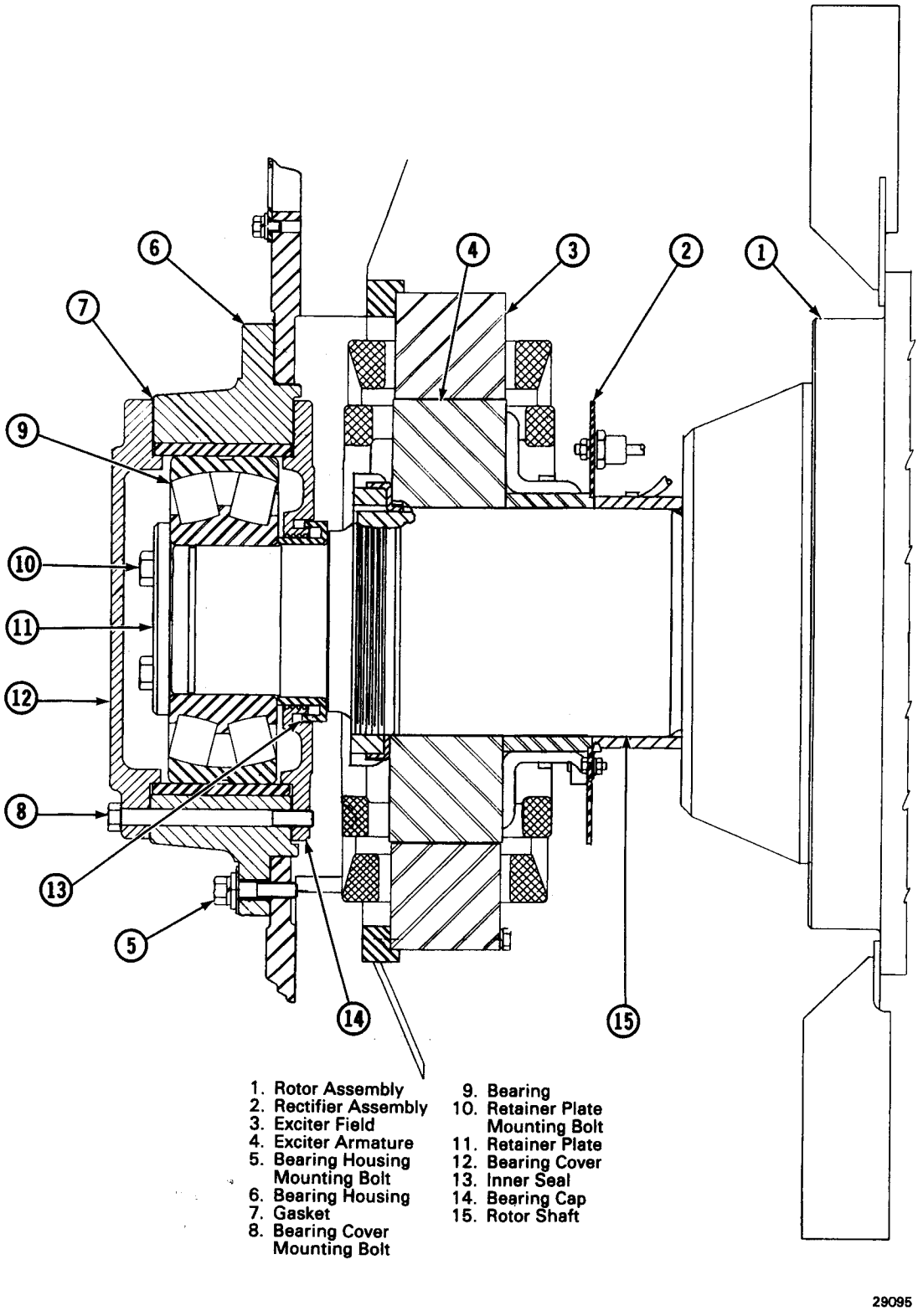


Fig.15 – Cross-Section Of Generator End Bearing

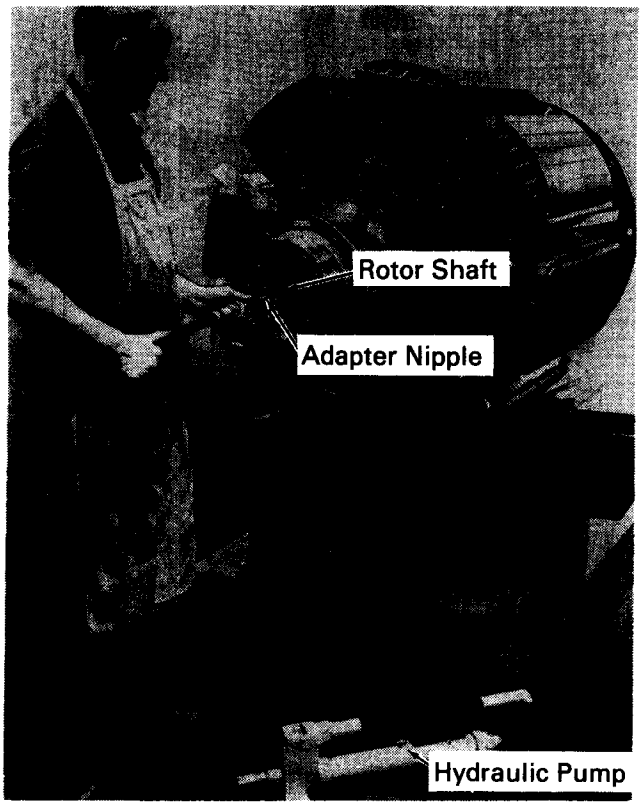


Fig.16 - Preparation For Removal Of Bearing

DISASSEMBLY OF BRUSHLESS EXCITER AND ROTATING RECTIFIER ASSEMBLY

NOTE

The rotating rectifier assembly consists of solid state components on a circular printed circuit board assembly mounted to a cylindrical metal sleeve. This sleeve is keyed to, and rotates with, the rotor shaft.

