ELECTRO-MOTIVE

M.I. 3304
*Rev. B

MAINTENANCE INSTRUCTION

D15 AND D25 MAIN GENERATORS

DESCRIPTION

The D15 and D25 main generators are very similar in appearance and construction. The D25 main generator is the current production generator which replaces the D15. A D25 main generator can directly replace a D15 main generator, but the older D15 main generator cannot replace a D25 main generator without electrical modification.

There are various models of D15 and D25 main generators designated by a letter after the model number, such as D15B or D25C. The letter represents the type of ventilation, air box arrangement, type of coupling, and generator feet position.

When the generator is equipped with an alternator as an integral part, the alternator number is added to the model number, such as D25B-D16.

A generator-alternator assembly, Fig. 1, is connected to the diesel engine crankshaft through the alternator rotor with a flexible coupling.

A generator assembly, Fig. 2, is connected to the diesel engine crankshaft through the generator armature shaft with a flexible coupling.

Ventilation is provided by one of two methods:

Self Ventilation -

A fan mounted on the generator-to-engine coupling disc which draws air from the commutator end of the generator past the stator field coils and around the armature. Only the upper portion of the commutator end bell assembly is enclosed.

Forced Ventilation -

Ventilation is provided by a blower connected to the auxiliary generator. The commutator end of the generator is totally enclosed with an air box and commutator cover.

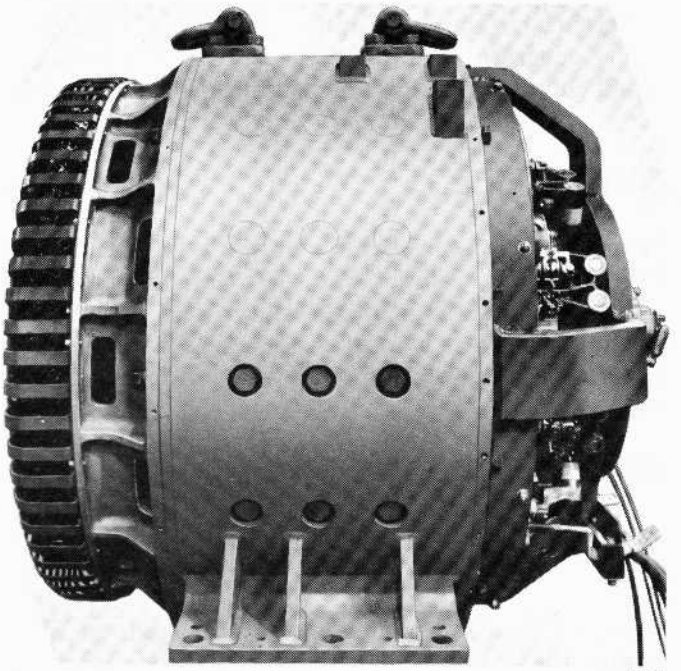

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Fig.1 – Generator-Alternator Assembly

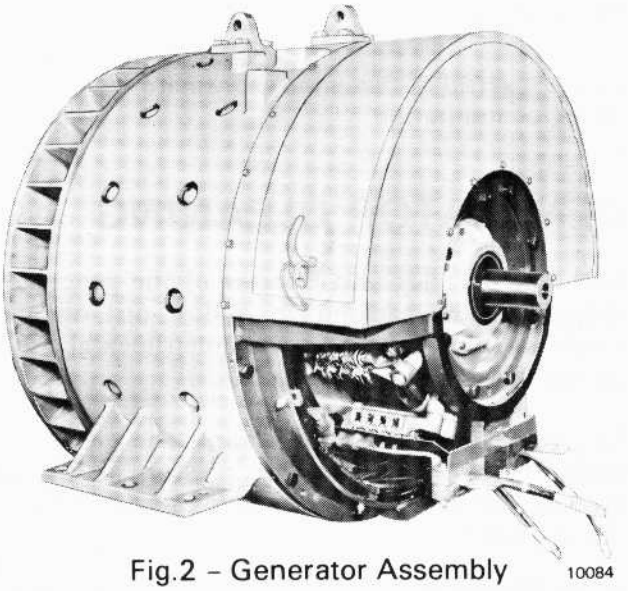

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Fig.2 – Generator Assembly

*The data contained in this Maintenance Instruction will apply to both the D15 and D25 main generators and generator-alternator assemblies unless specifically identified.

GENERATOR FIELDS

The generator contains five types of fields, Fig. 3, that perform the following:

STARTING FIELD

Energized by the locomotive batteries during engine start in order to motor the generator and crank the diesel engine.

DIFFERENTIAL FIELD

The differential field is wound so that it is differential to the shunt and battery fields. The field alters generator characteristics so that a relatively small change in the level of excitation is sufficient to obtain a constant kilowatt generator output.

SHUNT FIELD

A small portion of generator output is fed back and used to excite the shunt field. An external resistance connected in series with the shunt field is used to change generator characteristics in relation to the number and connection of motors powered by the generator.

BATTERY FIELD

A separately excited field connected to the battery and auxiliary generator circuit. The battery field is under control of the load regulator which serves to maintain a constant horsepower demand on the engine for any ampere demand within the capacity of the generator.

INTERPOLE

Assists reversal of current in the armature windings during commutation.

GENERATOR CLEANING

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

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

Clean, bound-edge, lintless wiping cloths should be used as necessary to remove oil, grease, and accumulations of dirt.

In case where air and dry wiping cloths prove incapable of removing caked grease and dirt, a stiff brush and soft wood or fibre scrapers may be used. In severe cases it may be necessary to dampen a cloth in solvent such as Stoddards Solvent to loosen and remove imbedded deposits. Every precaution should be taken to keep the solvent off the commutator, copper parts, coils, and windings.

Chlorinated hydrocarbon type cleaning solvents are not recommended for use on the equipment because of the possibility of insulation damage. This type solvent can deteriorate semi-cured silicone rubber and can swell ethylene-propylene rubber, natural rubber, neoprene, and hypalon during extended soaking periods. The vapor state at 70° C (160° F) attacks uncured silicone rubber within 20 minutes. The vapors of these solvents also have an adverse effect on commutation. Special care is also necessary to avoid subjecting the polyester glass insulated brush holder studs to alkaline type cleaning solutions.

CAUTION

Adequate ventilation and safety precautions are necessary when handling inflammable fluids such as Stoddards Solvent which has a flash point of 46° C (115° F).

BEARING MAINTENANCE

The bearing requires maintenance at intervals recommended in the Scheduled Maintenance Program. This can be accomplished either by removing the generator from the installation and performing the Generator Disassembly procedure of this instruction or by maintaining the bearing with the generator in place.

BEARING MAINTENANCE WITH GENERATOR IN PLACE

Perform the entire following procedure for a generator-alternator unit. If the generator does not have an attached alternator and therefore no collector ring assembly, perform only Steps 7 through 18.

1. Remove collector ring cover, Fig. 4.
2. Remove brushes from collector ring brush holders and remove brush holder cable connections. Remove brush holders.
3. Remove field lead connections from terminal posts of collector ring assembly.

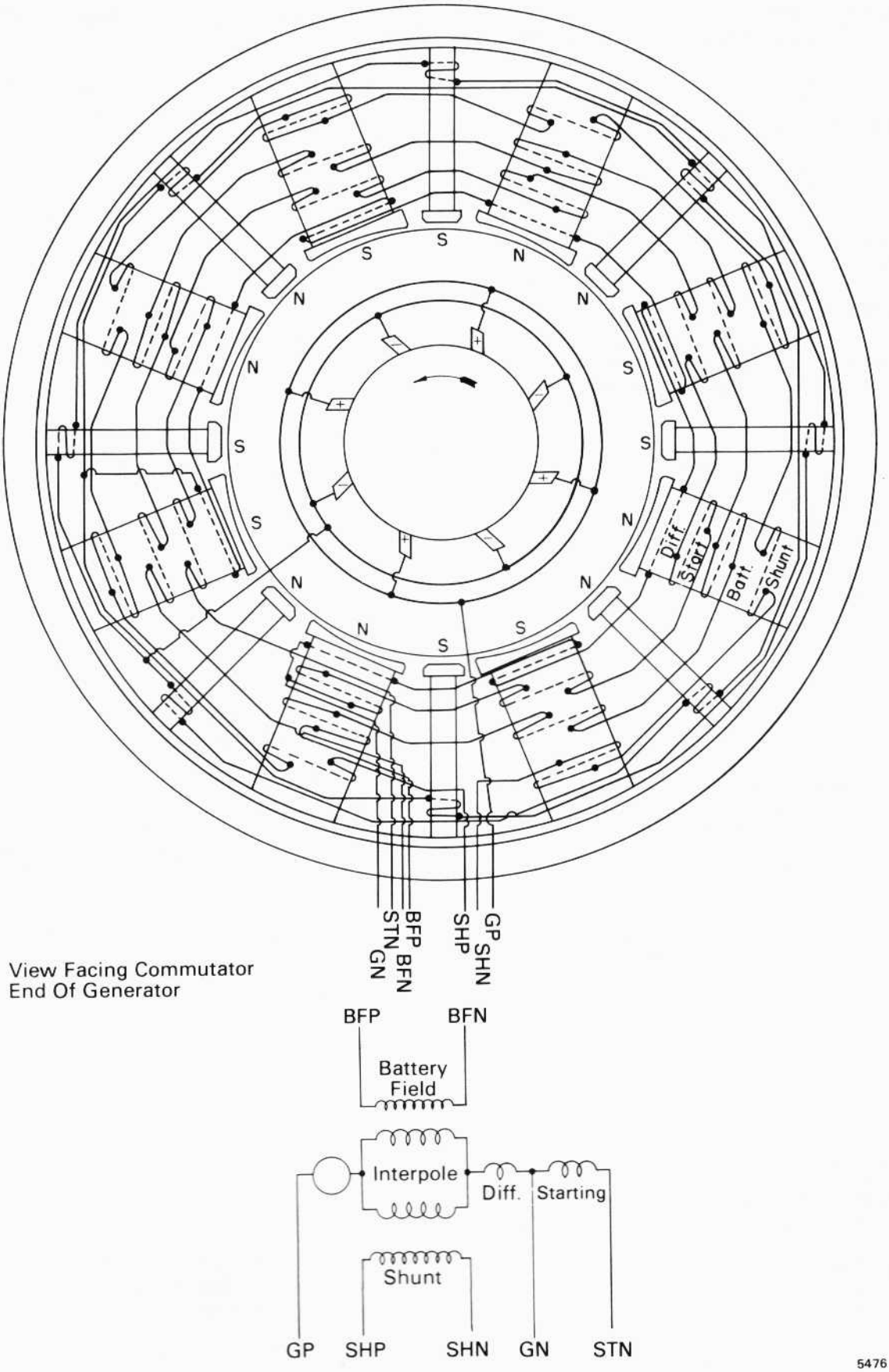


Fig.3 – Generator Wiring Diagram

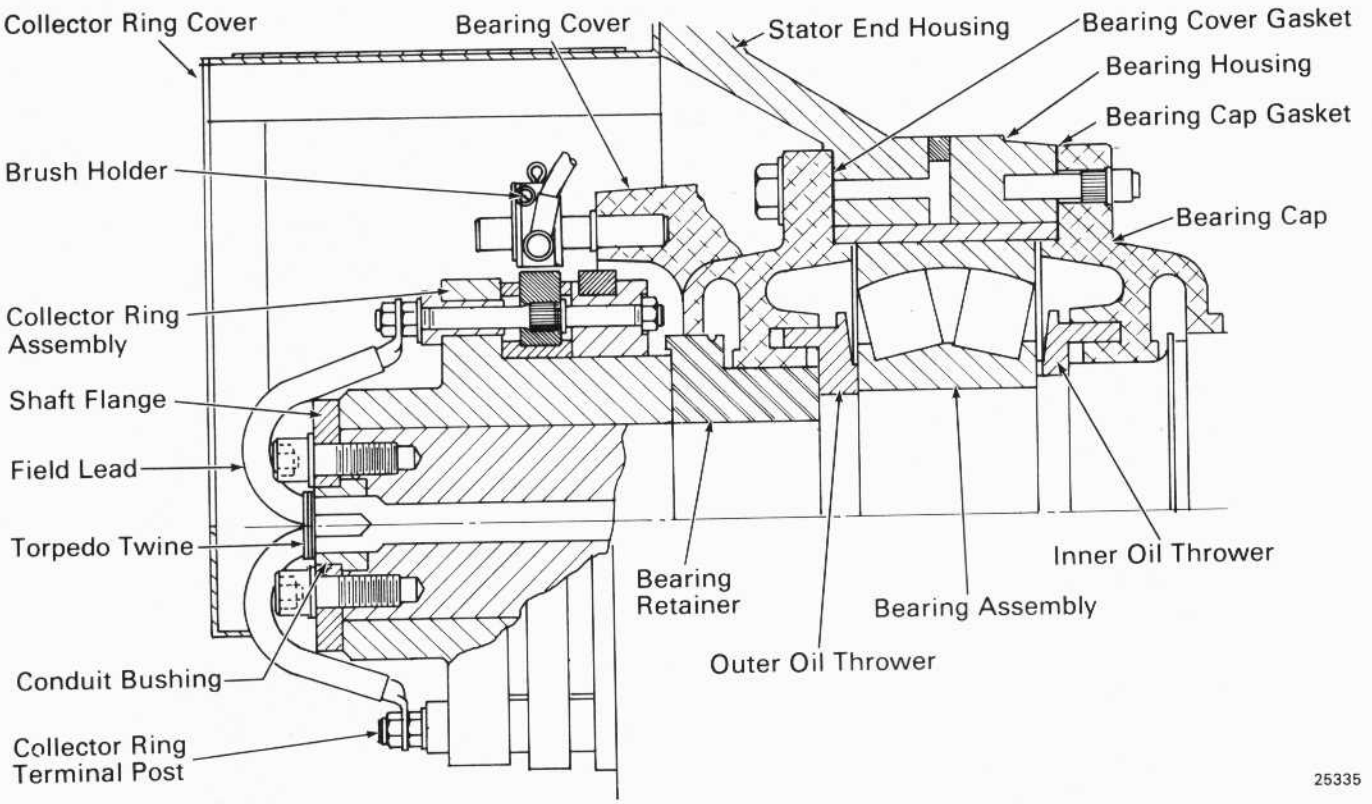


Fig.4 - Collector Ring And Bearing Assembly Cross-Section

4. Remove shaft flange and conduit bushing from end of shaft.

5. Place an extension cup around field leads and bolt extension cup to shaft as shown in Fig. 5.

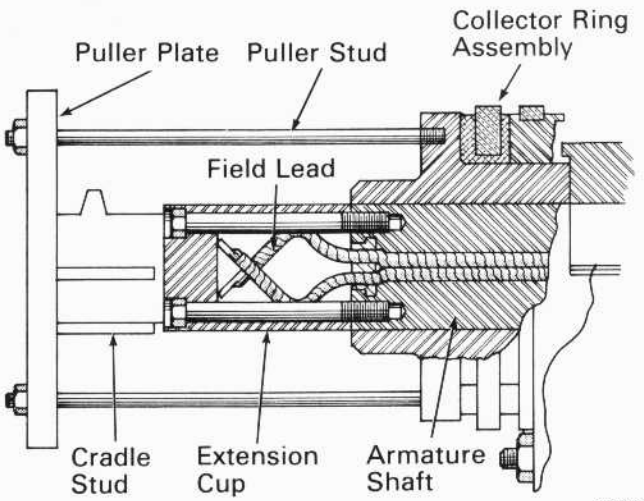


Fig.5 - Collector Ring Removal

6. Install a puller plate and puller studs to remove collector ring as shown in Fig. 5. Place a hydraulic jack between extension cup and puller plate, supported by cradle studs of puller plate. Remove collector ring using hydraulic jack.

7. Apply puller plate and studs and remove bearing retainer.

8. Remove bolts from bearing cover and remove bearing cover. It may be necessary to tap cover with a rawhide mallet or soft wood hammer and gently pry cover with a pry bar to remove.

9. Inspect the grease in the bearing cover and inspect the exposed side of the bearing. Look for metal particles such as brass flakes in the grease, excessive wear in the housing of the bearing, fatigue damage on the bearing rollers or roller paths, or evidence of overheating. Replace bearing with a new bearing if required, and replace any associated parts found in distress with new parts. Refer to Generator Disassembly procedure of this instruction to remove bearing or associated parts.

10. If no distress or damaged parts are found, thoroughly clean the bearing cover.

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

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

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

NOTE

If generator bearing had been greased with Shell Cyprina RA Grade 3 grease, Esso Unirex N-2 may be mixed with the Shell Cyprina RA Grade 3 during maintenance performed while generator is connected to engine. When generator is overhauled away from the installation, there is no reason to mix grease and only Esso Unirex N-2 should be used.

CAUTION

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

14. Pack grease into the bearing cap and cover cavities. Leave a free space at the top of the bearing cap and cover to limit grease churning and liquefaction of the grease. Using a spatula or putty knife, roughly form the grease to desired contour as shown in Fig. 6 and apply grease mask. Refer to Service Data for grease mask part number. The grease cavity should be filled to complete an arc of 240° to 270°. The grease arc must be packed without air voids.

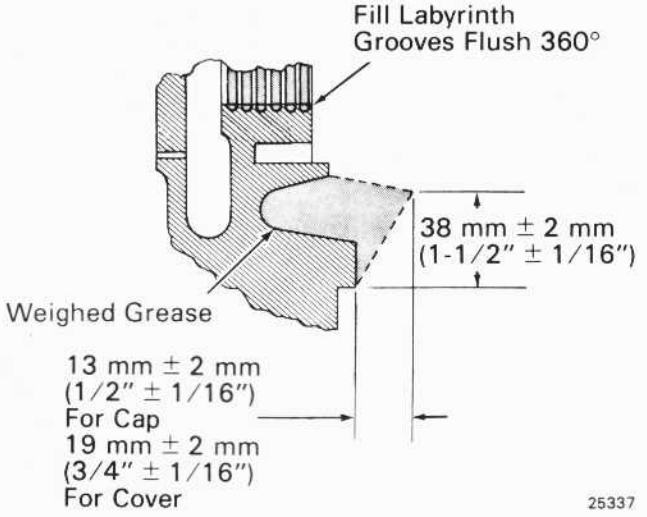


Fig.6 – Application Of Grease To Bearing Cap And Bearing Cover

15. Rotate grease mask to form proper contour, keeping grease mask seated. Several turns may be required to get proper contour. Use spatula or putty knife to fill in low spots with grease from the grease mask blade. The small amount of grease retained on the blade should be removed and applied to the ends of the grease arc. The contour should be built up to the limits of Fig. 6.