1. Disconnect the three exciter armature leads at the rotating rectifier assembly. Disconnect the F+ and F- field leads at the rotor field coil terminal and at the rotating rectifier assembly.

2. Unbolt the cable clamp from the rotor spider hub and remove the plastic insulation paper from the field leads.

3. Cut off the cable ties securing the three armature leads and the F+ and F- leads to the rectifier and spacer sleeves.

4. The lockwasher tang must be bent towards the vertical to disengage the locknut.

*NOTE
Use studs in all eight bearing cap mounting holes. Ensure puller is pulling equally on all studs to prevent damage to bearing parts due to unequal distribution of stress.

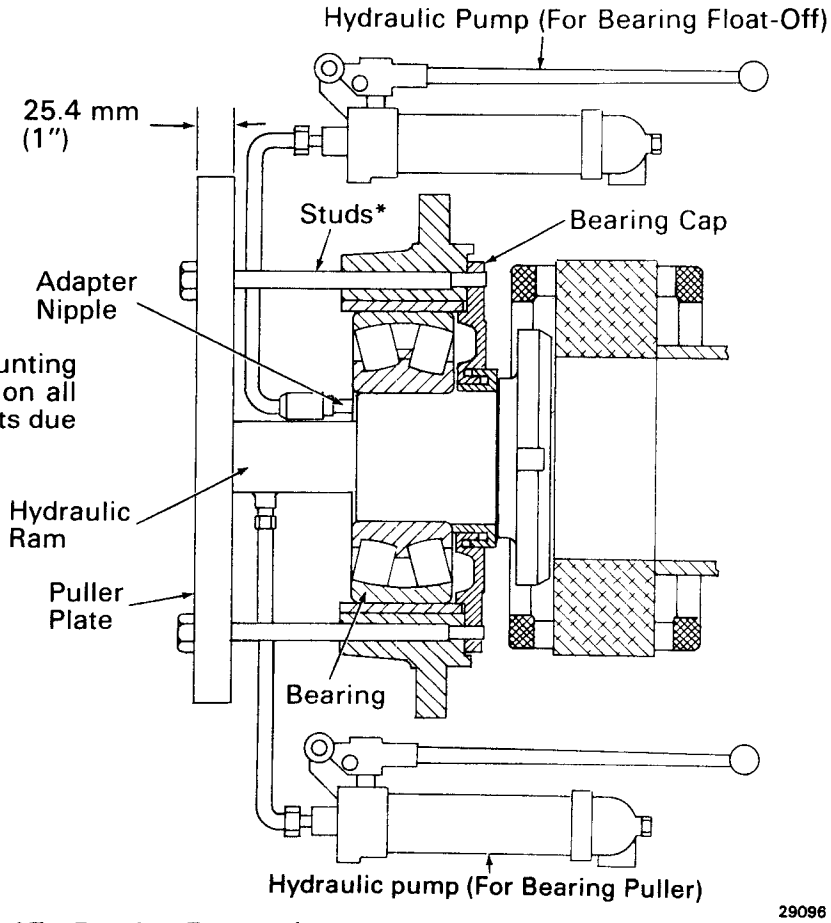


Fig.17 - Bearing Removal

5. Loosen the locknut with special spanner wrench (File Drawing 907).

CAUTION

Make sure that the spanner wrench clears the armature winding so that the armature is not damaged when removing the locknut.

6. Remove the locknut and lockwasher.

7. Slide exciter armature off of rotor shaft.

8. Slide rectifier assembly off of rotor shaft.

9. Remove key from rotor shaft.

10. Slide rectifier spacer sleeve off of rotor shaft.

11. Inspect exciter armature and rectifier assembly for physical damage.

12. Use an ohmmeter to measure the exciter armature resistance. This is performed by measuring between the three armature leads, two leads at a time. Resistance values are provided in the Service Data. If the resistance reading is not approximately equal to the values listed, then the exciter armature is defective.

13. Use an ohmmeter to measure the exciter field resistance. This is performed by measuring between the F+ and F– lead. Resistance values are provided in the Service Data.

BEARING INSPECTION

Bearing parts should be thoroughly inspected for possible evidence of impending failure. If the parts show signs of distress, they should be renewed. The following procedure is helpful in inspecting bearing parts.

CLEANING

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

NOTE

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

WEAR

Properly lubricated bearing parts 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 on the unloaded side. Do *not* roll a feeler through a bearing. For limits, see Service Data.

FATIGUE FAILURE

Signs of bearing fatigue will most usually appear on the bearing surface. Fatigue failure is usually evidenced as ragged craters, and may be of any size. Any bearing part showing signs of cracks or craters of any size, regardless of how small they may be, should be renewed.

This type of failure is more likely to occur on either the rollers or inner race.

DENTS

Dents are caused by hard particles of foreign matter being rolled between the races and rollers, causing slight depressions where the bearing surfaces have been permanently deformed. They are distinguished from fatigue failures by their smooth surface with a slightly raised edge around the dent.

Small dents in themselves cause little damage and are usually evident on bearings which have been run. However, should the bearing show signs of more than normal distress, and should there by any question as to whether they are dents or fatigue failures, or should there be any doubt as to their effect on the life of the bearing, the bearing should be renewed.

SCRATCHES

In general, scratches due to mishandling are not serious provided they are small.

Scratches on the bearing surface, parallel to the length of the bearing are more serious than those at an angle. Sometimes scratches are difficult to differentiate from cracks and, for this reason, if there is any doubt as to their character, they should be treated as cracks due to fatigue failure.

HEAT

Any bearing showing evidence of having been overheated should be renewed.

CAGES

Bearing cages with excessive wear should be renewed.

ELECTRICAL INSULATION TEST

Before the generator is assembled, it is advisable to electrically qualify the stator, exciter, and rotor. Use the following steps to qualify the generator parts.

1. Stator, exciter, and rotor must be clean.

CAUTION

The rotating rectifier assembly has five leads connected to it. The three leads connected to the disc on the exciter side are from the exciter armature. The two leads connected to the disc on the main field side are the main generator field leads (F+ and F–).

Before performing an electrical insulation test all five of the leads connected to the rectifier disc must be short circuited simultaneously. This can be done by jumpering together all five terminals where the leads connect to the disc. A simple jumper can be made by connecting five alligator clips to a single length of wire.

After the short circuit is completed, perform an electrical insulation test on the main machine field, main machine stator, and exciter field.

2. Stator, exciter, and rotor must show a steady insulation resistance reading for at least three hours at any given temperature.

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.

4. The insulation resistance of the rotor must be not less than one megohm at any temperature.

Any stator, exciter, 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.

NOTE

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

5. The insulation resistance between the end housing and the bearing housing should be at least one megohm.

6. Take resistance readings of rotor, exciter, and stator. Refer to Service Data.

ASSEMBLY OF GENERATOR

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. Refer to Service Data.

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

ROTATING RECTIFIER ASSEMBLY AND EXCITER ARMATURE MOUNTING TO ROTOR (Fig. 18)

NOTE

The rotating rectifier assembly consists of solid state components on a circular printed circuit board assembly which is mounted to a cylindrical metal sleeve. The metal sleeve is keyed to, and rotates with, the rotor shaft.

1. The rotor shaft must be free of any irregularities that will prevent a slip fit for the rotating rectifier sleeve and exciter armature assemblies. Make sure that the key fits into the keyway. Check the threads on the rotor shaft and make sure that the locknut screws on and off by hand.

CAUTION

The rotating rectifier assembly is vulnerable to damage and must be handled carefully.

2. Make sure that the key fits the keyway in the rectifier sleeve and that both ends of each sleeve are free of nicks, burrs, or foreign material. The rectifier sleeve seats against the spacer sleeve which in turn seats against the rotor spider hub face. The exciter armature core then assembles against the rectifier sleeve.

CAUTION

Attempt to slide the spacer sleeve and the rectifier assembly over the rotor shaft without forcing them. If they slide on with minimal effort, then proceed with the assembly operation Step 3. If the rectifier assembly or spacer sleeve do not slide easily on the shaft, then the sleeves must be heated in a convection oven to a temperature of 150° C (300° F) maximum before proceeding with the assembly operation.

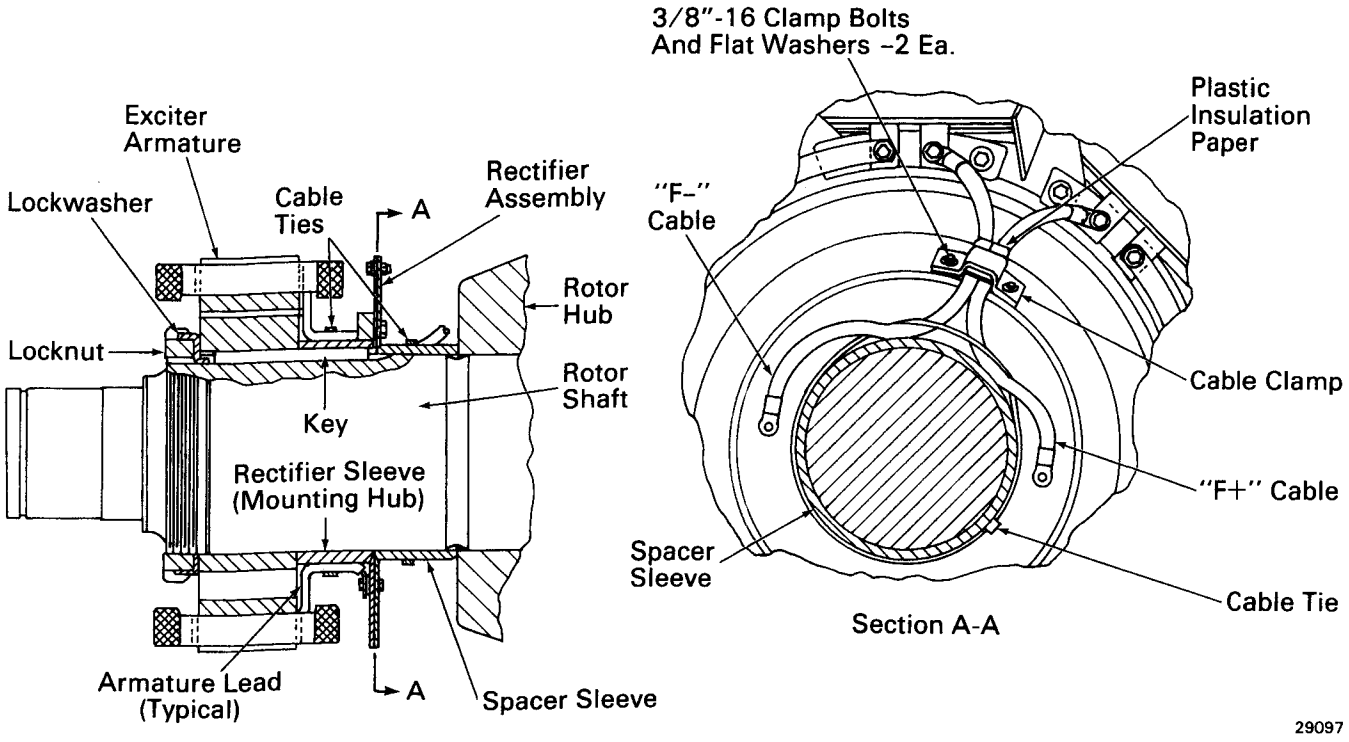


Fig.18 - Rotating Rectifier Assembly And Exciter Armature Mounting To Rotor

NOTE

If rectifier assembly requires heat for application, remove rectifier from sleeve and heat sleeve only. One piece rectifiers must be slid on to spacer sleeve before application of rectifier sleeve. Two-piece rectifiers can be applied at any convenient point in the assembly process.