16. 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 foreign substance into the bearing. Repack all spaces on the exposed side of the bearing with grease. Pack as much grease as can be solidly pressed into the cage and roller assembly. Esso Unirex N-2 can be added to the grease already in the bearing.

17. Install the greased bearing cover with a 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).

18. Heat the bearing retainer in an oil bath, electric oven, or an induction heater to 127° C (260° F) and shrink onto shaft. If an oil bath is used for heating, remove oil from bearing retainer with clean, bound-edge cloths prior to shrinking to the shaft. When using induction heater, pyrometer readings (with heater current off) should be taken periodically.

19. Place collector ring assembly in an oven and heat to 120° C (248° F). Clean keyway and assemble key to shaft. After heating, place collector ring on shaft and hold in position until ring seizes the shaft. Refer to Fig. 4.

20. Install alternator brush holder assemblies on posts pressed in bearing cover. Torque brush holder clamping bolts to 20-27 N·m (15-20 ft-lbs). Set brush holder assemblies so that a 3 mm (1/8") clearance is obtained between bottom of each brush holder and the collector ring, Fig. 7.

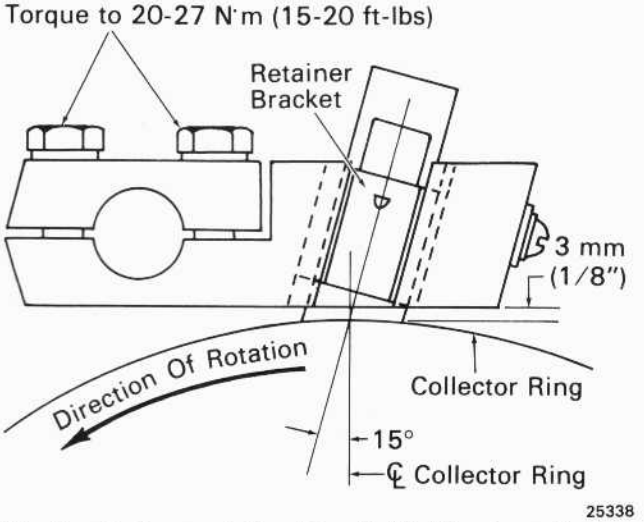


Fig.7 – Collector Ring Brush Holder Installation

21. Reconnect brush holder cable assemblies to brush holders as shown in Fig. 8.

22. Assemble conduit bushing on field leads and insert conduit bushing into end of armature shaft as shown in Fig. 4. Bolt shaft flange to end of armature shaft. Tie field leads with torpedo twine as shown in Fig. 4 and paint twine with red air drying enamel.

23. Reconnect field leads to collector ring terminal posts. Cables are not marked for any particular post.

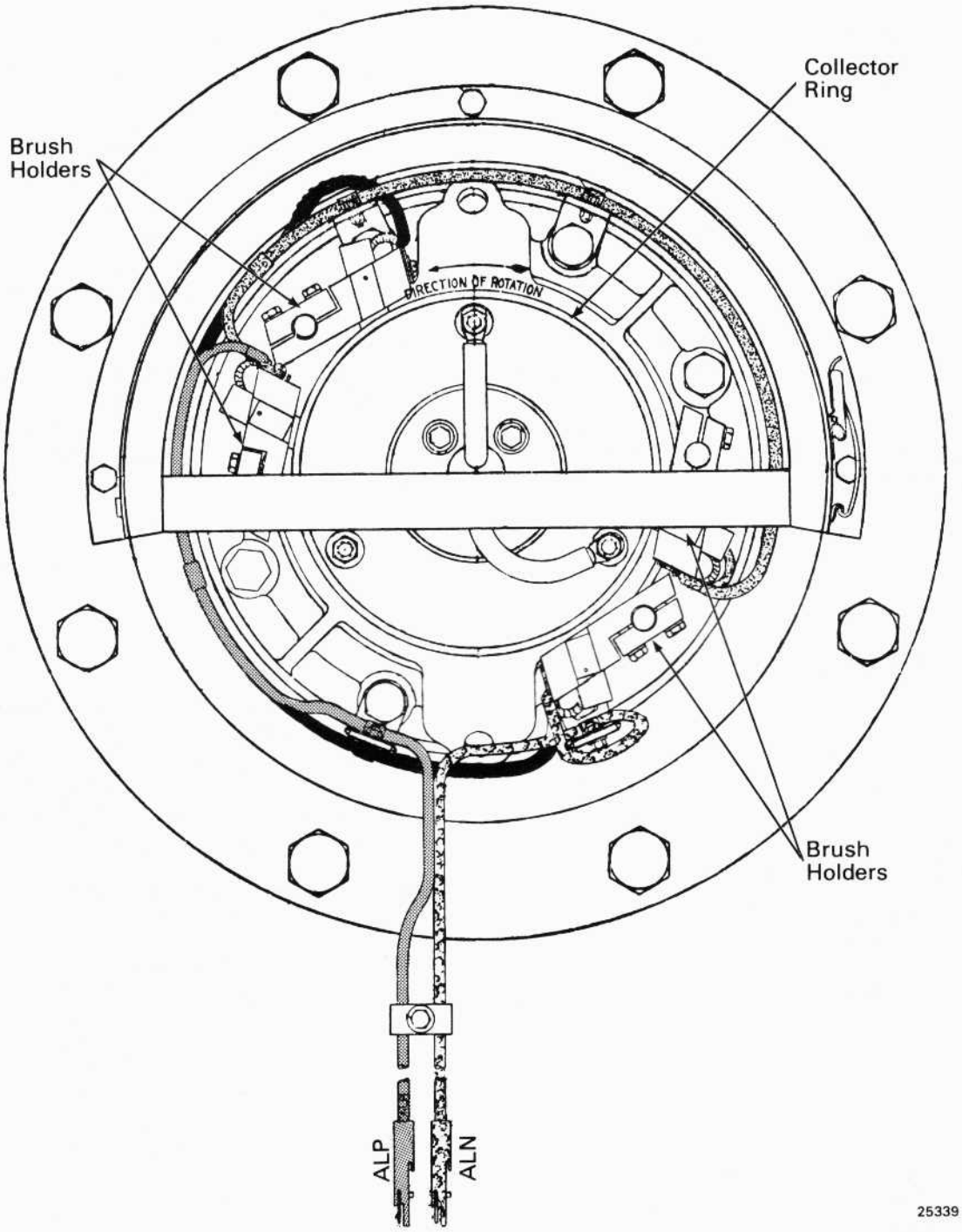


Fig.8 – Collector Ring Brush Holder Cable Connections

COLLECTOR RINGS AND BRUSHES (Generator-Alternator Unit Only)

When the generator has an alternator attached, the generator is equipped with a collector ring assembly and associated equipment at the commutator end shaft to provide excitation to the alternator.

Collector rings should be checked frequently while generator is in operation. Any sparking should be corrected immediately. It is normal for the negative ring to experience electrical wear more rapidly than the positive ring. The unequal wear can be minimized by reversing polarity of the rings. The frequency of this reversal is provided in the applicable Scheduled Maintenance Program.

Sparking on collector rings may be due to the various causes listed below:

1. Collector rings not running concentric with shaft.
2. Collector ring surface rough or pitted.
3. Brushes tight in brush holders.
4. Oil on surface of collector ring.
5. Vibration of brush holder studs.

Collector ring concentricity should be within 0.15 mm (.006″) total indicator reading (rings installed on generator), and lateral runout within 0.8 mm (1/32″). If these tolerances are exceeded, the rings will have to be machined or stoned to bring rings into tolerance.

A rough or pitted collector ring surface is normally due to prolonged sparking. Usually this condition can be corrected by grinding. The minimum acceptable diameter on the collector rings is 225.42 mm (8.875″). If rough rings cannot be cleaned up without going below the minimum diameter, the rings should be replaced with new rings.

A collector ring grinder is available which is mounted to the generator. Refer to Service Data for grinder part number.

Remove a brush holder assembly and install the grinder to the applicable tapped holes or studs provided.

Position the grinder so there will be 3.2 mm (1/8″) clearance between it and the rings to be ground.

Install grinding stones in position on the grinder, making certain there will be enough travel to grind the rings.

Make the necessary preparation to start the engine and run at approximately 600 RPM.

CAUTION

Be sure the grinding stones do not contact the collector rings until the generator begins rotating. Then gradually bring the stones in contact with the rings.

When the stones are in contact with the rings, grind until the ring surface is smooth. After grinding, check the surface with a dial indicator. Concentricity should not exceed 0.15 mm (0.006″) total indicator reading.

When the grinding operation is complete, stop the engine and remove the grinding equipment. Blow out all grinding dust, and reassemble the brush holder assembly in its proper position. Replace brushes if necessary.

CAUTION

Never use emery cloth for polishing collector rings, due to its continued abrasive action.

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

If a brush holder is vibrating, tighten brush holder support bolt and see that brush holder is fastened securely to support.

When installing new brushes, they should be sanded to fit the curvature of the collector ring. This can be done by putting a piece of aluminum oxide paper on the surface of the ring with the rough side against the brush. Then with the brush held down with pressure arm of the brush holder, move aluminum oxide paper in direction of rotation of the rings. Repeat motion until brush fits curvature of the rings.

Make sure the coil spring rests on top of the brush and not on the holder when applying the spring clip.

COMMUTATOR BRUSH HOLDERS

The generator is equipped with adjustable spring type brush holders as shown in Fig. 9. The adjustable spring tension should be at the limits as specified in the Service Data. It is important that all brushes be adjusted to the same pressure. Unequal

brush pressure will cause unequal current distribution in the brushes. The spring type brush holder may lose some tension during the first few weeks of operation. Spring tension should be checked during this period. Measure the spring tension with the lever arm 3 mm (1/8") above the top of the brush holder box as shown in Fig. 10. The spring tension is adjusted as follows:

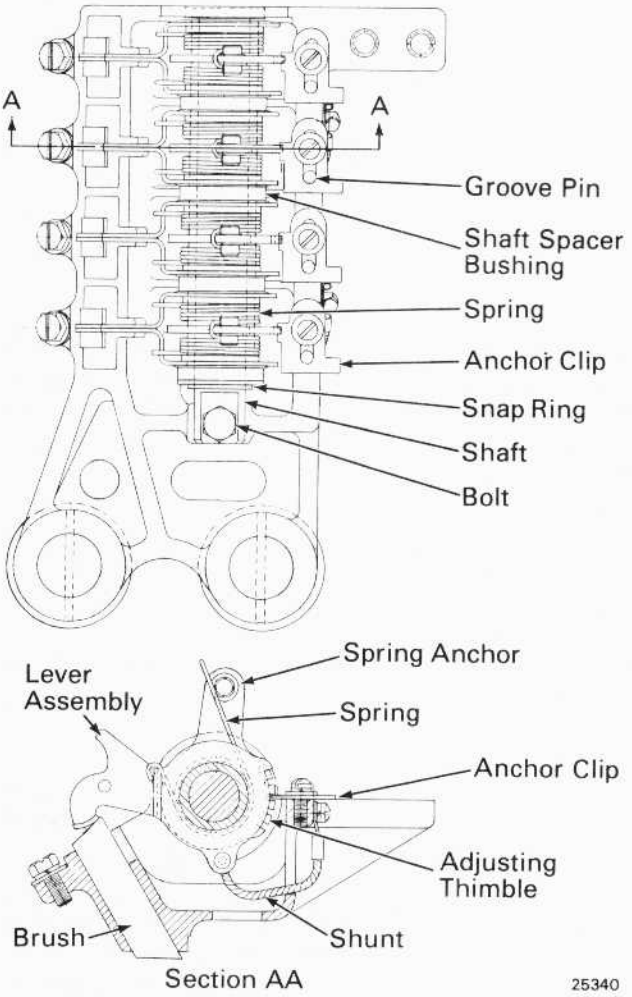


Fig.9 – Commutator Brush Holder Assembly

1. Release the spring from the spring anchor and remove brushes from brush holder.

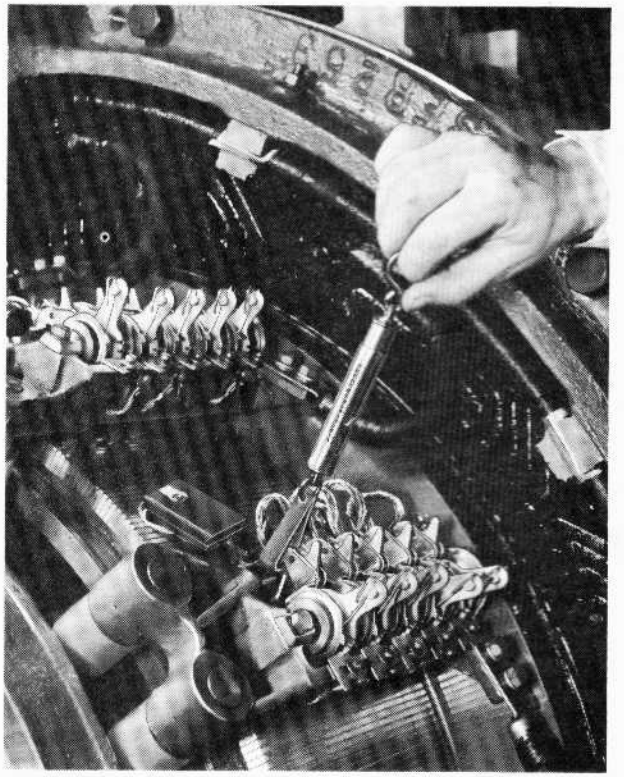
2. Loosen screw and slide anchor clip away from adjusting thimble. Adjust thimble to suit (usually second or third slot).

3. Install anchor clip and secure with screw.

4. Apply spring to spring anchor.

NOTE

Care must be used in measuring spring tension because of brush spring and finger friction. Wiggle brush finger and spring while holding tension or take an average reading while raising and lowering brush fingers with tension scale.



NOTE

Generator shown is not correct model. Illustration used to show proper use of brush tension scale.

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Fig.10 – Measuring Brush Spring Tension

5. Ensure the brush holder assembly is securely mounted and the cable and brush shunt connections are tight.

LEVER AND SHAFT ASSEMBLY REMOVAL

1. Free springs from spring anchor, Fig. 9.

2. Remove bolt from shaft assembly and remove shaft and lever assemblies from brush holder.

3. Use snap ring pliers and remove snap ring and washer. The individual assemblies may now be slipped off the shaft.

LEVER AND SHAFT ASSEMBLY INSTALLATION

1. Assemble anchor and pin assembly, lever and shunt assembly, and spring to the bushing. Assemble bushing to shaft as shown in Fig. 9.

Four such assemblies constitute one brush holder lever and shaft assembly. When the last assembly is placed on the shaft, assemble washer and a new snap ring to the shaft. Use a snap ring installing tool to apply snap ring to shaft.

2. When installing a complete lever and shaft assembly, a U-shaped tool can be made as shown in Fig. 11 to aid in the assembly. The U-shaped tool is used as shown in Fig. 12.

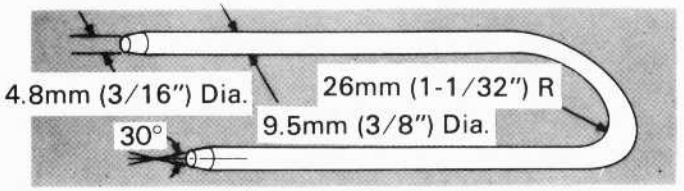

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Fig.11 – Lever And Shaft Assembly Alignment Tool

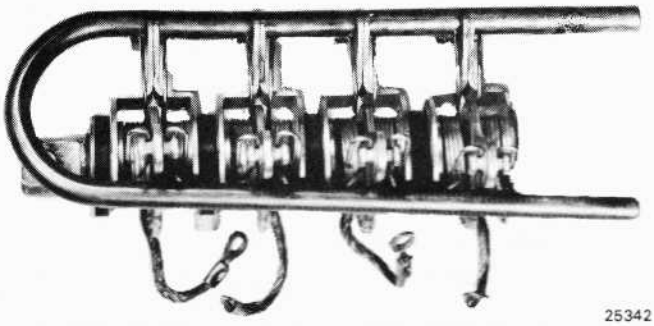

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Fig.12 – Lever And Shaft Assembly Alignment Tool Application

3. Apply anchor clips to hold adjusting thimbles, and set spring tension as described at beginning of section.

4. Brush holders must be adjusted to maintain a dimension of 3 mm (1/8") to 5 mm (3/16") between the bottom of the carbonway and the commutator surface. The brush rigging is arranged so that the brush holder may be moved toward commutator surface as the commutator surface wears or is turned.

5. Ensure brush holder is securely mounted and the cable and brush shunt connections are tight.

COMMUTATOR BRUSHES

The generators are equipped with a two-wafer brush. Four of these two-wafer brushes are used in each of the eight brush holders.

Brushes should be carefully inspected and replaced with new brushes if chipped, broken, or worn to the condemning limit. Refer to Service Data for wear limits of brushes.

Brushes may be replaced with new brushes individually as they wear to the condemning limit. Replacement brushes should be of the same type and grade as the other brushes. Mixing brushes in the same generator can be detrimental to successful operation.