3. Slide spacer sleeve over the shaft until it is tight against the rotor spider hub. If sleeve was heated, then hold it against the rotor hub until it shrinks in place.

4. Line up the rectifier sleeve keyway with the shaft keyway. Install the key and slide the rectifier sleeve over the shaft until it is tight against the spacer sleeve. If the assembly was heated, then hold the sleeve against the spacer sleeve until it shrinks in place. Re-apply one piece rectifier to sleeve (if used).

5. Make sure that the bore, keyway, and laminated core surfaces at both ends of the exciter armature are free of burrs, insulating resin, or any foreign material.

CAUTION

Attempt to slide the exciter armature over the rotor shaft without forcing it. If it slides on with minimal effort, then proceed with the assembly operation Step 6. If the exciter armature does not slide easily on the shaft, then it must be heated in a convection oven to a temperature of 150° C (300° F) maximum before proceeding with the assembly operation.

6. Line up the keyway with the key in the shaft and rectifier sleeve keyway. Slide the exciter armature on the shaft until it is tight against the rectifier sleeve. If the armature was heated, then hold it against the rectifier sleeve until it shrinks in place.

CAUTION

Make sure the three exciter armature leads are not pinched between the armature core and rectifier sleeve.

7. Apply Texaco Threadtex (8307731) to shaft and locknut threads, then immediately apply the lockwasher and locknut on the shaft. Insert the driving keys of special spanner wrench (File Drawing 907) into key slots of locknut.

CAUTION

Make sure the wrench clears the armature winding so the winding is not damaged during the locknut tightening operation.

8. Apply repeated impact blows with a 4.5 kg (10 lb) sledge hammer (copper head) against the spanner wrench handle about 356 mm (14 inches) from the center of rotation. Continue the blows until the reaction on the spanner wrench feels and sounds solid.

9. If armature was heated, then allow it to cool to room temperature. Retighten further until one of the locknut slots line up with a lockwasher tang.

   Use special tool (File Drawing 908) to bend lockwasher tang into locknut slot. Wipe off excess Threadtex.

10. Apply two-piece split ring rectifier assembly (if used) to rectifier sleeve. Connect the three exciter armature leads to the rectifier assembly. The leads should be formed so they press against the rectifier sleeve where they will be secured tightly with cable tie 8428101. The terminal lugs of these leads should be bolted to the rectifier with a torque of 2.8 to 4.5 N·m (25 to 40 in.-lbs).

CAUTION

Make sure the lead terminals are not contacting any of the components mounted on the rectifier assembly.

11. Apply the F+ and F– cables. Form these cables so they press against the spacer sleeve where they can be secured tightly with cable tie 8428101 in a manner which does not apply stress to the rectifier. Tightly wrap plastic insulation paper around field leads. Apply clamp over insulated leads to rotor spider hub. Center the insulation paper under the clamp. Apply a torque of 2.8 to 4.5 N·m (25 to 40 in.-lbs) to the rectifier connections and 13.6 to 20.3 N·m (10 to 15 ft-lbs) to the rotor field coil terminal block connections.

BEARING AND END HOUSING

Refer to following procedure to assemble bearing and end housing:

1. Clean rotor shaft. Remove any burrs or gall marks.

CAUTION

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

2. Using an induction heater (see Service Data), heat the inner oil seal to a temperature of 120° C (248° F). Use a pyrometer (see Service Data) to obtain temperature readings. Take pyrometer readings only when heater current is off.

3. After heating, place inner seal on shaft, Fig. 15. Hold in place until cooled to room temperature.

4. Apply grease (see Service Data) to clean bearing cap and cover. Refer to following procedure:

   a. Weigh piece of paper that will be used in handling grease to fill bearing part. Weight of paper must be compensated for when weighing grease.

   b. Carefully weigh amount of grease needed to fill bearing part. Refer to Service Data for proper quantity.

CAUTION

Esso Unirex N-2 grease must be used exclusively, not mixed with other lubricants. Adequate lubrication depends upon precise weight of grease. Too much grease is as detrimental to life of bearing as too little.

   c. Pack grease into bearing part, Fig. 19. To limit churning and liquefaction, the arc of the grease should include lower 240° to 270° of bearing part. Keep ungreased portion at top of greased part when assembled on generator.

   d. Form grease to proper contour as shown in Fig. 20. Work grease into bearing cap and cover, making sure that no air pockets or voids exist in grease.