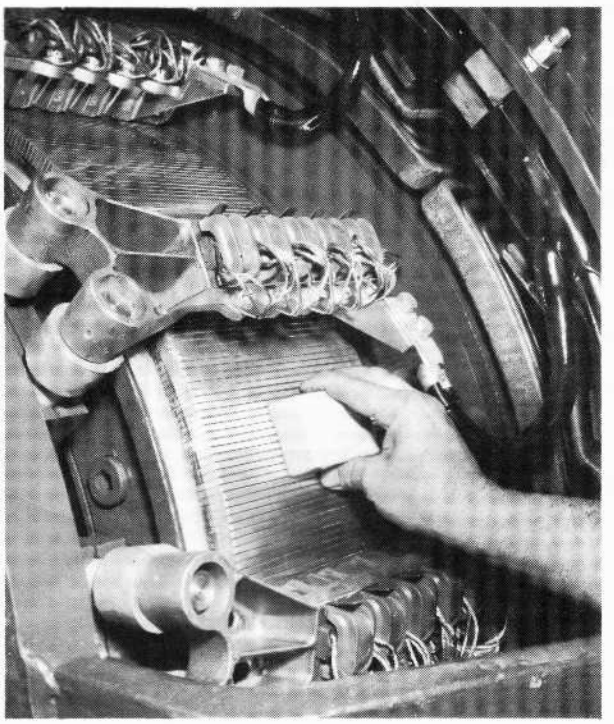
When a full set of brushes is replaced with new brushes, it is important that the brushes are seated properly.

CAUTION

The friction created by improperly seated brushes may result in the commutator heating to the point of melting solder.

Seat the brushes by wrapping 1-1/2 turns of aluminum oxide paper (with abrasive side out) around the commutator before brushes are applied. Install brushes and rotate armature until all the brushes are seated. A 90% seat is satisfactory. Complete the seating of the brushes by using a seater stone as shown in Fig. 13. Refer to Service Data for part number of seater stone and for size and grade of aluminum oxide paper.

Remove aluminum oxide paper and blow out carbon dust with clean, dry compressed air at reduced pressure. Do not blow carbon dust into armature coils. Blow away from commutator riser.



NOTE

Generator shown is not correct model. Illustration used to show proper use of seating stone.

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Fig.13 – Seating Brushes

BRUSH HOLDER INSULATOR STUDS

Brush holder insulator studs should be kept clean and free of defects. The polyester insulated type brush holder studs, Fig. 14, are usually resistant to flashover damage. If flashover damage should occur, the insulator studs usually can be restored to satisfactory condition by polishing them with fine sandpaper. Polyester glass material should never be subjected to alkaline cleaning solutions.

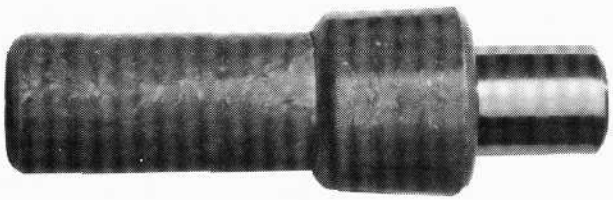

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Fig.14 – Polyester Brush Holder Insulator Stud

NOTE

Early model brush holder insulator studs were insulated with porcelain and should be replaced with the polyester insulated studs. Polyester is more durable and does not become permanently carbon tracked.

When stud insulation is broken, cracked, or burned to the extent that it cannot be cleaned, much time can be saved by replacing the stud with a new stud.

Brush holder insulator studs have a silicone rubber insulated sleeve over the base of the studs, Fig. 15. When replacing or reconditioning brush holder assemblies, ensure insulated sleeves are in place.

Replacement polyester glass insulated studs are available in the following sizes:

Standard size - 8159003

To be used in new brush holders or when stud holes are within 25.235 mm ± 0.013 mm (0.9935″ ± 0.0005″).

0.05 mm (0.002″) Oversize - 8209068

0.20 mm (0.008″) Oversize - 8219773

For stud holes which have had a standard size pressed out.

The following studs can be used for extensively scored stud holes which have been reamed out.

0.79 mm (0.031″) Oversize - 8209069

0.84 mm (0.033″) Oversize - 8222653

1.57 mm (0.062″) Oversize - 8222652

1.65 mm (0.065″) Oversize - 8222654

The oversize studs may be identified by the number 2, 8, 31, 33, 62, or 65 stamped on the bottom of the stud. The number is in reference to the amount oversize in thousandths of an inch. For example, the number 2 identifies the 0.05 mm (0.002″) oversize stud. The number 65 identifies the 1.65 mm (0.065″) oversize stud.

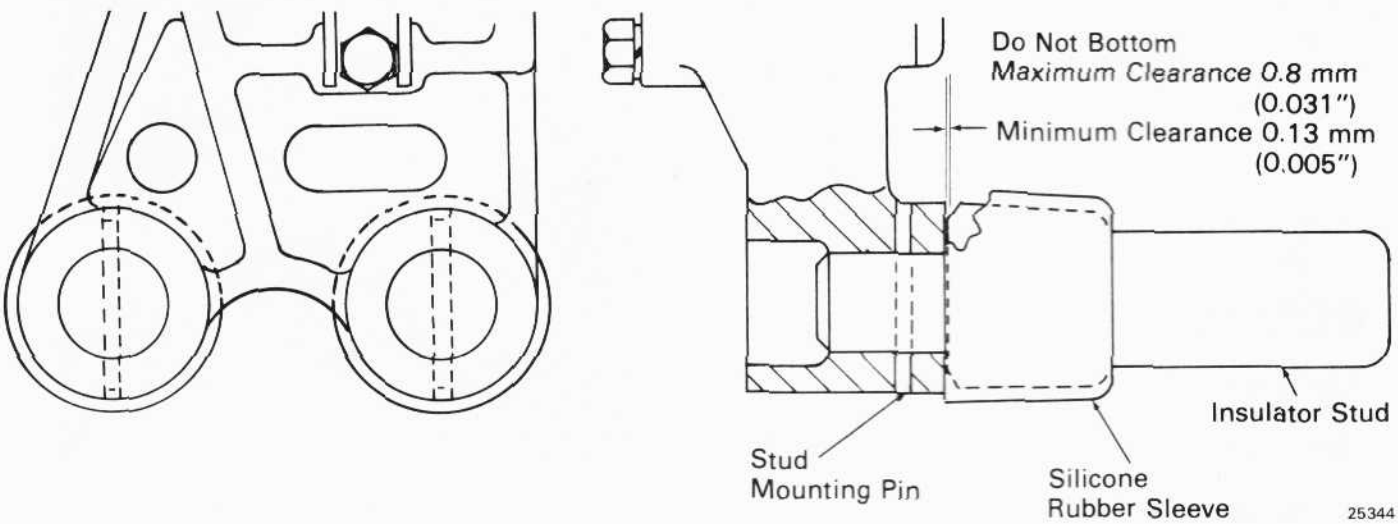


Fig.15 – Brush Holder Insulator Stud Installation

INSULATOR STUD INSTALLATION

A sleeve-type tool made of half-hard brass, Fig. 16, should be used for pressing the studs into the brush holder.

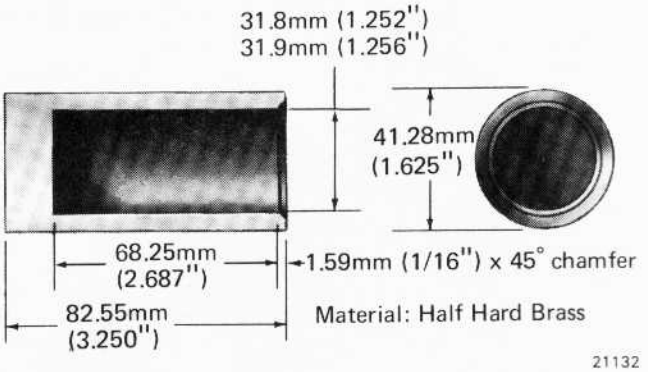


Fig.16 - Insulator Stud Installation Tool

To replace the brush holder insulator studs, perform the following procedure:

1. Press out brush holder insulator stud, shearing retaining pin.

2. Clean up stud hole of brush holder, if required.

3. Select proper oversize stud. Ensure that 0.05 mm ± 0.025 mm (0.002″ ± 0.001″) press fit is obtained. Press in stud using sleeve-type tool, Fig. 16. Clearance between the stud shoulder and brush holder must be maintained to ensure the insulation does not get damaged against the brush holder. Refer to Fig. 15.

4. Drill and pin brush holder and stud. Use a No. 23 drill and a 4 mm x 35 mm (0.156″ x 1-3/8″) pin. Peen over hole on both ends after installing pin.

COMMUTATOR

The commutator is a vital area on the generator. It should be kept in the best condition possible. Inspections should be made at frequent intervals to ensure detection of surface faults before loss of service or before repairs become necessary. Such conditions as film stripping, burned bars, high or low bars, high mica, or flat spots become more serious with time. When a defect is found, determine the cause and correct as soon as possible.

CREEPAGE SURFACES

The creepage areas, Fig. 17, should be cleaned and repainted with red air drying enamel as follows:

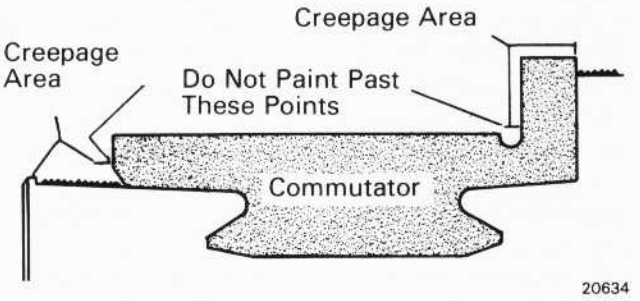


Fig.17 - Commutator Creepage Areas

1. Clean surfaces thoroughly with alcohol. Remove any trace of carbon.

2. Apply red air drying enamel with a clean brush to the creepage surfaces. Make as thin a coat as possible applying the enamel evenly, leaving no dabs or overlapping areas. Do not get enamel into commutator slots or the relief at the bottom of the commutator neck.

NOTE

Do not apply red air drying enamel over carbonized or charred insulation. If the insulation cannot be cleaned up, the generator should be removed for permanent repairs.

3. Wait until enamel is dry before running generator.

COMMUTATOR SURFACE CONDITIONS

Commutator surface irregularities can cause frayed brush shunts, highly polished brush to brush box contact surfaces, excessively worn brush pressure arms, broken pressure springs, and rapid brush wear. Monitoring these conditions can determine when a commutator should be ground.

Some slight commutator bar movement can be caused by road seasoning (repeated heating and cooling of the commutator), standstill burns, and overspeed. The bar movement, depending upon the number and location, can damage the commutator and brushes. A commutator with certain profile irregularities could operate satisfactorily at lower speeds, but when operated at higher speeds, could cause problems. A very rough commutator will have these same problems occurring at even lower speeds.

A rough commutator may not be obvious. The commutator should be checked with a dial indicator attached to the motor or generator so that the plunger of the indicator rides on the commutator

surface. Ensure the dial indicator rides on one of the brush tracks. Rotate the armature slowly and carefully observe the dial indicator indications. The overall minimum and maximum indications of the dial indicator are not applicable as a measurement of commutator irregularity. Commutator irregularity is concerned with bar to bar movement. An example of this would be to have readings around the commutator that have a total variation of 0.05 mm (0.002"), however hidden within the 0.05 mm variation are six low areas, each spanning one or more bars. This commutator would cause the brushes to bounce with resultant damage. A commutator having a total variation of 0.10 mm (0.004") with the minimum and maximum readings 180° apart is an acceptable commutator whereas the first example, 0.05 mm variation with several low areas, is not acceptable even though the total variation is much less. It is difficult to give a number value which would determine when a commutator should be ground. The values obtained by dial indicator must be evaluated with respect to performance of the generator (brush problems, flashovers, etc.) and a certain amount of personal judgement must be used. A useful "rule of thumb" is that any condition worse than 0.05 mm in a six (6) bar span calls for grinding the commutator.

Resurface the commutator by turning in a lathe or by the use of a grinder and grinder adapter. Hand stoning is definitely not recommended.

COMMUTATOR GRINDER MAINTENANCE

In order to produce an acceptable commutator surface finish, it is imperative that the jig stoning fixture be maintained in good condition. The use of a poorly maintained or incorrectly adjusted grinder will result in perpetuating the surface irregularities. Refer to Fig. 18 and check the grinder as follows:

There can be no abnormal movement, however slight, between the grinder cross-slide and the grinder frame or between the down-feed slide and the cross-slide. The movement can be detected by placing the fingertip on the parting of the two pieces and attempting to move either one of the pieces in all directions other than the normal direction of travel.

The travel of the cross-slide should be smooth with no binding, jerking, or tightness during the full travel from end to end. Any binding or tightness in the cross-slide travel is usually the result of one or more of the four Allen screws being incorrectly adjusted. Jerky movement of the cross-slide travel is usually the result of either grinding dust trapped

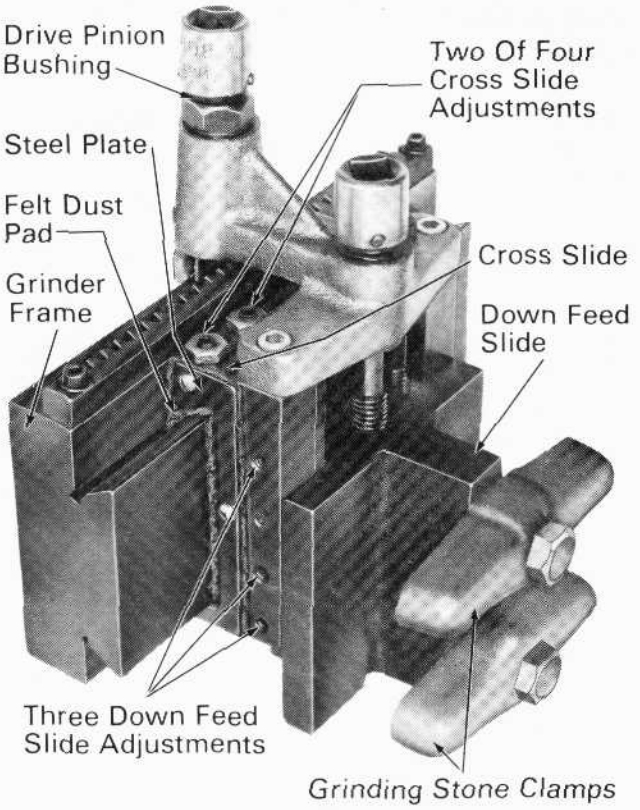


Fig.18 - Commutator Grinder Adjustments

between the two sliding surfaces or an incorrectly adjusted or loose bushing on the pinion shaft.

The grinder must be periodically cleaned and adjusted. The frequency of the cleaning is determined by the use of the grinder and should be performed before there is any binding or jerky movement of the cross-slide.

Do not attempt to clean an assembled grinder by dipping in a solvent or by using air pressure to blow out dust. The grinder must be completely disassembled to clean.

GRINDER DISASSEMBLY

Refer to Fig. 18 to disassemble the grinder as follows:

1. Remove the three small screws securing the felt dust pad and steel plate to one end of the cross-slide.

2. Loosen the three small Allen screws on the side of the cross-slide and the four Allen screws on the top of the cross-slide approximately 1/2 turn. The four Allen screws on the top of the cross-slide have lock nuts which must be

loosened before loosening the four Allen screws. The loosening of these seven Allen screws will make it easier to disassemble and reassemble the grinder.

3. Remove the two large Allen screws located on the top of the cross-slide casting.

4. The grinder can now be completely disassembled. Pull up on the down slide until it clears the cross-slide. Then move the cross-slide towards either end until it clears the frame.

5. Remove the brass wear plate from the cross-slide slot and down-feed slot.

GRINDER LUBRICATION

Apply a thin film of graphite oil or grease to the sliding surfaces only.

GRINDER REASSEMBLY

Refer to Fig. 18 and reassemble the grinder as follows:

1. Install one of the brass wear plates in the cross-slide slot and slide the cross-slide into the grinder frame. The two brass wear plates are interchangeable, but the one having the least amount of wear should be used in this step.

2. Adjust the four Allen screws located on the top of the cross-slide for smooth travel from end to end with no abnormal movement of any kind. This adjustment is usually a 1/4 turn loose after lightly bottoming the Allen screw. When adjustment is completed, tighten the locking nut on each screw. Use Allen wrench to hold Allen screw when locking nut is tightened.

3. Place the brass wear plate in the down-feed slot on the cross-slide and install the down-feed slide into the top side of the slot.

4. Install and tighten the two Allen screws at the top of the cross-slide.

5. Adjust the three Allen screws for the travel of the down-feed slide. This adjustment is usually a 1/8 turn loose after lightly bottoming the Allen screw. The travel movement should be adjusted to have a slight resistance to movement. The adjustment of the down-feed slide is not as critical as that of the cross-feed slide because of the fewer number of times that the slide will travel full length.

6. Install the felt dust pad and steel plate removed from the cross-slide. The pad and plate have both a wide and narrow end. The wide end should be on the same side as the brass wear plate on the cross-slide.

COMMUTATOR GRINDING

Commutator surface irregularities such as etching, roughness, or slight burning can often be corrected by resurfacing, using a grinding fixture. Refer to Service Data for grinding tools required.

NOTE

In order to produce an acceptable commutator surface finish, it is imperative that the jig stone fixture be maintained in good condition. The in-feed and cross-feed gib ways must be clean and free from burrs so the device feeds smoothly. The gib keys must be adjusted so that no free play exists in the sliding assemblies, but not so tight as to cause binding. Refer to Commutator Grinder Maintenance Section prior to grinding commutator.

1. Remove all brushes from four of the eight brush holders. Two of the remaining four brush holders should be positive polarity and two negative polarity. Refer to Fig. 19.