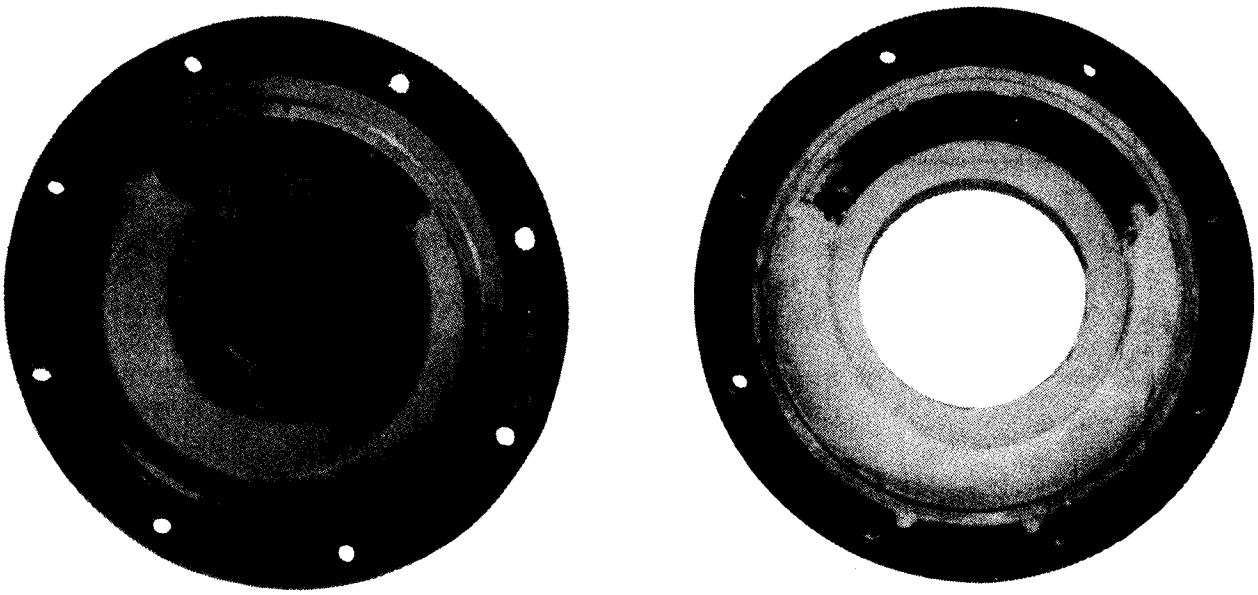
   e. Fill all labyrinth grooves in bearing cap, Fig. 20, flush with grease. This grease need not be weighed.

CAUTION

Voids or pockets in the grease will cause grease to lose its contour and pull away from bearing during operation. This could result in bearing failure.

5. Place freshly greased bearing cap squarely on rotor shaft, Fig. 21. Keep ungreased portion at the top of cap when assembling.

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



BEARING COVER 8700 BEARING CAP 29098

Fig.19 – Properly Greased Bearing Cover And Cap

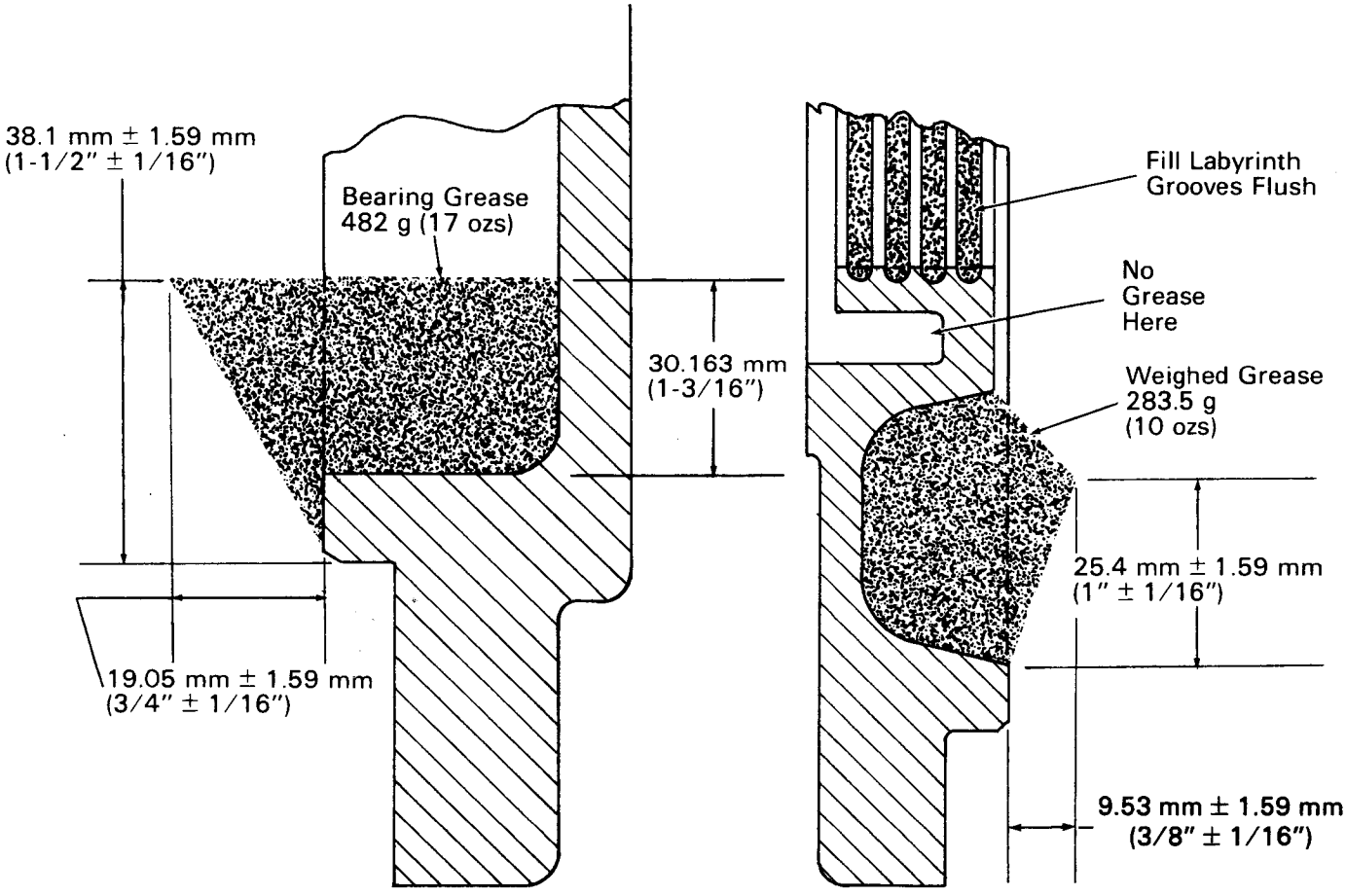
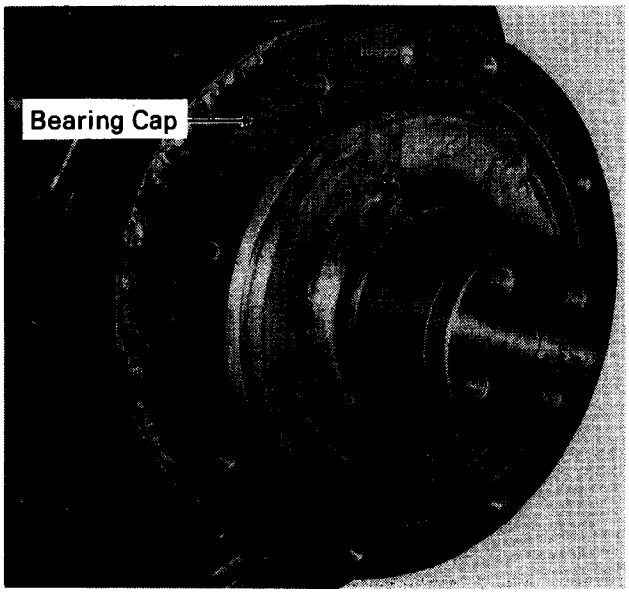