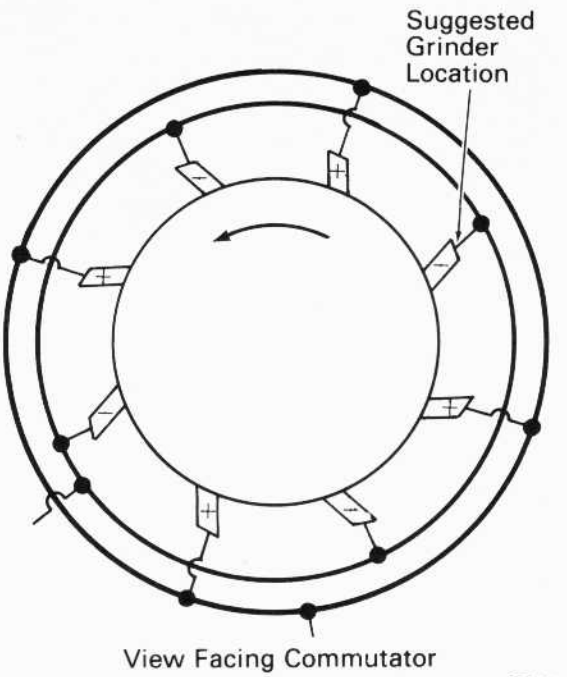


Fig.19 – Commutator Brush Polarity And Grinder Location

2. Remove a brush holder. Refer to Fig. 19 for suggested location. Install grinder supporting adapter in place of the removed brush holder.

NOTE

Tape the copper lug of the lead which was disconnected from the brush holder so it will not short against generator frame.

3. Install the alignment bar on the grinder down-feed slide. Check alignment bar contact to down-feed slide for zero clearance with a thickness gauge. Refer to Fig. 20. Any clearance at either side of the alignment bar contact surface indicates that the bar is not parallel to the grinder.

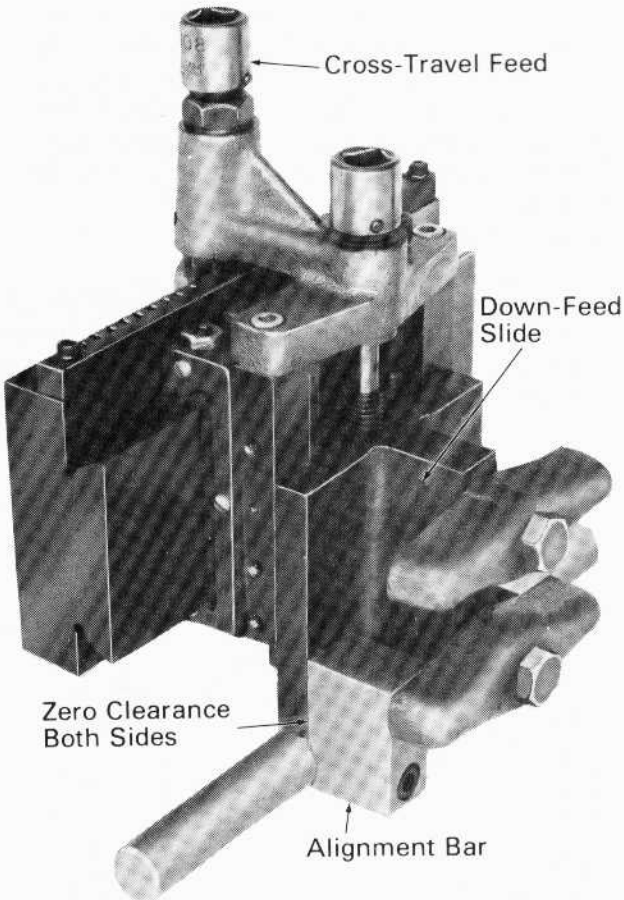
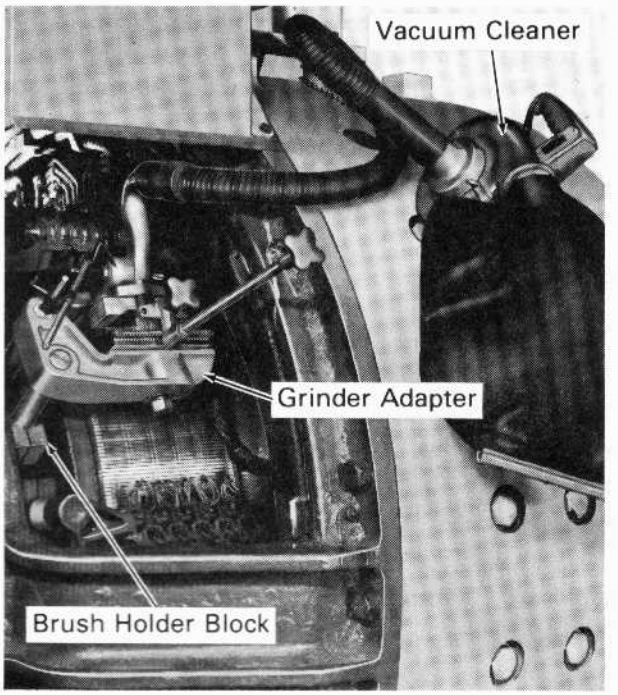


Fig.20 – Commutator Grinder Alignment Bar Installation

4. Mount the grinder with alignment bar on the grinder supporting adapter, Fig. 21.

5. Position the generator armature so that the alignment bar will contact the approximate center of the commutator bar. Parallel the alignment bar to the commutator surface using the small areas outside of the brush track at both ends of the commutator bar. The alignment bar should be within 0.08 mm (0.003″) of paralleling the commutator bar.



NOTE

Generator shown is not correct model. Illustration used to show proper grinding fixture installation.

25346

Fig.21 – Commutator Grinding Fixture Installation

6. Remove the alignment bar from the grinder and install the two grinding stones. Mount the stones so that they are seated squarely on the commutator. Pull stones away from the commutator using the grinder cross-travel feed.

7. Start the diesel engine and run at normal idle speed.

8. Feed grinding stones into commutator slowly using the down-feed handle until light contact is made. Proceed to grind the commutator by feeding the stones not more than 1/8 turn of the down-feed handle (45°) and move the stones across the commutator at a moderate speed for three complete passes. One pass being the movement across the commutator in either direction. Upon completion of the third pass, the stones can be fed down another 1/8 turn of the down-feed handle.

Alternating the end of the commutator from which the stones are fed down will minimize the possibility of the development of a taper across the commutator. Continue this procedure until all low areas have been completely eliminated.

NOTE

Feeding the grinding stones down more than 1/8 turn of the down-feed handle will result in very rapid wear of the grinding stones and also cause copper rollover on the trailing edge of the commutator bar. The copper rollover will have to be removed with the use of a de-burning tool. The recommended light feed will result in very small copper slivers on the trailing edge of the commutator bar which can easily be removed with a wire brush.

9. Remove the stones from the grinder and place them in their original box so that they will not become contaminated with oil or dirt. Remove the grinder and adaptor.

10. With the armature rotating, clean the outer end of the commutator bars with a small piece of grinding stone.

11. Remove and discard the brushes used to start the diesel engine.

12. Thoroughly clean the generator to remove all copper and grinding dust by directing clean, dry compressed air at moderate pressure on the face of the commutator. Blow out brush holders, stator windings, and end housing. Rotate the armature by hand when blowing out commutator slots.

13. Remove the slivers of copper on the trailing edge of the commutator bar with a clean wire brush. Position the brush close to the commutator riser with the wire bristles toward the riser face and roll the wire bristles down toward the commutator slot until they enter the slot. Move the brush across the commutator until the wire bristles have cleared the end of the commutator slots. While moving the brush across the commutator, apply moderate pressure in towards the commutator as well as pressure towards the trailing edge of the commutator bar. This procedure will remove all copper slivers on the bar and in the slots without damaging the commutator surface.

NOTE

The scratch marks will disappear when the soft grade of chalk stone is used to finish the seating of the brushes.

14. When the depth of the mica undercut between copper bars is less than 1.2 mm (3/64″), use commutator slot file, Fig. 22, to undercut the mica to proper depth. Do not exceed the undercut maximum depth of 2.4 mm (3/32″).

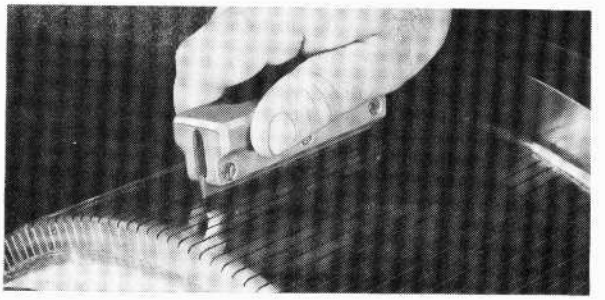


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Fig.22 – Commutator Slot File

15. Use chalk stone for final clean up of commutator. Do not use emery cloth or sandpaper for this purpose. Lubricant should never be used on commutators, as brushes have enough graphite to supply their own lubrication.

16. Rotate armature by hand and blow clean dry air into the commutator slots to remove any loose pieces of copper. Wipe dirt and copper dust away with clean cloths. Carefully inspect cleaning job and particularly the slots between commutator bars to see that all traces of undesired copper have been removed.

17. Replace brush holder assemblies and brushes. Install either new or the used brushes, but do not use any brush that had been left in the brush holder during the grinding operation. Reconnect cables.

18. Seat the brushes by wrapping 1-1/2 turns of aluminum oxide paper (with abrasive side out) around the commutator before brushes are applied. Install brushes and rotate armature until all the brushes are seated. A 90% seat is satisfactory. Complete the seating of the brushes by using a seater stone as shown in Fig. 13. Refer to Service Data for part number of seater stone and for size and grade of aluminum oxide paper.

19. Remove aluminum oxide paper and blow out carbon dust with clean, dry compressed air at reduced pressure. Do not blow carbon dust into armature coils. Blow away from commutator riser.

COMMUTATOR TURNING

If the commutator is damaged to such an extent that grinding the commutator is not effective, the generator armature will have to be removed and the commutator turned in a lathe.

1. Place a suitable covering over the armature end winding to prevent chips from working into the armature.

2. The commutator must be turned just enough to give a uniform surface. For a light machine cut the speed of the armature should be 181 RPM or 504 meters per minute (1654 feet per minute). A carboloy-tipped lathe cutting tool should be used when making a light cut.

3. Finish commutator with fine grinding stones.

4. Round off ends of the commutator segments to at least a 2 mm (1/16") radius with a fine mill file.

COMMUTATOR WEAR LIMITS

Overall Diameter – The commutator is designed for 10 mm (3/8") radial wear which allows a minimum diameter of 667 mm (26-1/4").

Neck Width – The face of the commutator is cleaned up by a light machine turned cut. The allowable minimum neck width is 17.5 mm (11/16").

COMMUTATOR UNDERCUTTING

After the commutator has been turned and ground with a fine stone, the mica between the commutator bars should be undercut to a depth of 1.6 mm to 2.4 mm (1/16" to 3/32") and a width of 0.76 mm (0.030"). Refer to Service Data for tool number of undercutting saw.

After undercutting, de-burr the commutator with a hand scraper to remove sharp edges from commutator bars. Apply crocus cloth lightly around the commutator. Remove all copper cuttings and mica with clean dry compressed air.

GENERATOR DISASSEMBLY

NOTE

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

For generator-alternator disassembly, refer to Generator-Alternator Disassembly procedure which follows.

Before generator is moved from its location, place strips of fish paper 2 mm x 80 mm x 900 mm (1/16" x 3" x 36") in the bottom air gap between the armature assembly and stator coils.

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

Refer to Fig. 23 during this procedure.

1. Mount the generator on a sturdy stand at a suitable height. Use anchor shackle and base fixture for lifting complete generator assembly.

2. Remove commutator cover.

3. Remove brushes from commutator brush holders. Place a ring of fish paper around the commutator for protection.

4. Remove insulation wrapping from bolted connections of bus bars. Remove bolts from bus bars. Remove cleats and straps from bus bars and remove bus bars.

5. Support end housing with a wire cable and a crane and remove bolts holding end housing to stator.

6. Insert three 3/4"-10 jack bolts equally spaced around the end housing. Turn jack bolts until end housing is separated from stator.

7. Remove coupling disc. Observe coupling disc position in relation to the main drive coupling. Each is stamped with the armature number in the same position to ensure coupling disc will be assembled in its original position.

8. Apply arbor fixture to bore of main drive coupling and attach a wire cable to arbor fixture.

9. Raise the arbor fixture with a second crane until the air gap is equal around the circumference of the armature.

10. Carefully remove the armature assembly from the stator, Fig. 24, moving the armature toward the commutator end of the generator until the armature clears the stator assembly and can be rested on a cradle. Ensure stand is high enough from the floor to clear the connections on the end housing.

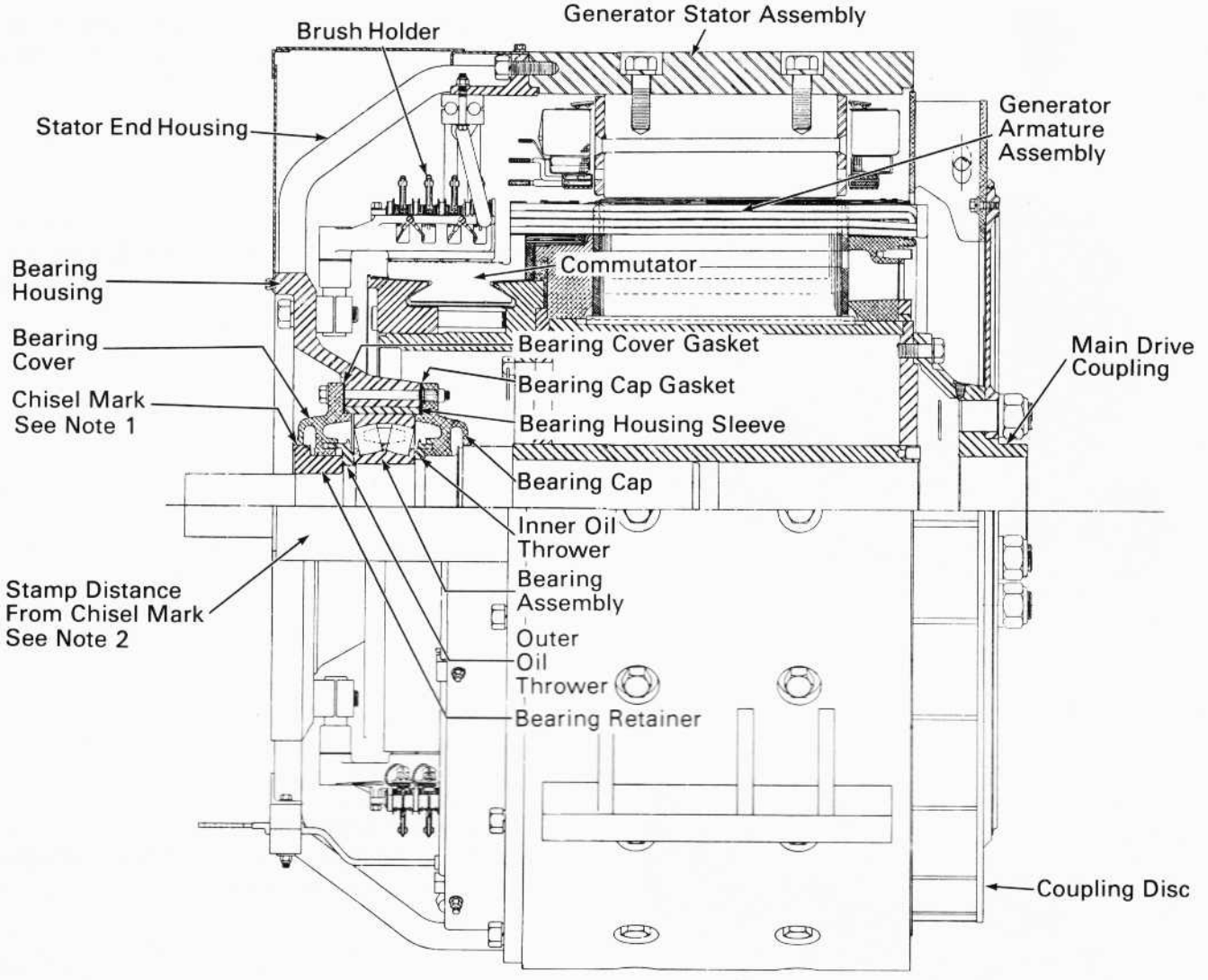

Fig.23 - Generator Assembly Cross-Section

11. Apply puller plate and studs to bearing retainer and remove bearing retainer.
12. Remove bolts from bearing cover and remove bearing cover. It may be necessary to tap cover with a rawhide mallet or soft wood hammer and gently pry with a pry bar to remove.
13. Remove stator end housing from bearing. Use care in easing bearing housing off the outer bearing race.
14. To remove the remainder of the bearing assembly, insert eight 1/2"-20 N.F. Class 3 bolts into the spline nuts which are pressed into the bearing cap. With the use of a pulling plate, Fig. 25, or a hydraulic puller, remove the inner oil thrower, the bearing, outer oil thrower, and bearing cap. All eight studs must be used when studs are applied to the bearing cap to prevent breaking the bearing cap.

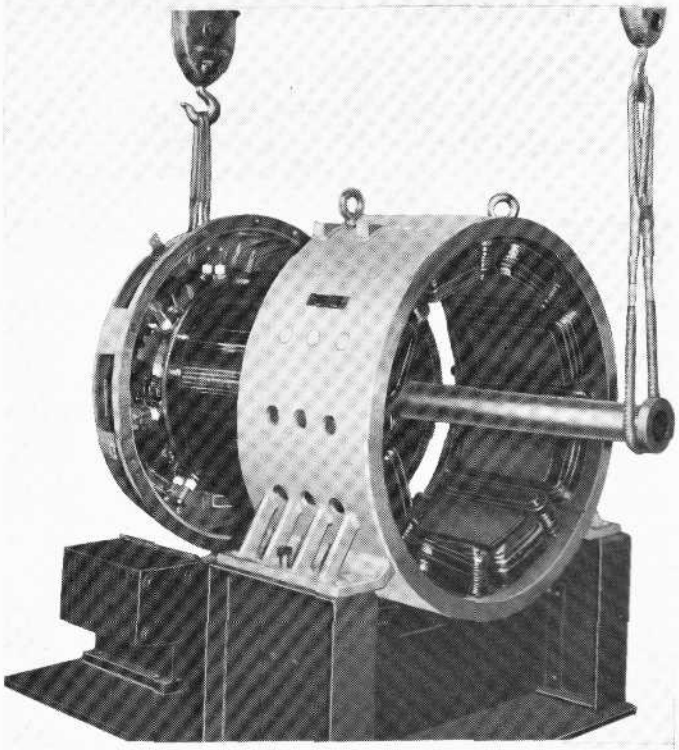

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Fig.24 – Removing Armature Assembly From Stator

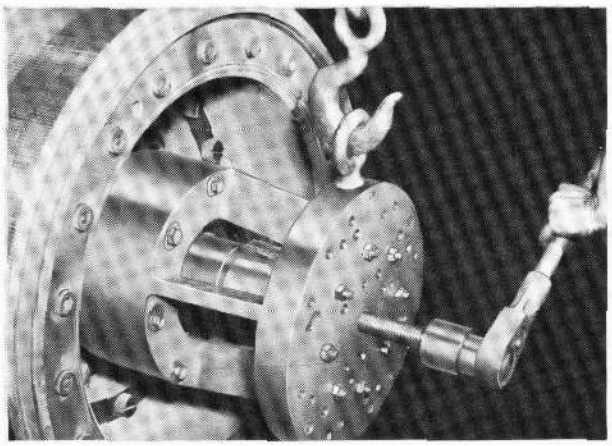

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Fig.25 – Generator Bearing Puller Plate

GENERATOR-ALTERNATOR DISASSEMBLY

NOTE

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

Before generator-alternator is moved from its location, place strips of fish paper 2 mm x 80 mm x 900 mm (1/16" x 3" x 36") in the bottom air gap between the armature assembly and stator coils.

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

Refer to Fig. 26 during this procedure.

1. Mount the generator-alternator on a sturdy stand at a suitable height. Use anchor shackle and base fixture for lifting complete generator-alternator assembly.
2. Remove air box assembly and collector ring cover, Fig. 27.
3. Remove brushes from collector ring brush holders.
4. Remove cables between collector ring brush holders and terminal board.
5. Remove brushes from commutator brush holders. Place a ring of fish paper around the commutator for protection. Fish paper does not have to be placed between the alternator rotor and alternator stator.
6. Remove insulation wrapping from bolted connections of bus bars. Remove bolts from bus bars. Remove cleats and straps from bus bars and remove bus bars.
7. Remove collector ring brush holders and cable connections, and remove cables from terminal posts to collector rings.
8. If field leads are to be replaced with new leads, unsolder terminal lugs, remove looms from leads, remove cable conduit bushing, and remove shaft flange.
9. Place an extension cup around field leads and bolt extension cup to shaft as shown in Fig. 28.
10. Install a puller plate and puller studs to remove collector ring as shown in Fig. 28. Place a hydraulic jack between extension cup and puller plate, supported by cradle studs of puller plate. Remove collector ring assembly using hydraulic jack.
11. Apply puller plate and studs to bearing retainer and remove bearing retainer.
12. Remove bolts from bearing cover and remove bearing cover. It may be necessary to tap cover with a rawhide mallet or soft wood hammer and gently pry cover with a pry bar to remove.

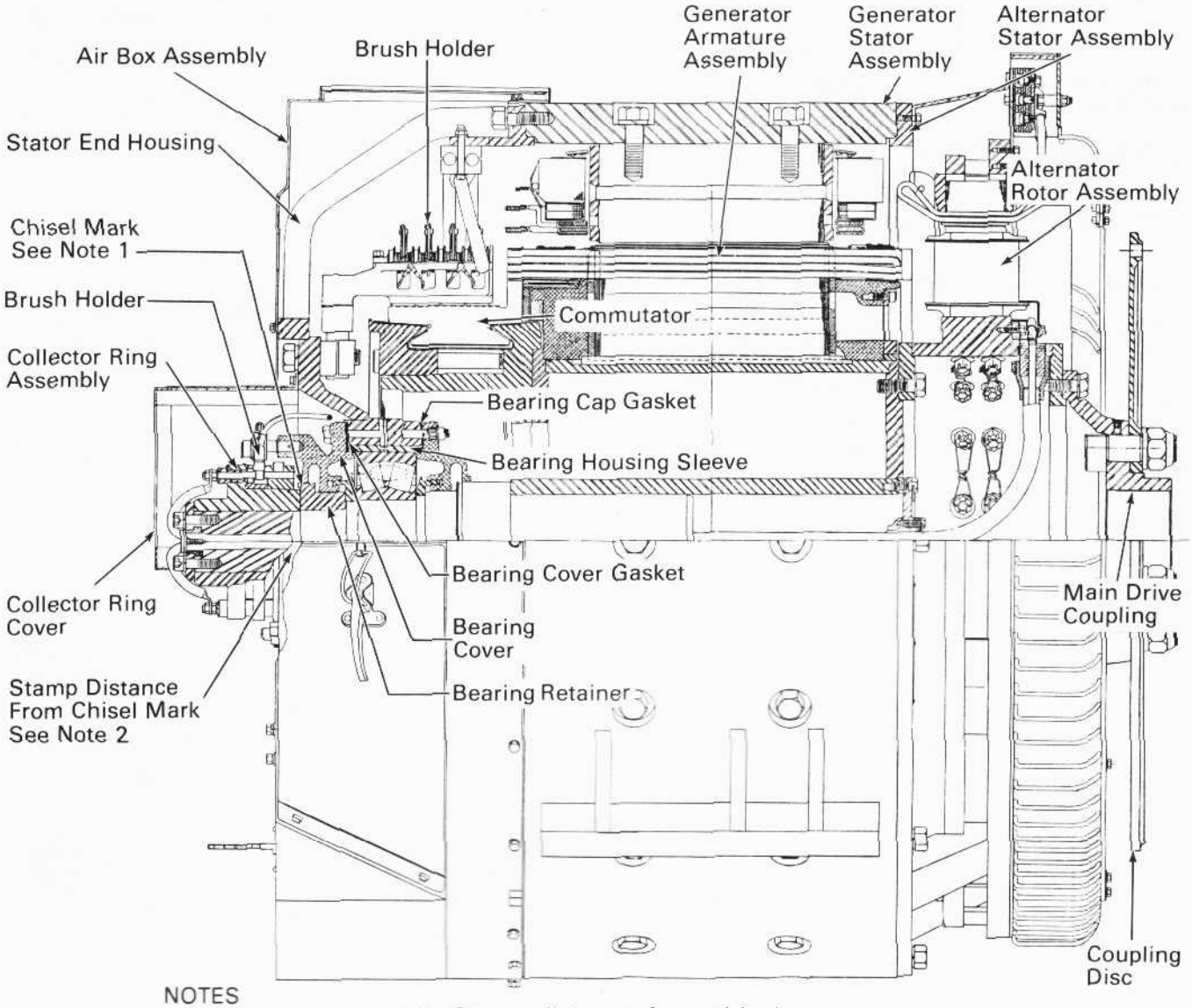

Fig.26 – Generator-Alternator Assembly Cross-Section

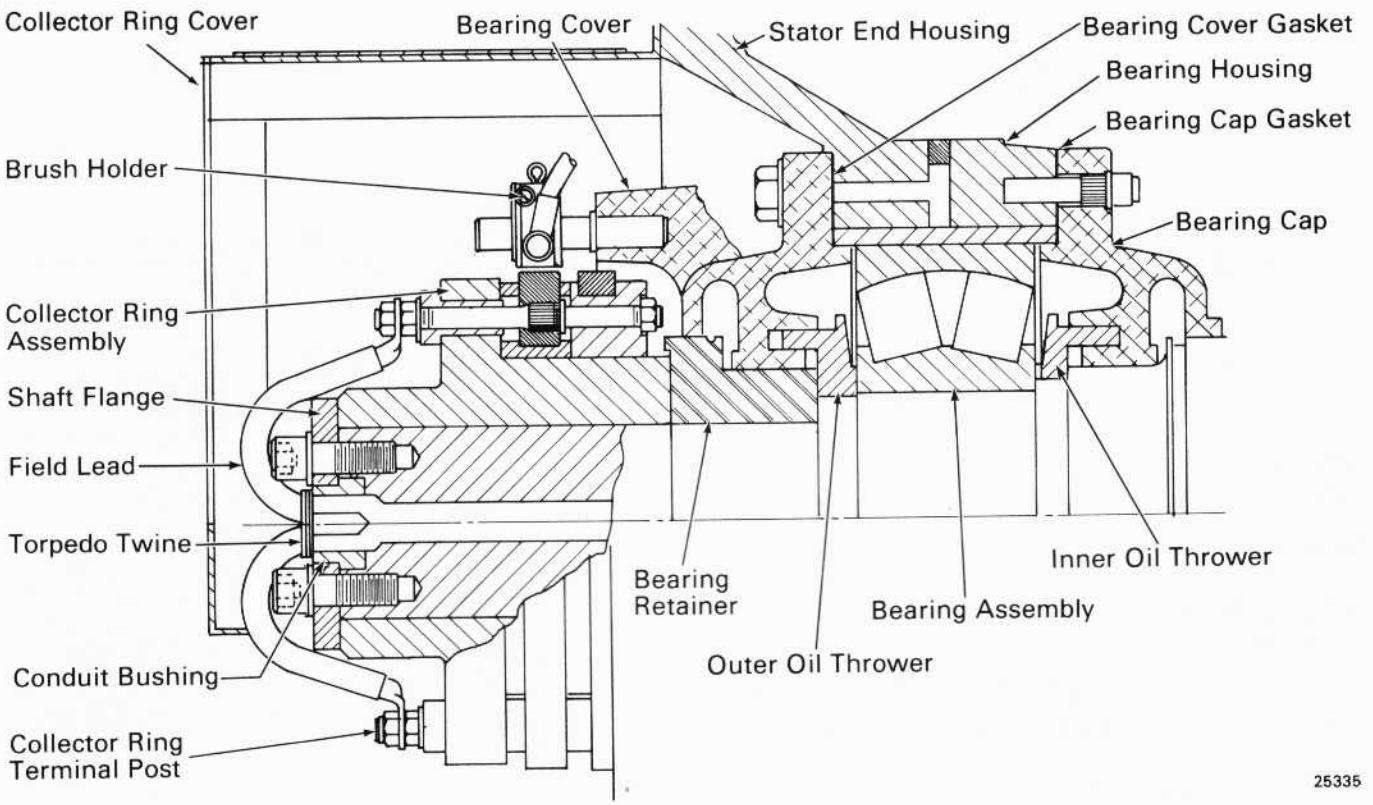

Fig.27 - Collector Ring And Bearing Assembly Cross-Section

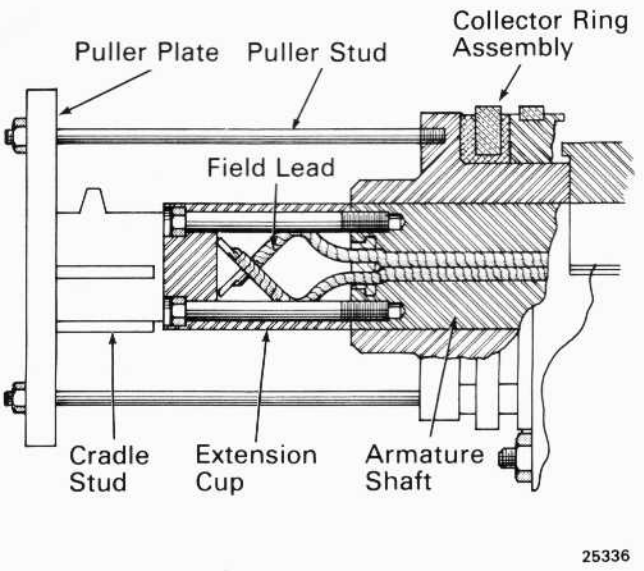

Fig.28 - Collector Ring Removal

13. Support end housing with a wire cable and crane and remove bolts holding end housing to stator frame.

14. Insert three 3/4"-10 jack bolts equally spaced around the end housing. Turn jack bolts until the end housing is separated from the stator. Remove end housing. Use care in easing bearing housing off the outer bearing.

15. Apply arbor fixture over the commutator end of the armature shaft and attach a wire cable to arbor fixture.

16. Raise arbor fixture with a crane until air gap is equal around the circumference of the armature.

17. Place a wire cable loop over main drive coupling and using a second crane, raise the armature off the pole pieces.

18. Carefully remove the armature assembly from the stator, moving the armature toward the alternator end until the armature clears the stator assembly and can be rested on a cradle.

To remove the remainder of the bearing assembly, insert eight 1/2"-20 N.F. Class 3 spline nuts which are pressed into the bearing cap. With the use of a pulling plate, Fig. 29, or a hydraulic puller, remove the inner oil thrower, the bearing, and bearing cap. All eight studs must be used when studs are applied to the bearing cap to prevent breaking the bearing cap.

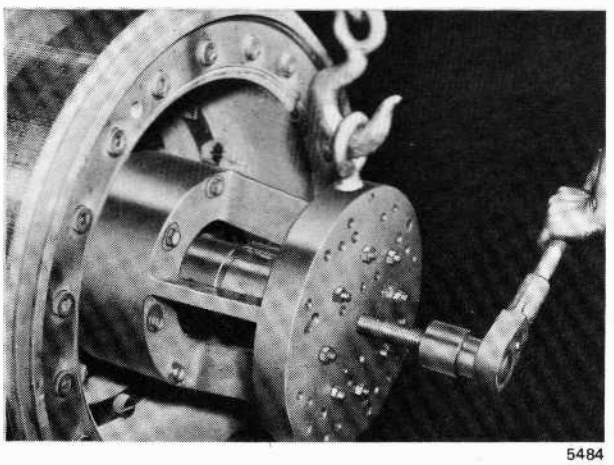

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Fig.29 – Generator Bearing Puller Plate

REMOVING ALTERNATOR STATOR (Generator-Alternator Unit Only)

1. Remove alternator stator enclosure, if required.

2. Properly support alternator stator. If unit has ventilating openings around the stator frame, place a steel cable through the top two ventilating openings. Support the alternator stator with a crane, but do not apply too much tension, as some alternator stator frames are constructed of cast aluminum and could crack.

3. Remove bolts holding alternator stator frame to generator frame.

4. Install 1/2"-13 jacking bolts in the tapped holes provided in the alternator stator frame. Rotate jacking bolts evenly, taking care to avoid binding.

5. Remove alternator stator.

REMOVING ALTERNATOR ROTOR (Generator-Alternator Unit Only)

1. Remove generator coupling disc, if not removed earlier.

2. Mark the position of generator main drive coupling, Fig. 30, on the alternator rotor spider with a cold chisel to assure reassembly in original position. Remove bolts holding main drive coupling to alternator rotor spider. Install three 1/2"-13 jacking bolts in the tapped holes provided in the main drive coupling. Rotate jacking bolts evenly to remove main drive coupling from alternator rotor.

3. Support alternator with a crane, using a sling as shown in Fig. 31.

4. Remove lockwire and bolts holding conduit tube sleeve and conduit tube flange to generator armature. Ensure alternator field leads are disconnected at collector ring terminal posts.

5. Remove bolts holding alternator rotor to generator armature.

6. Install three 1/2"-13 jacking bolts in holes provided in armature spider. Rotate jacking bolts evenly to avoid binding. Remove alternator rotor.