Fig.20 – Grease Contours



24472

Fig.21 - Bearing Cap Application

6. Pack bearing with 368.6 g (13 ozs.) of grease. Bearing rollers and space between the two rows of rollers must be full. Use full amount of grease specified. Work grease uniformly into bearing.

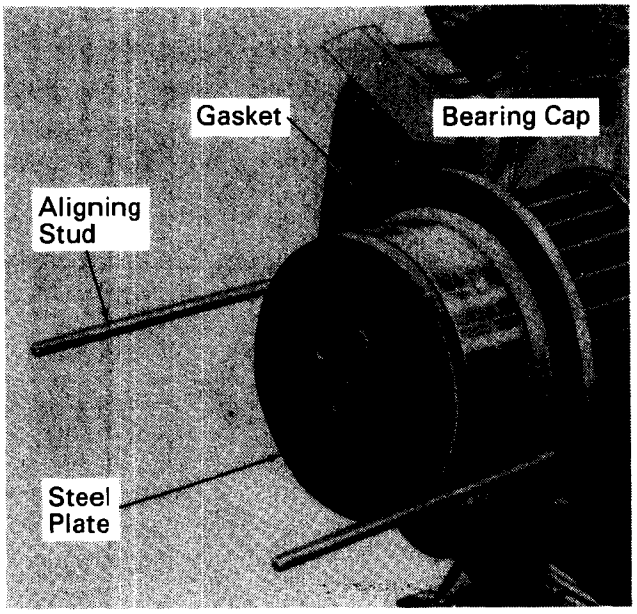
7. Heat roller bearing with an induction heater to 104° C (220° F). Take pyrometer readings (with heater current off) at outside face of inner race only (See Caution before Step 2). Shrink bearing to shaft with the bearing part number toward the outside. Do *not* cock the bearing when placing it on shaft. Use a brass pipe to push bearing on shaft up to and against inner oil seal. Let bearing cool to room temperature.

8. Apply two studs 180° apart to the threaded nut inserts in the bearing cap, Fig. 22. The purpose of these studs is to line up the bearing cap with the end housing assembly. The studs will be removed later.

9. Place a new gasket over the alignment studs and up against the face of the bearing cap, making sure all holes line up, Fig. 22.

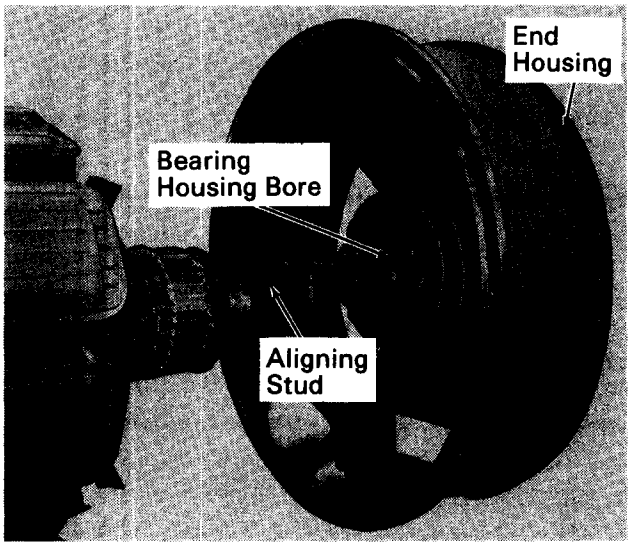
10. Apply one coat of Molykote (see Service Data) to bearing housing bore, Fig. 23. Make certain bore is clean, dry, and free of any oil or grease.

11. Before assembling end housing to the bearing, a steel plate should be bolted to the end of the rotor shaft, Fig. 22. Use the tapped holes that normally hold the retaining plate mounting



29100

Fig.22 - Application Of Aligning Studs



24474

Fig.23 - Mounting End Housing

bolts. The purpose of this plate is to prevent the outer race of the bearing from cocking as the end housing is pushed over the bearing. In constructing the steel plate, its diameter should be made slightly smaller than the outside diameter of the bearing so it will not interfere with the bearing sliding into the housing bore.

12. With the end housing hanging in position and the bore of the bearing housing level with the outside diameter of the bearing, position the bearing cap so the bottom of the cap lines up with the bottom of the housing. Keep ungreased portion at top of cap.