STATOR ASSEMBLY

CLEANING

The extent of stator cleaning required is determined by the operation and service the generator is subjected. When the generator armature assembly is removed from the stator it is advisable to

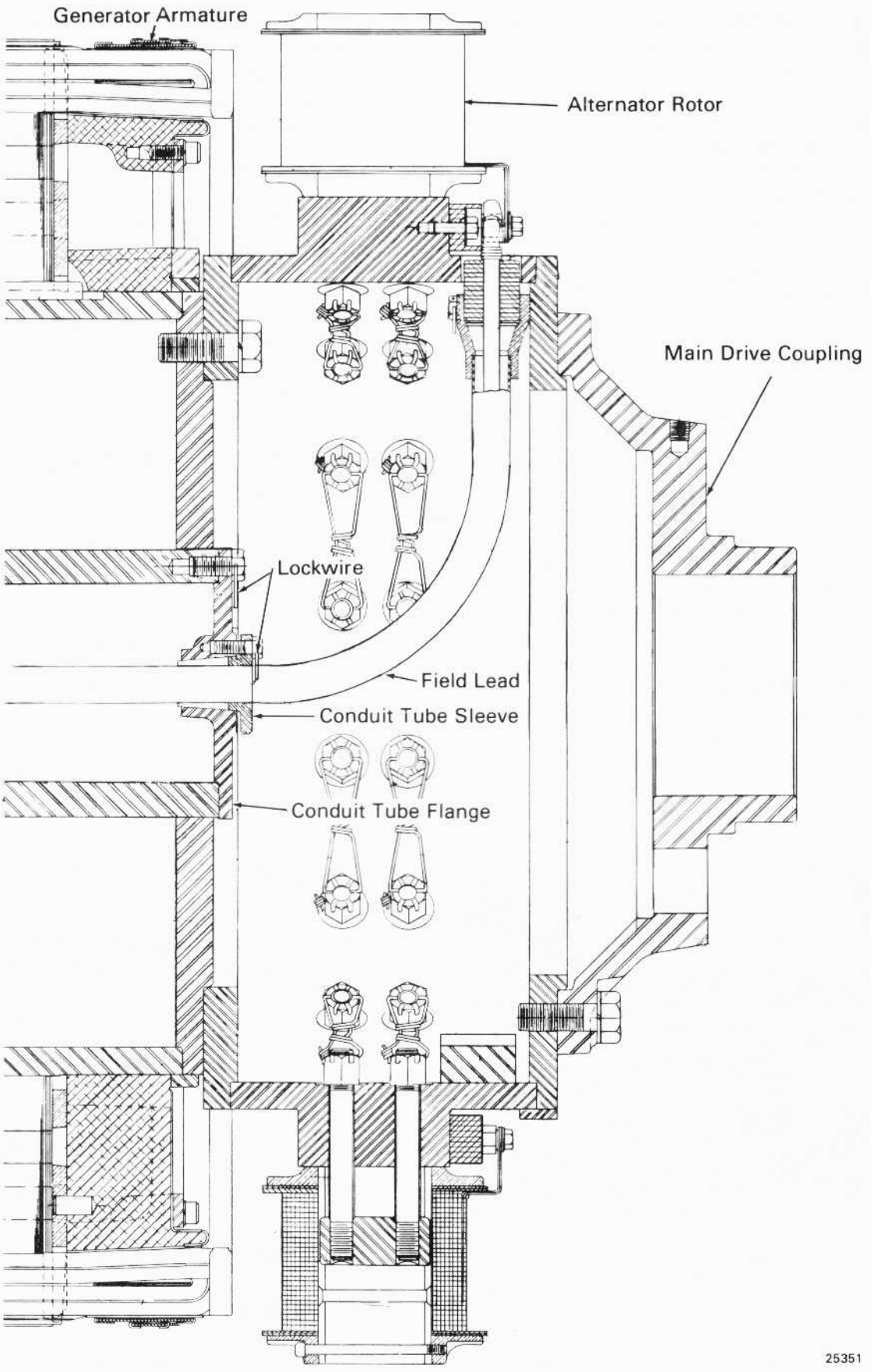


Fig.30 – Alternator Rotor Assembly To Generator Armature

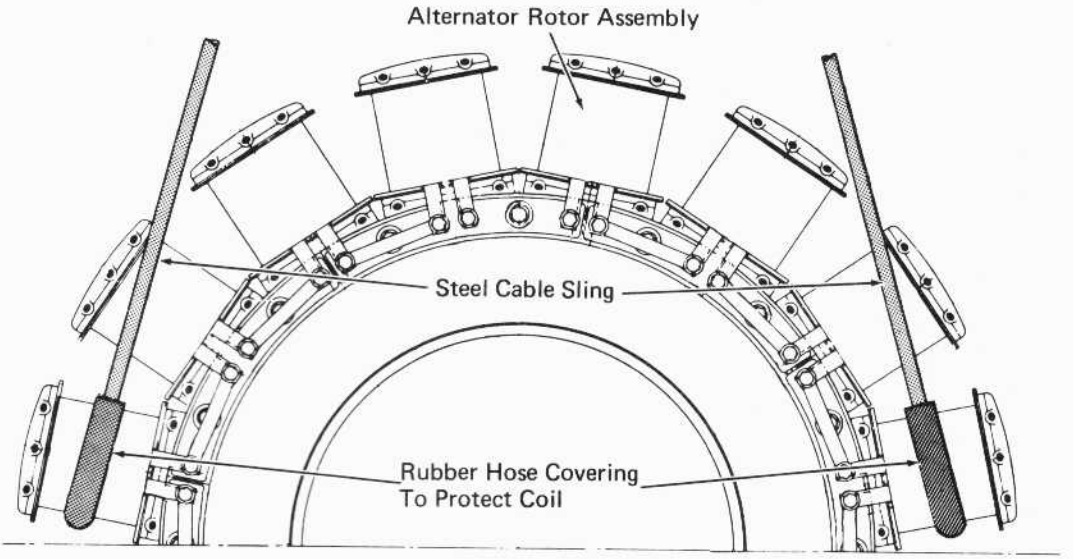


Fig.31 – Alternator Rotor Support

thoroughly clean the stator. The stator should be cleaned to remove all carbon dust, grease, and dirt.

One satisfactory method of cleaning and degreasing the stator is by granulated corn cob material applied with a controlled air blast. This method produces a clean, bright, oil free surface suitable for immediate varnish treatment.

When using the granulated corn cob air blast method, care should be exercised as it is possible to remove varnish and cut into the layers of insulation by prolonged application of the blast material. The pressures used with this method of cleaning should be from 300 to 400 kPa (45 to 60 psi).

The corn cob material trapped in the pockets or crevices of the stator should be removed by a straight air blast at reduced air pressure.

If air blast equipment is not available, or if it is determined that the stator does not require extensive cleaning, refer to Generator Cleaning paragraph of this instruction.

If a solvent is used to clean the stator assembly, the stator assembly should be thoroughly dried out by placing the stator assembly in a convection-type oven and baked at 115°-125° C (239°-257° F) for 3 to 6 hours.

INSPECTION AND REPAIR

Inspect the condition of the main pole and interpoles for charred or damaged insulation, or rubbed or deformed pole faces.

Overheating of field coils may result from a partial short circuit or a short in one of the field coils.

Removal of field pole cores from the field assemblies is not recommended. Loose poles should be tightened and loose ties must be replaced.

Pole pieces with a rubbed or deformed face should be replaced with a new or reconditioned pole. Main pole and interpole assemblies are only serviced as complete units.

Before removing any field poles from the stator assembly, obtain a measurement with an inside micrometer, from pole face of pole to be removed, to the diametrically opposite pole face. Record this measurement. Obtain a pole spacing measurement between the side of the main pole core and the side of the adjacent interpole cores, and record this measurement. These measurements are used for aligning new poles. Ensure there is no excess varnish at points of measurements.

Field poles or interpoles should be removed as a complete assembly, and the defective assemblies should be returned to Electro-Motive.

When replacing field poles, line up pole washer and spring assembly before tightening the pole bolts. Reassemble all interpole shims in their original position.

Before soldering or brazing connector straps or cable connections, align the pole spacing as follows. Refer to Fig. 32.

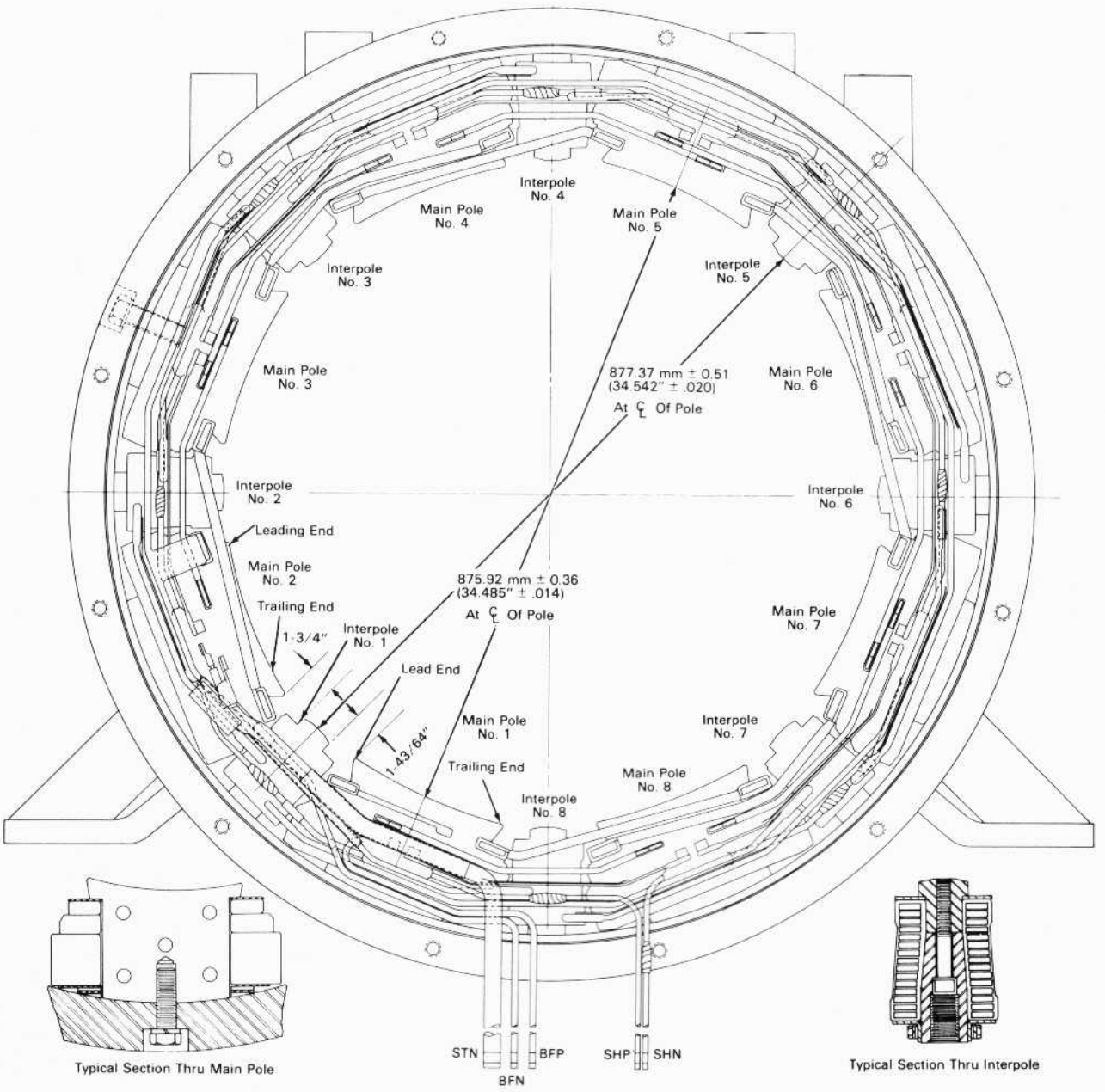


Fig.32 – Generator Stator Assembly 25352

1. The pole spacing between the side of the interpole core and the adjacent side of the lead end of the main pole core has a nominal spacing of 42.5 mm (1-43/64″). The pole spacing between the side of the interpole core and the adjacent side of the trailing end of the main pole core has a nominal spacing of 44.5 mm (1-3/4″). The total variation between these spacings shall not exceed 12.7 mm (.050″).

2. Every interpole air gap of the stator shall be within plus or minus 0.51 mm (.020″) of the average interpole air gap of the stator. Take air gap readings at centerline of the poles.

3. Every main pole air gap of the stator shall be within plus or minus 0.36 mm (.014″) of the average main pole air gap of the stator. Take air gap readings at the centerline of the poles.

4. The spacing from the centerline of one main pole to the centerline of the adjacent main pole shall not vary from a nominal centerline by more than 0.8 mm (1/32″).

STATOR CONNECTOR JOINTS

The generator stator has the following connections. Refer to Service Data for material part numbers.

CAUTION

Ensure solder does not run down the field conductors when performing any of the soldering operations.

1. Battery field connections are soldered with tin base (50-50) solder.

2. Shunt field coil lead connections are pressure applied crimp-type connections.

3. Interpole connector joints are brazed with brazing tongs and Sil-Fos solder.

4. All other cable and connection joints are soldered with Hi-Temp solder.

INSULATION OF CONNECTIONS

Connections, straps, and cable leads to coils should be inspected to determine if they are properly connected and secured. If connections are satisfactory, insulate as follows:

Shunt field connections –
Two layers of vinyl tape half-overlapped.

One layer of glass adhesive tape half-overlapped.

Apply fish paper insulation around shunt cables and tie to interpole straps with torpedo twine.

Interpole soldered connections next to frame –
Two layers of vinyl tape half-overlapped.

One layer of glass adhesive tape half-overlapped. Paint glass adhesive tape with red air drying enamel.

Battery field soldered connections –
Two layers of vinyl tape half-overlapped.

One layer of glass adhesive tape half-overlapped.

Insulate between battery connectors and starting connectors with fish paper 8095000. Tie with 1.6 mm (1/16″) torpedo twine.

Insulate between starting connectors with fish paper 8097643. Tie with 1.6 mm (1/16″) torpedo twine.

Insulate between interpole connectors with fish paper 8080042. Tie with 1.6 mm (1/16″) torpedo twine.

Wrap interpole connector with one piece of insulation 8080039. Tie with 1.6 mm (1/16″) torpedo twine.

Insulate external lead cables with two layers of glass adhesive tape half-overlapped as follows:

Starting leads –
Tape 152 mm (6″) from coil connector and extend 25 mm (1″) beyond clamp.

Battery leads –
Tape from coil to 25 mm (1″) beyond clamp.

Shunt leads –
Tape from splice to 25 mm (1″) beyond clamp.

Insulate the internal bolted connections with one layer, double thickness Empire cloth. Tape over Empire cloth with two layers of vinyl tape half-overlapped. Apply one layer of glass adhesive tape over vinyl tape.

Seal pole bolt holes above the horizontal centerline with a liberal coat of liquid neoprene.

STATOR ELECTRICAL INSPECTION

After stator is clean and dry, the following electrical tests should be made. Refer to Fig. 33.

HIGH POTENTIAL TEST

Before high potential tests are made, it is highly desirable to check first with a megohmmeter. A megohmmeter reading of 2 megohms, when tested with a 1000V 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 on 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 wil increase the leakage effect.

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

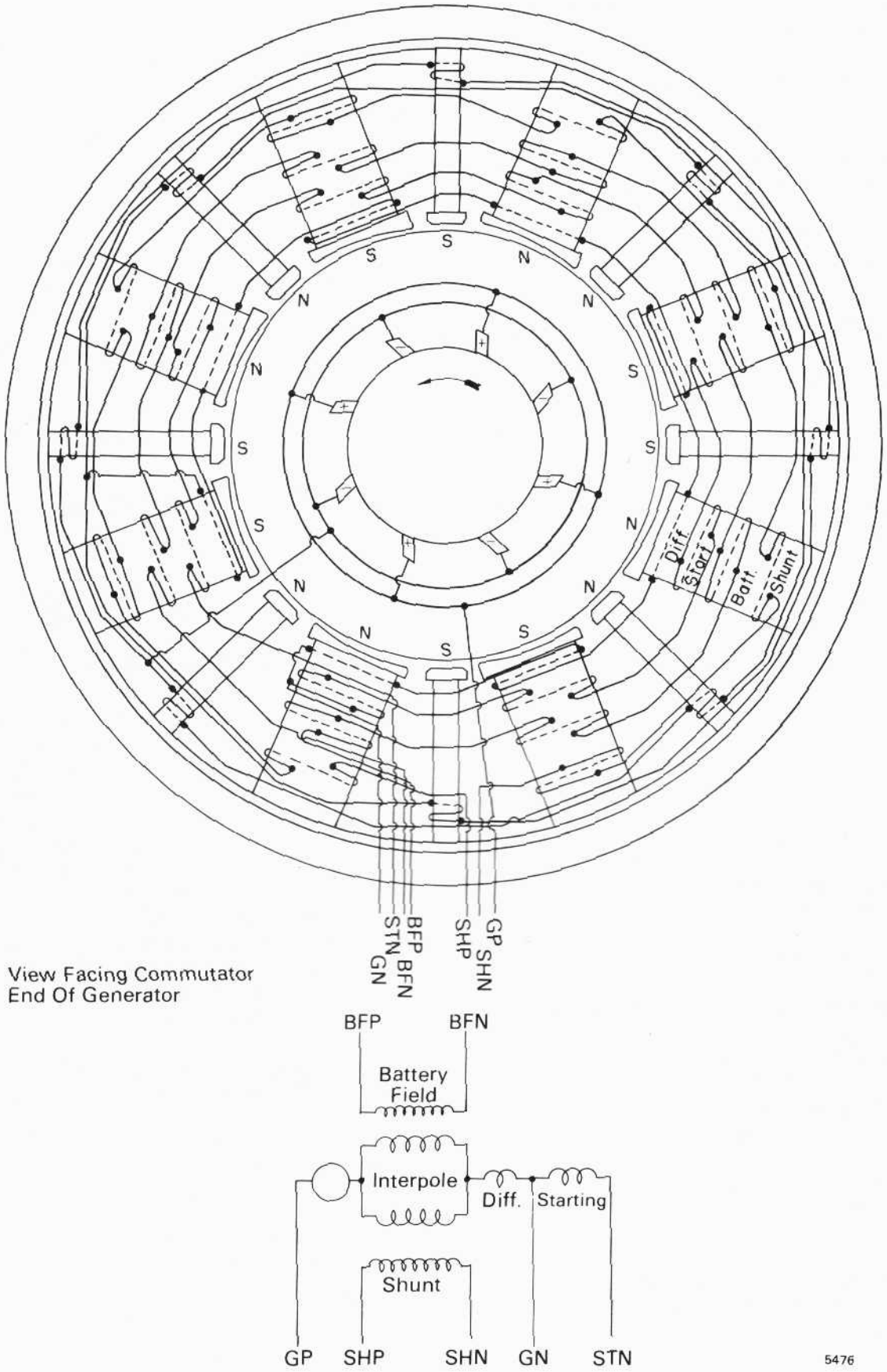


Fig.33 – Generator Wiring Diagram

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.

3. Perform high potential test as follows:

   a. Apply 4200 volt high potential test for 10 seconds to main circuits, ground the battery and shunt field circuits.

   b. Apply 4200 volt high potential test for 10 seconds to shunt field, ground both leads of battery field.

   c. Apply 1200 volt high potential test for 10 seconds to battery field, ground both leads of shunt field.

COLD RESISTANCE TEST

Make a cold resistance measurement of the stator fields. The resistance values of the field circuit should be as follows when corrected to 75° C (167° F).

Differential field	0.000898 to 0.000934 ohms
Interpoles	0.00405 to 0.00421 ohms
Starting field	0.00514 to 0.00536 ohms
Battery field	1.117 to 1.163 ohms
Shunt field	
D15 and D15A	106.4 to 110.8 ohms
D15B and D15C	71.3 to 74.3 ohms
D25B and D25C	71.3 to 74.3 ohms

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

$$\text{resistance at } 75^\circ \text{ C} = \frac{\text{measured resistance x } 309.5}{234.5 + \text{temperature of item being tested in } ^\circ\text{C}}$$

POLARITY TEST

If resistance is satisfactory, polarity should be checked to determine that the coils are properly located in their magnetic position. Using low voltage DC power supply and a compass, check the polarity as follows:

1. Apply 15 volts to shunt or battery fields. Hold compass at center of the top main field coil. The compass should indicate a north or south pole reading. Refer to Fig. 33. Move compass from pole to pole. Each pole should indicate a definite change in polarity on the compass. If compass does not indicate a definite change in polarity, two poles of the same polarity are positioned next to each other or there is a wrong connection at the bus bars.

2. Apply 80 amperes DC to the starting, differential, and interpole fields. Check the interpoles in the same manner as the main poles.

3. If there is evidence of wrong polarity in either the main or interpoles circuits, the defective coils or connections will have to be corrected to obtain proper generator performance.

ARMATURE ASSEMBLY

The armature should be closely inspected for the condition of bands, wedges, coils, insulation, general assembly and commutator.

Armature bands and core wedges should be tight and secure. The soldering on the bands should be intact. If solder has been thrown off, the cause should be determined and corrected, and bands replaced. Unless proper facilities for banding are available, the generator should be returned to Electro-Motive.

The coil insulation should be clean and free from blisters, flakes, or cracks on the insulating varnish surface. When the condition of the insulating varnish on the armature requires treatment, and the proper facilities for vacuum impregnating are not available, return the generator to Electro-Motive.

If solder has been thrown out of the commutator risers, the armature may have to be rewound.

The surface of the commutator should present an even, smooth appearance, free from pitting. Under normal conditions where split type brushes are used, cleaning of the commutator with a cleaning stone should not be necessary.

If the commutator is etched, burned, or pitted to the extent that resurfacing is required, grinding will be necessary. Refer to Commutator section of this instruction.

CLEANING

The extent of armature cleaning required is determined by the operation and service the

generator has been subjected. When the armature assembly is removed from the stator, it is advisable to thoroughly clean the armature. The armature should be cleaned to remove all carbon dust, grease, and dirt.

One satisfactory method of cleaning and decreasing the armature is by granulated corn cob material applied with a controlled air blast. This method produces a clean, bright, oil free surface for immediate varnish treatment.

When using the granulated corn cob air blast method, care should be exercised as it is possible to remove varnish and cut into the layers of insulation by prolonged application of the blast material. The pressures used with this method of cleaning should be between 300 to 400 kPa (45 to 60 psi).

The corn cob material trapped in the pockets and crevices of the armature should be removed by a straight air blast at reduced air pressure.

If air blast equipment is not available or if it is determined that the armature does not require extensive cleaning, refer to Generator Cleaning paragraph of this instruction.

If a solvent is used to clean the armature assembly, the armature assembly should be thoroughly dried out by placing the stator assembly in a convection-type oven and baked at 115°-125° C (239°-257° F) for 3 to 6 hours.

INSULATION RESISTANCE AND HI-POT TEST

Perform an insulation resistance test on the armature using a megohmmeter test set. If a megohmmeter reading of less than 2 megohms is found, bake armature for four hours at 110° C (230° F) in a convection type oven. Recheck armature megohm reading after cooling armature to room temperature. If the reading is still low, strip and rewind armature.

When armature passes the megohmmeter test, apply a high potential test at 3200 volts at ambient temperature. If armature fails on high potential test and the ground or short is located in one of the upper armature coils and the armature is otherwise sound, the top section of that coil can be raised out of the core slot and a new ground insulation (or cell) should be applied. If ground or shorts are located in bottom section of coil or cannot be located, the armature must be stripped and rewound.

When the armature passes high potential test, apply a bar-to-bar resistance comparison test (ductor test) with a low resistance ohmmeter test set. If the test indicates resistance readings are 10% or more above normal, hand solder all coil leads to commutator neck connections.

If test indicates resistance readings of 1/2% or more below normal, this will indicate a short which must be eliminated, or the armature must be stripped and rewound.

After soldering and clearing of shorts, apply a second ductor test to ensure that the faults have been corrected.

VACUUM IMPREGNATING ARMATURE ASSEMBLY

Armatures which pass the insulation resistance and hi-pot test should be varnish treated. Varnish should be thinned to maintain Ford cup No. 4 orifice viscosity at 250-325 seconds at 21.1° C (70° F). Refer to Service Data for varnish and thinner information.

Perform vacuum impregnation of armature assembly as follows:

1. Clean armature core section thoroughly with Xylol or petroleum solvent and wipe dry with clean dry cloths.

2. Preheat armature in a convection oven so that the average armature core temperature stabilizes at 120° C + 5° - 10° C (248° F + 9° - 18° F). Ensure core temperature does not exceed 125° C (257° F).

NOTE

Armature core temperature must be between 110°-120° C (230°-248° F) for impregnation cycle. If armature is overheated, allow to cool until the desired temperature of 120° C (248° F) is reached.

3. Remove armature from oven and place in vacuum impregnation tank. Do not allow armature core to cool below 110° C (230° F) before placing in tank.

4. Apply 710-760 mm (28"-30") vacuum to tank for 15 minutes.

5. With vacuum still on tank, run varnish into tank to level of commutator risers. Break down

foam by occasionally injecting small amounts of CO_2 into impregnating tank as varnish rises around armature. If the vacuum is not sufficient to draw varnish up to the required level, CO_2 may be injected into the tank to force the varnish up to the desired level. Do not open release valve to admit atmospheric air into the impregnating tank.

6. Reduce vacuum to zero with CO_2 additions. Check that varnish is at proper level, then increase CO_2 pressure to 200-275 kPa (30-40 psi). Allow armature to remain under pressure for a minimum of 15 minutes to a maximum of 20 minutes.

7. Reduce CO_2 pressure to 70-100 kPa (10-15 psi) by opening the vacuum valve. Do not open release valve to atmospheric air. Empty varnish from impregnating tank using the 70-100 kPa (10-15 psi) CO_2 pressure.

8. Immediately pull vacuum on impregnating tank by opening the vacuum valve. Hold 710-760 mm (28″-30″) vacuum for 30 minutes (pressure must be corrected to sea level).

9. Remove armature from impregnation tank and wash varnish from shaft, and commutator face and risers with a rag saturated with petroleum solvent.

10. Place armature in a convection oven.

NOTE

Bake cycle should start within 15 minutes after completion of impregnation cycle.

11. Attach thermocouple to armature commutator. Bake armature 9 hours after average core temperature reaches 155° C (311° F). Ensure commutator temperature does not exceed 155° C.

12. Remove armature from oven.

13. Armatures which have been rebuilt should be tested at 3200 volts to ground for 60 seconds at 50° ± 10° C (122° ± 18° F).

MAGNETIC PARTICLE INSPECTION

A magnetic particle inspection should be performed to qualify the shaft for reuse. Ensure the shaft is clean and free of all rust and oil.

The shaft must be magnetized to perform a magnetic particle inspection, but the shaft may retain enough residual magnetism to check. Check the shaft for residual magnetism by one of the following two methods:

1. Apply magnetic powder to the end of shaft. The powder should adhere. If it does not adhere, it will be necessary to magnetize the shaft.

2. Suspend a short length of iron or steel wire at the end of a piece of string near the end of the shaft. Observe any attraction of the wire to the shaft. If no attraction is observed, it will be necessary to magnetize the shaft.

NOTE

If there is any doubt as to the shaft being sufficiently magnetized, the shaft should be magnetized.

The shaft can be magnetized by using a unit capable of producing 500 to 700 amperes of alternating current and wrapping three turns of No. 0000 flexible cable around the ends of the shaft.

Apply current to the cable turns to magnetize the shaft.

After it is determined that shaft is magnetized, apply magnetic powder sparingly to the machined surfaces, refer to Fig. 34. Any cracks or defects are causes for rejection.

Production tolerance for armature shaft bearing seat is 120.040 mm, +0.000, -0.013 (4.7260″, +.0000, -.0005).

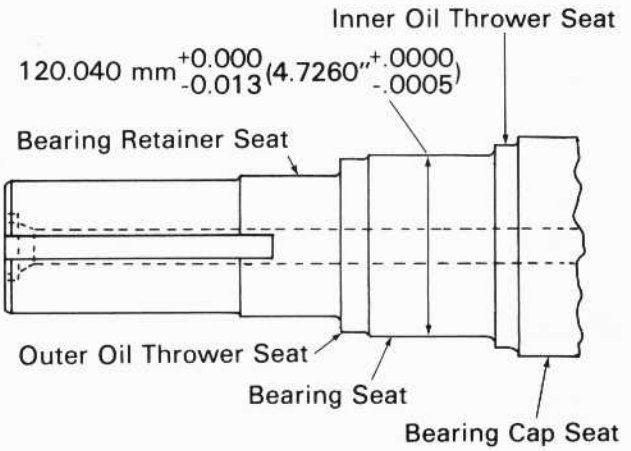


Fig.34 - Armature Shaft

DYNAMIC BALANCING

The generator armature and the alternator rotor are dynamically balanced individually (the alternator rotor at 500 RPM and the generator armature at 375 RPM) and as a generator armature and alternator rotor assembly at 375 RPM. After dynamic balancing, the assembly is floated through and checked at the critical speed of balancing machine.

When balancing generator armature assembly, counterweights are added to the spider on the rear end of armature and to the inside diameter of the commutator "V" ring.

When balancing alternator rotor assembly, counterweights are added to each end of the inside diameter of the rotor spider.

When balancing generator armature and alternator rotor assembly, counterweights are added to outside diameter of the alternator rotor spider and the inside diameter of the commutator "V" ring.

BEARING INSPECTION

The roller bearing should be thoroughly inspected for possible evidence of impending failure. If the bearing shows signs of distress, it should be replaced with a new bearing. The following procedure is helpful in inspecting bearings.

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. After inspection, bearings should be dipped in hot oil to prevent corrosion, unless they are to be used immediately. A good grade of bearing oil should be used, or grease that is used for its lubrication in service.

CAUTION

Adequate ventilation and safety precautions are necessary when handling inflammable fluids.

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 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 showing signs of cracks or craters of any size, regardless of how small they may be, should be replaced with a new bearing.

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 the bearings which have been run. However, should the bearing show signs of more than normal distress, and should there be 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 replaced with a new bearing.

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 replaced with a new bearing.

BEARING CAGES

Bearing cages which show excessive wear should be replaced with a new bearing.

GENERATOR ASSEMBLY

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 stator end 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.

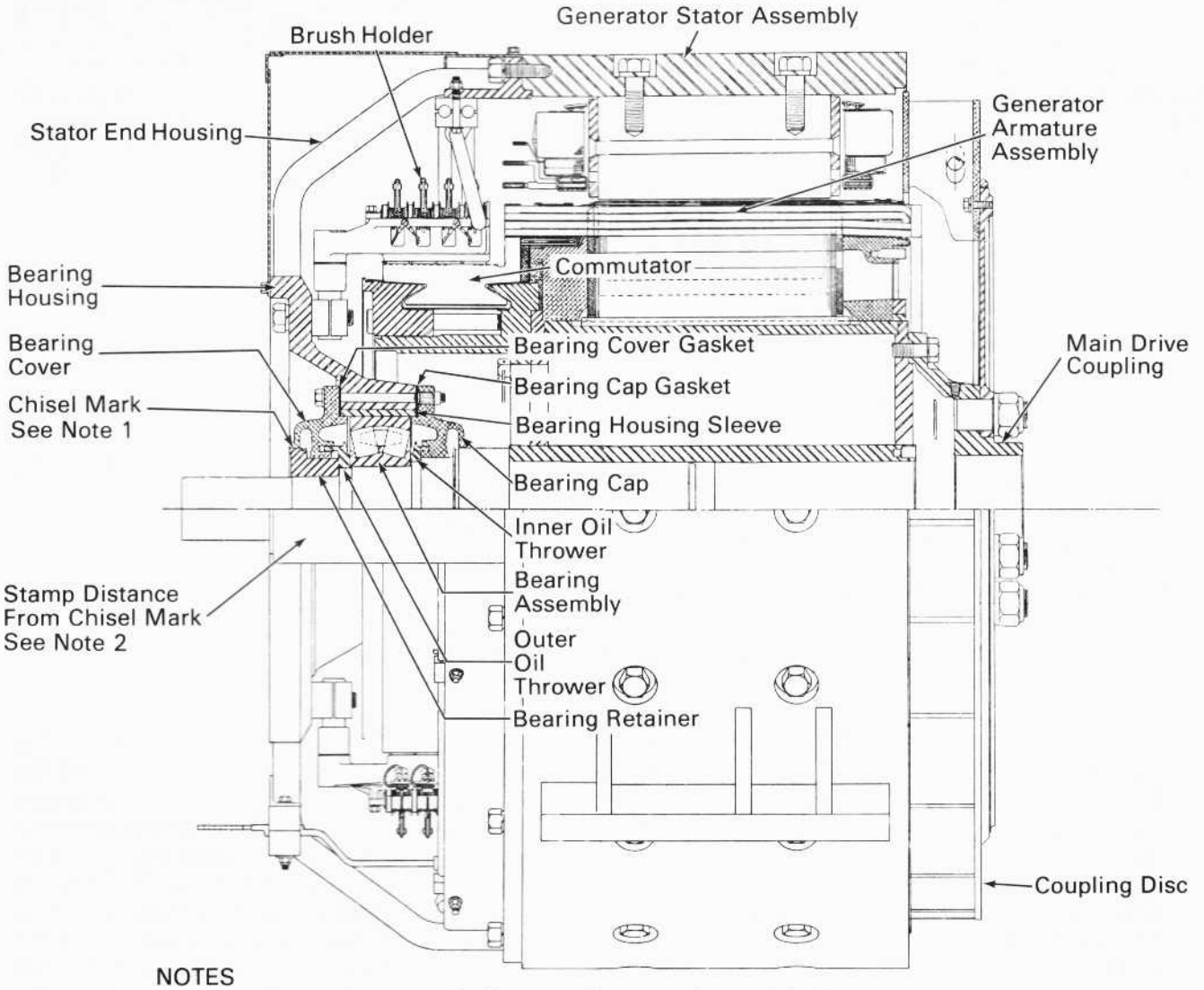
If a new bearing and housing are being used, it may be necessary to hone housing bore. The bearing must have a push-fit having clearance of 0.05 mm to 0.08 mm (.002″ to .003″). Refer to Service Data for bearing dimensions and tolerances.

Refer to cross-section of generator, Fig. 35, or cross-section of generator-alternator, Fig. 36, during assembly procedure.

BEARING AND END HOUSING ASSEMBLY

1. Remove old grease from bearing cap and cover. Clean bearing cap and cover. Repaint with crankcase paint and allow to dry.

2. Fill the labyrinth grooves in the bearing cap and cover with Unirex N-2 grease, Fig. 37. This grease need not be measured.



NOTES

1. With shaft all this way → chisel mark bearing retainer flush with edge of bearing cover.

2. Stamp distance from chisel mark to end of bearing retainer, on rib of bearing end housing assembly.

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Fig.35 – Generator Assembly Cross-Section

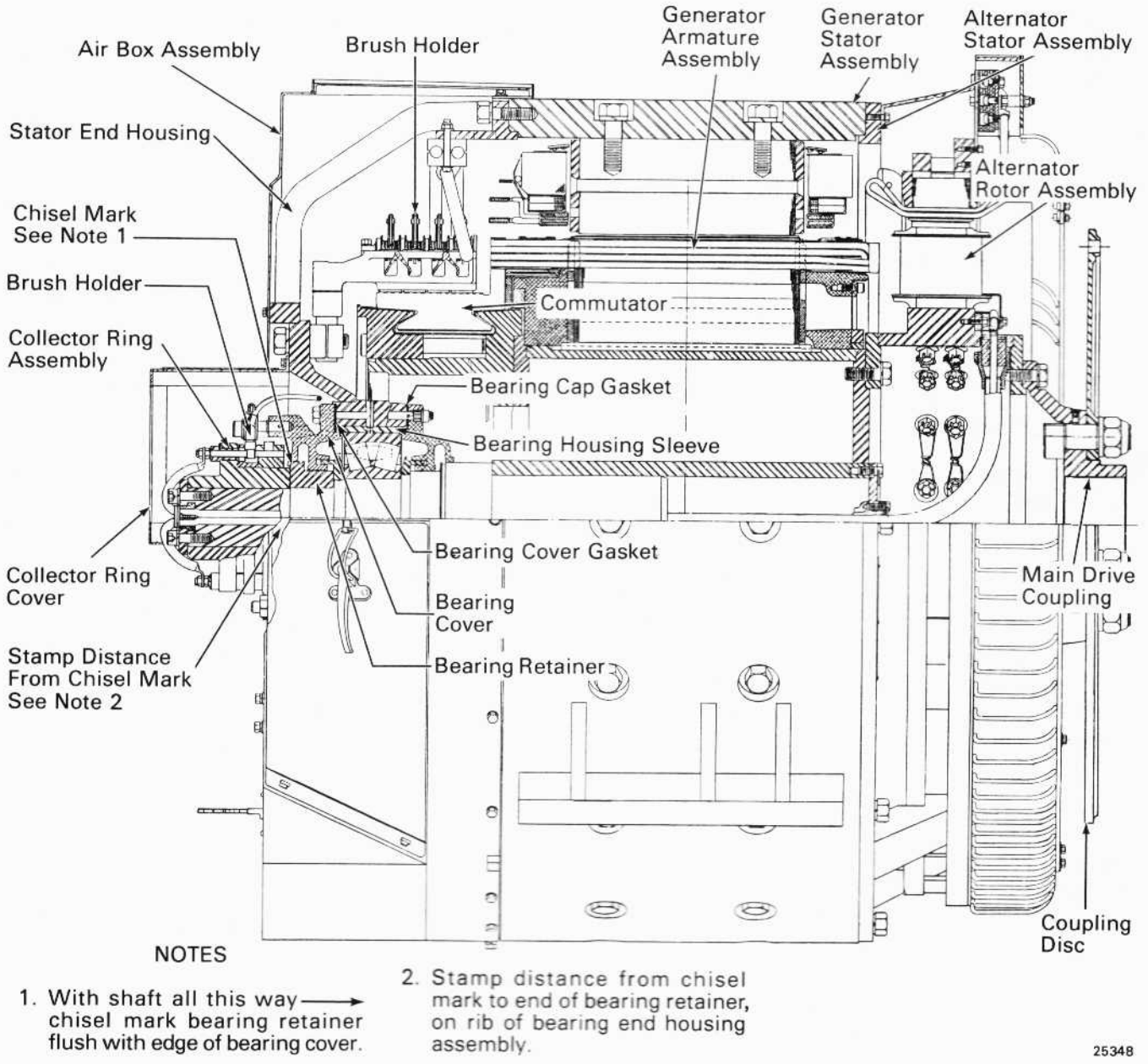

Fig.36 – Generator-Alternator Assembly Cross-Section

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

4. Carefully weigh the grease for the bearing cap and cover cavity. Refer to Service Data for quantity.

CAUTION

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

5. Pack grease into the bearing cap and cover cavities. Leave a free space at the top of the bearing cap and cover to limit grease churning and liquefaction of the grease. Using a spatula or putty knife, roughly form the grease to desired contour as shown in Fig. 37 and apply grease mask. Refer to Service Data for grease mask part number. The grease cavity should be filled to complete an arc of 240° to 270°. The grease arc must be packed without air voids.