13. Line up the two studs in the bearing cap with the proper holes in the end housing, Fig. 23.

14. Bring the housing slowly up to the bearing, being careful not to cock the bearing in the end housing bearing bore. If properly lined up, the bearing housing will slide freely onto the bearing and against the bearing cap.

15. Remove the temporary steel plate bolted to the end of the rotor shaft.

16. With bearing assembled to shaft and the end housing on bearing, check bearing roller clearance. Pass a feeler gauge between the rollers and race on the unloaded side (see Service Data for limits).

17. Using four 5/8″–11 bolts, mount bearing retainer plate to end of rotor shaft, Fig. 15. Torque bolts to 149 to 163 N·m (110 to 120 ft-lbs).

18. Before removing aligning studs place freshly greased bearing cover with a new gasket into position. Keep ungreased portion at top of cover. Install six bolts in the bearing cover hand tight.

19. Remove two aligning studs and install the two remaining bearing cover bolts. Torque all cover mounting bolts to 68 to 75 N·m (50 to 55 ft-lbs).

20. To check end play or lateral movement of the bearing in its housing, perform the following steps:

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

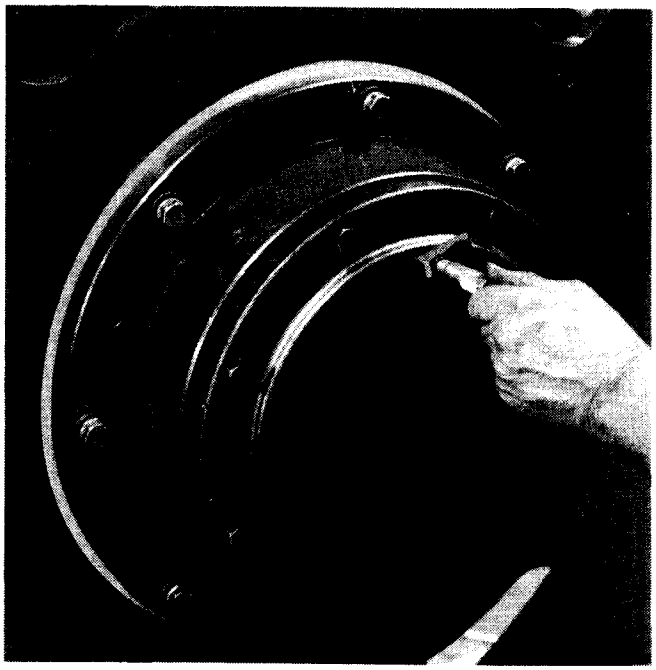
    b. Remove the brass plug from the bearing cover and measure the distance from the outside of the cover to the outer race of the bearing, Fig. 24. If this measurement is not the same as the original figure stamped on the bearing cover, blot out original figure and stamp new figure, to the nearest 0.4 mm (1/64″).

    c. Reposition rotor so that all lateral movement is taken up in the opposite direction of the coupling disc.

    d. Remeasure the distance from the outside of the bearing cover to the outer race of the bearing, Fig. 24. This measurement should be 9.5 mm ± 0.8 mm (3/8″ ± 1/32″) less than measurement obtained in Step 20b above. If new measurement is within tolerance but is not the same as the original figure stamped on the bearing cover, blot out the original figure and stamp new figure adjacent to it.

NOTE

If measurement obtained in Step 20d above does not fall within tolerance the generator may be assembled incorrectly. Refer to Fig. 15 and recheck assembly.



21432

Fig.24 – Checking End Play

ASSEMBLY OF ROTOR TO STATOR

1. Apply arbor fixture (File Drawing 754) to spider bore of rotor.
2. Position rotor assembly into stator frame, Fig. 25.
3. Using two cranes, raise rotor assembly to clear its cradle stand. Remove stand, keep rotor assembly level, with equal clearance around the coils, while installing it into stator.

21424

Fig.25 – Installing Rotor Into Stator

CAUTION

Use extreme care to ensure that laminations or windings are not damaged when installing rotor.

4. Push rotor assembly into stator frame being careful not to damage the six connector leads. The connector leads must line up with the opening near the bottom of the end housing.

5. With end housing flush with the stator frame install eight 3/4″–10 bolts to hold the end housing to the stator frame. Torque bolts to 271 N·m (200 ft-lbs).

6. Place fish paper strips, 1.6 mm x 76 mm x 914 mm (1/16″ x 3″ x 36″), in air gap between rotor assembly and stator.

7. Set rotor down on fish paper.

8. Remove arbor fixture.

9. Install stator lead cleat assembly at bottom or side of generator.

10. Install all rodent screens or louvered access covers removed during disassembly.

NOTE

For information concerning generator alignment, refer to Maintenance Instruction M.I. 1765.

11. Occasional temperature checks during the first few hours of operation after reassembly should be made on the bearing. 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 POTENTIAL TESTING

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 normal routine maintenance items.

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

The rotating rectifier assembly has five leads connected to it, as shown in Fig. 5 and Fig. 18. The three leads connected to terminals on the exciter side are from the exciter armature. The two leads connected to terminals on the main field side are the main generator field leads (F+ and F–).

CAUTION

Before performing a high potential test all five of the leads connected to the rectifier disc must be short circuited simultaneously. This can be done by jumpering together all five terminals where the leads connect to the rectifier. A simple jumper can be made by connecting five alligator clips to a single length of wire.

After the short circuit is completed perform a high potential test on the main machine field, main machine stator, and exciter field.

SAFETY PRECAUTIONS

- Make certain that rotor, exciter, and stator meet qualifications under the Electrical Insulation Test section, before performing high potential tests.

- 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.

SERVICE DATA

SPECIFICATIONS

MODEL	POLES	GENERATOR SPEED	OUTPUT FREQUENCY	OUTPUT VOLTAGE		OUTPUT POWER (.8 P.F.)	
				WYE	DELTA	WYE	DELTA
A33	6	1000 RPM	50 Hz	6600 V		2700 kW	2700 kW
				4160 V	4160 V	2700 kW	2700 kW
				3300 V	3300 V	2700 kW	2700 kW
AB20-6	8	900 RPM	60 Hz		480 V		1600 kW
					600 V		2190 kW
AB20-24	8	750 RPM	50 Hz	3300 V	1905 V	2200 kW	2200 kW
		900 RPM	60 Hz	4160 V	2400 V	2600 kW	2600 kW
AB21-6	8	900 RPM	60 Hz		480 V		1600 kW
					600 V		2190 kW
AB21-24	8	750 RPM	50 Hz	3300 V	1905 V	2425 kW	2425 kW
		900 RPM	60 Hz	4160 V	2400 V	2865 kW*	2865 kW*
AB22-24	8	750 RPM	50 Hz	3300 V	1905 V	2607 kW	2607 kW
		900 RPM	60 Hz	4160 V	2400 V	3080 kW*	3080 kW*

*ABS rating of generator.

WEIGHTS (APPROXIMATE)

MODEL	TOTAL	END HOUSING AND BEARING	ROTOR	STATOR
A33	11 294 kg (24,900 lbs)	680 kg (1500 lbs)	4 400 kg (9700 lbs)	6 440 kg (14,200 lbs)
AB20-6	8 437 kg (18,600 lbs)	680 kg (1500 lbs)	3 674 kg (8100 lbs)	4 082 kg (9000 lbs)
AB20-24	8 437 kg (18,600 lbs)	680 kg (1500 lbs)	3 674 kg (8100 lbs)	4 082 kg (9000 lbs)
AB21-6	8 500 kg (18,740 lbs)	680 kg (1500 lbs)	3 738 kg (8240 lbs)	4 082 kg (9000 lbs)
AB21-24	8 500 kg (18,740 lbs)	680 kg (1500 lbs)	3 738 kg (8240 lbs)	4 082 kg (9000 lbs)
AB22-24	8 732 kg (19,250 lbs)	750 kg (1650 lbs)	3 900 kg (8600 lbs)	4 082 kg (9000 lbs)

BEARING (NEW)

Outside Diameter . . . . . 259.999 mm +0.000 mm –0.036 mm (10.2362″ +0.0000″ –0.0014″)
Bore Diameter . . . . . 120.000 mm +0.000 mm –0.020 mm (4.7244″ +0.0000″ –0.0008″)
Width . . . . . 85.999 mm +0.00 mm –0.13 mm (3.3858″ +0.000″ –0.005″)
Internal Clearance (Before Assembly) . . . . . 0.114 mm to 0.155 mm (0.0045″ to 0.0061″)
Internal Clearance (After Assembly) . . . . . 0.064 mm Min. (0.0025″ Min.)
Housing Bore Diameter . . . . . 260.152 mm +0.102 mm –0.000 mm (10.2422″ +0.0040″ –0.0000″)

LUBRICANT CAPACITIES

Bearing Cover . . . . . 482 g (17 ozs)
Bearing . . . . . 368.6 g (13 ozs)
Bearing Cap . . . . . 283.5 g (10 ozs)

STATOR, EXCITER, AND ROTOR RESISTANCES IN OHMS @ 75° C (167° F)**

MODEL	MAIN FIELD (ROTOR)			STATOR, PER PHASE		
	NOMINAL	MAX.	MIN.	NOMINAL	MAX.	MIN.
A33	1.3756	1.4031	1.3486	.07789	.07945	.07636
AB20-6	1.251	1.305	1.205	.00304	.00311	.00297
AB20-24	1.251	1.305	1.205	.04591	.0468	.0449
AB21-6	1.251	1.305	1.205	.00304	.00311	.00297
AB21-24	1.251	1.305	1.205	.04591	.0468	.0449
AB22-24	1.297	1.353	1.250	.04591	.0468	.0449

EXCITERS:
EXCITER FIELD (F+ to F–)
All, except AB21-24 and AB22-24 . . . . . 23.35
AB21-24 and AB22-24 . . . . . 24.81
EXCITER ARMATURE (between any two leads), All 0.1195

**Use the following formula to convert resistance measured at any temperature to resistance at 75° C (167° F):

$$\text{resistance at } 75°\text{ C} = \frac{\text{measured resistance x } 309.5}{235.5 + \text{temperature of item being tested in °C}}$$

Coupling Disc Torque (Lubricated With Texaco Threadtex)

6 Bolt Application Using 1-1/2″–12 (8336209) Bolt . . . . . 2 440 N·m (1800 ft-lbs)
12 Bolt Application Using 1-1/4″–12 (8363312) Bolt . . . . . 1 830 N·m (1350 ft-lbs)

EQUIPMENT LIST

Heater, Induction Type 8041446
Stone, 25 mm x 38 mm x 127 mm (1″ x 1.5″ x 5″) – 2 req'd 8204167
Wrench, Locknut Spanner . . . . . *File Drawing 907
Tool, Lockwasher Tang Bending . . . . . *File Drawing 908
Tester, Megohmeter 8306539
Bearing Puller Kit, Hydraulic 8173948
Pyrometer, Hand Type 8364533
Fixture, Arbor . . . . . *File Drawing 754
Nipple, Adapter . . . . . 1/8″–27 NPT

MATERIAL LIST

Thread Lubricant, Texaco Threadtex No. 2303, 19 liter (5 U.S. gal.) 8307731
Enamel, Red Air Drying
0.95 liters (1 qt.) 8061130
3.8 liters (1 U.S. gal.) 8061131
Molykote Lubricant
0.473 liters (1 pt.) Paste 9517921
Bearing Lubricant, Esso Unirex N-2
15.88 kg (35 lb) Drum 9507146
54.43 kg (120 lb) Drum 9507147

*File number represents 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.