6. Rotate grease mask to form proper contour, keeping grease mask seated. Several turns may be required to get proper contour. Use spatula or putty knife to fill low spots with grease from

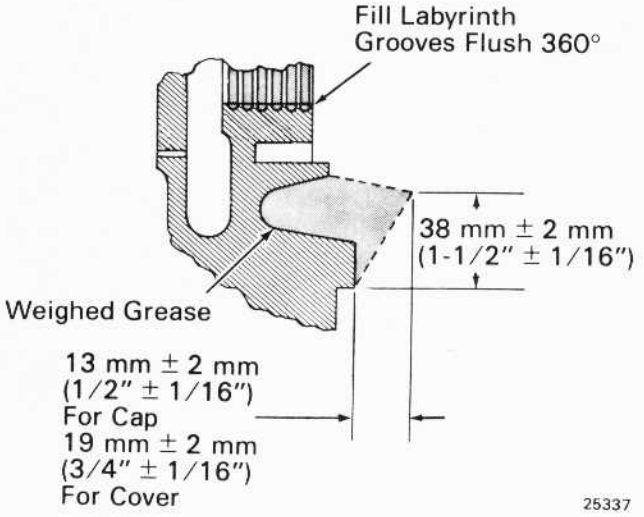

Fig.37 – Application Of Grease To Bearing Cap And Bearing Cover

the grease mask blade. The small amount of grease retained on the blade should be removed and applied to the ends of the grease arc. The contour should be built up to the limits of Fig. 37.

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

8. Place bearing cap on shaft. Ensure space free of grease is at the top of the bearing cap. Refer to Fig. 38 for bearing assembly cross-section.

CAUTION

Use care when heating bearing parts. Overheating may result in warping or damaging the metal.

9. Heat the inner and outer oil thrower in an oil bath, electric oven, or induction heater to 120° C (248° F). If an oil bath is used for heating, remove oil from inner and outer oil throwers with clean, bound-edge cloths prior to shrinking to shaft. When using induction heater, pyrometer readings (with heater current off) should be taken periodically.

10. After inner oil thrower is heated to proper temperature, shrink the inner oil thrower to the shaft. Refer to Fig. 38 for position. Allow inner oil thrower to cool to room temperature.

11. Pack the bearing rollers and the space between the two rows of rollers completely with the quantity of grease specified in the Service Data.

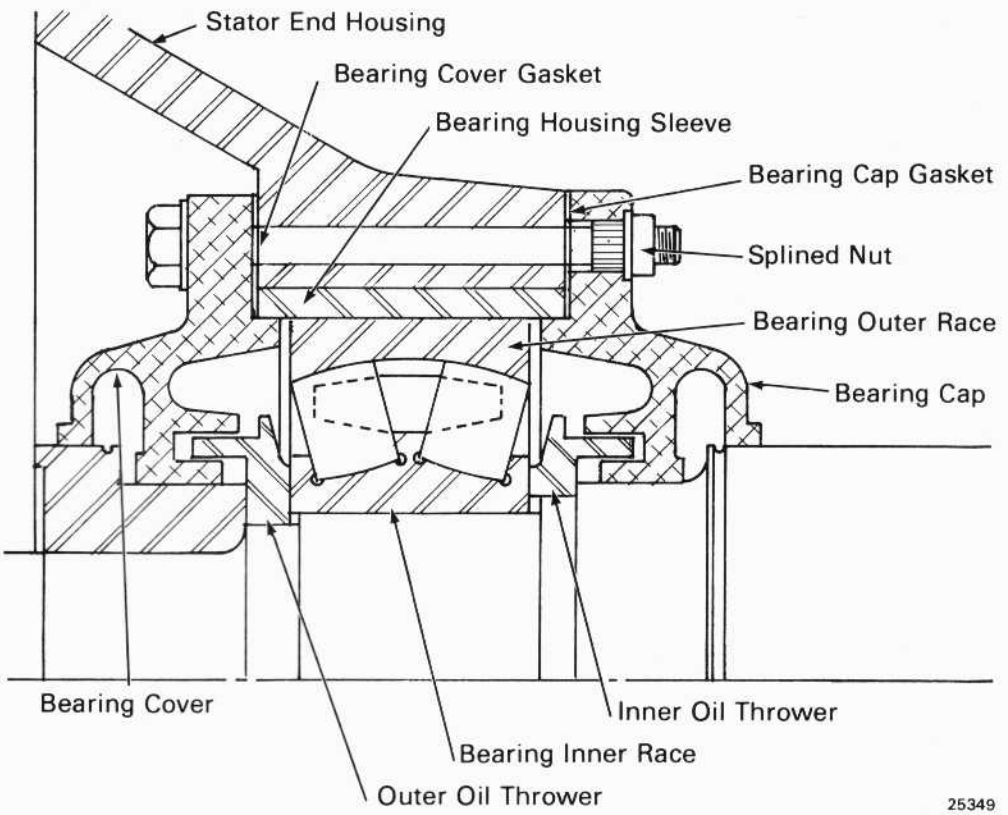

Fig.38 – Bearing Assembly Cross-Section

12. Heat the roller bearing with an induction heater to 120° C (248° F). Take pyrometer readings (with the heater current off) at outside face of inner race only. Do not cock the bearing when placing it on the shaft. Use a brass pipe to push the bearing up to the inner oil thrower. Allow bearing to cool to room temperature.

13. Check the runout of the bearing inner race. Runout should be within 0.05 mm (.002") total indicator reading.

14. After outer oil thrower is heated to proper temperature, remove from heating unit. If an oil bath is used for heating, remove oil from outer oil thrower with clean bound-edge cloths prior to shrinking to the shaft. Shrink outer oil thrower to the shaft. Refer to Fig. 38 for position. Allow outer oil thrower to cool to room temperature.

15. On generator-alternator unit, perform the following procedure:

    a. If alternator rotor assembly was removed from the armature, bolt these two assemblies together using the 7/8"-9 bolts removed during disassembly. Ensure the alternator rotor leads are threaded through the armature shaft. Torque bolts to 366 N·m (270 ft-lbs).

    b. If the alternator stator was removed from the generator stator, bolt these two assemblies together using the 3/4"-10 bolts removed during disassembly. Torque bolts to 271 N·m (200 ft-lbs).

    c. When installing the armature into the stator, the commutator end of the armature is first inserted through the alternator stator end. Apply arbor fixture over the commutator end shaft.

    d. If the main drive coupling was removed from alternator rotor spider, bolt it to alternator rotor spider. Align chisel mark on main drive coupling with chisel mark on alternator rotor. Secure bolts with lockwire.

    e. Place stator assembly and armature assembly on stands close enough to each other so that the arbor fixture protrudes through the stator.

    f. Using two cranes, attach one steel cable to the arbor fixture and one steel cable to the main drive coupling. Lift and guide the armature assembly into the stator assembly slowly and carefully so insulation will not be damaged.

    g. When the armature is fully inserted, place fish paper strips 2 mm x 80 mm x 900 mm (1/16" x 3" x 36") in air gap between the armature assembly and the bottom field poles to prevent the armature from rolling on pole cores during transportation.

    h. Remove wire cables and arbor fixture.

    i. Apply coupling disc to alternator rotor hub using bolts removed at disassembly. Apply Texaco Threadtex lubricant to bolts, install hardened washers and self-locking nuts, and torque to 2440 N·m (1800 ft-lbs).

16. Apply Molykote to inside diameter of the bearing housing sleeve of the stator end housing prior to assembling housing to bearing. If Molykote spray (9316707) is used, it must be allowed to dry, but Molykote paste (9517921) will allow immediate assembly.

17. Place aligning tool on shaft to hold the bearing outer race stationary and to assist in placing the end housing over the bearing. Refer to Service Data for part number of bearing alignment tool.

18. Apply two 1/2"-20 UNC-2B studs, 180° apart to the spline nuts, Fig. 38, pressed into the bearing cap. These studs are required to guide the bearing housing of the stator end housing up to the bearing cap as shown in Fig. 39.

19. Apply a new gasket to the bearing cap. Gasket may be held in place with a spot of grease.

20. Lift the stator end housing as shown in Fig. 39. Align bearing housing with the aligning studs. Push the end housing onto the shaft until the stator end housing is snug against the bearing cap. Ensure the housing drain hole is lined up with the cover drain hole.

21. Install the greased bearing cover with a new gasket. Ensure the space free of grease is at the top of the cover. Bolt the bearing cover to the end housing, lining up the cover drain hole with the housing drain hole.

22. Heat the bearing retainer in an oil bath, electric oven, or induction heater to 127° C (260° F)

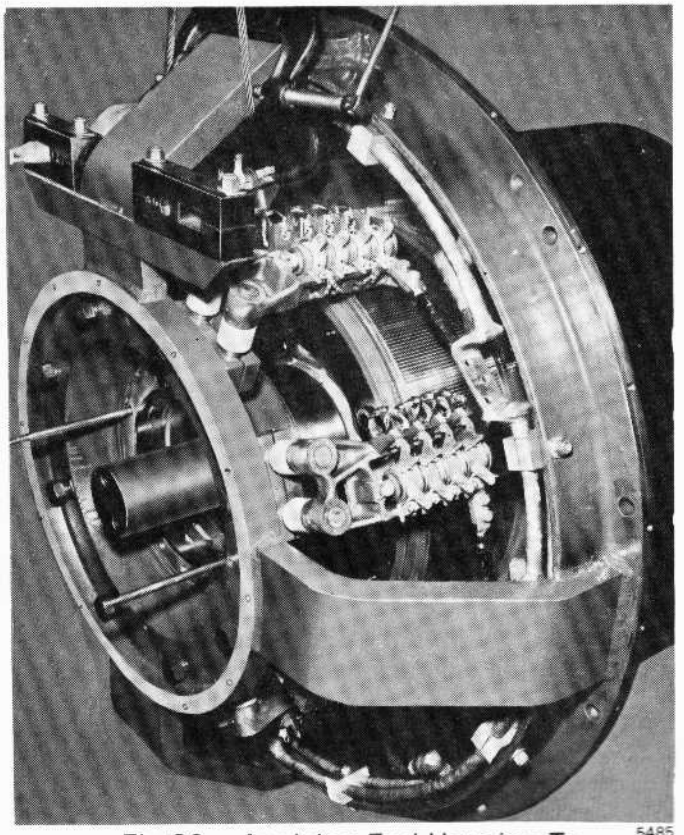

Fig.39 – Applying End Housing To Armature Assembly

and shrink to shaft. Refer to Fig. 38. If an oil bath is used for heating, remove oil from retainer with clean, bound-edge cloths prior to shrinking to shaft. When using an induction heater, pyrometer readings (with heater current off) should be taken periodically.

23. On generator-alternator units, perform the following procedure:

    a. Place collector ring assembly in an oven and heat to 120° C (248° F). After heating, place collector ring assembly on shaft and hold in position until shrunk on shaft. Refer to Fig. 40.

    b. Install brush holder assemblies on posts pressed in bearing cover. Torque brush holder clamping bolts to 20-27 N·m (15-20 ft-lbs). Set brush holder assemblies so that a 3 mm (1/8″) clearance is obtained between bottom of each brush holder and the collector ring, Fig. 41.

    c. Reconnect brush holder cable assemblies to brush holders as shown in Fig. 42.

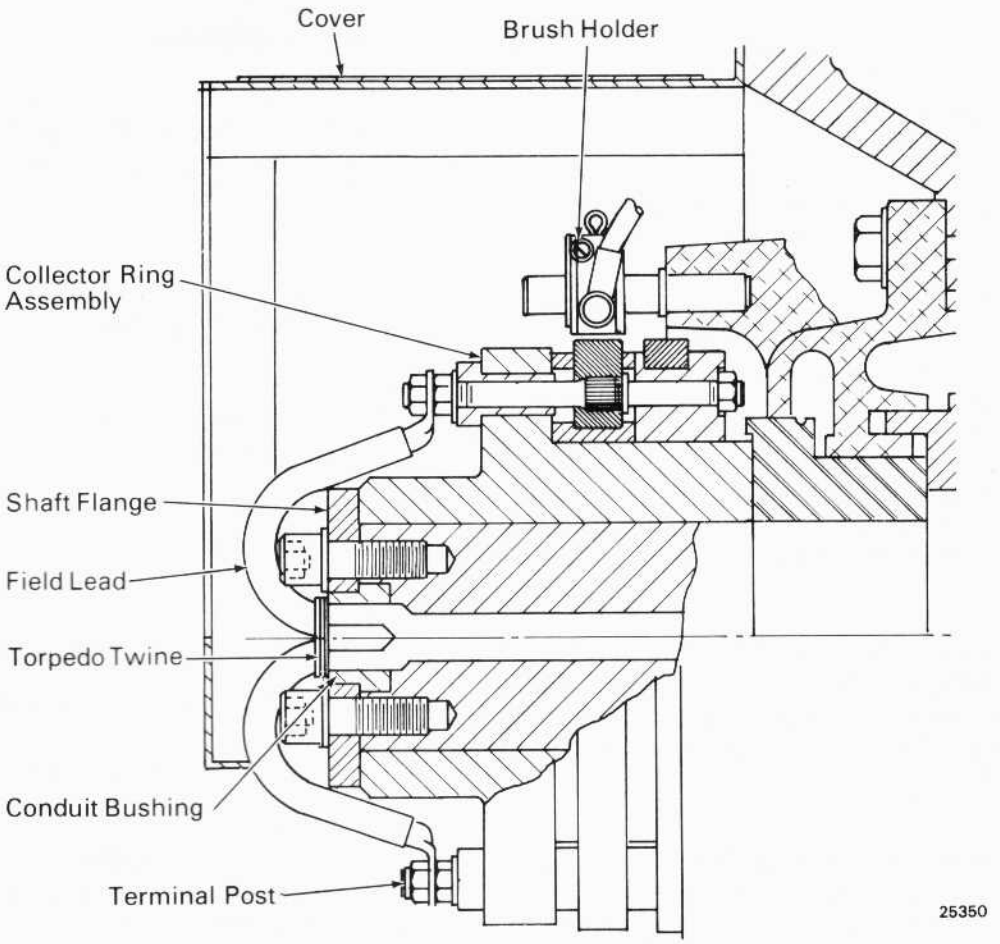

Fig.40 – Collector Ring Assembly

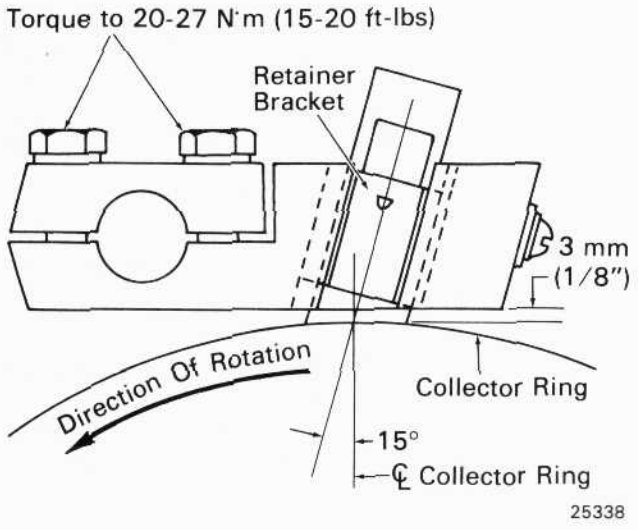

Fig.41 - Collector Ring Brush Holder Installation

d. Assemble conduit bushing on field leads and insert conduit bushing into end of armature shaft as shown in Fig. 40. Bolt shaft flange to end of armature shaft. Tie field leads with torpedo twine as shown in Fig. 40 and paint twine with red air drying enamel.

e. Reconnect field leads to collector ring terminal posts. Cables are not marked for any particular post.

24. On generator unit (without alternator), perform the following procedure:

a. When installing the armature into the stator, the main drive coupling end of the armature is inserted first through the commutator end of the stator. Apply arbor fixture to the bore of the main drive coupling. Ensure coupling disc is removed from main drive coupling because outside diameter of coupling disc is larger than inside diameter of the stator field assembly.

b. Place stator assembly and armature assembly on their stands close enough to each other so that the arbor fixture protrudes through the stator assembly as shown in Fig.43.

c. Using two wire cables and two cranes, place one wire cable through the stator end housing and the other wire cable through the arbor fixture as shown in Fig. 43. Using the cranes, lift and guide the armature assembly through the stator assembly, slowly and carefully so the insulation will not be damaged. When the stator end housing is flush against the stator frame, install 3/4"-10 bolts to hold the stator end housing to the stator frame. Torque the bolts to 271 N·m (200 ft-lbs).

d. Place fish paper strips 2 mm x 80 mm x 900 mm (1/16" x 3" x 36") in air gap between the armature assembly and stator assembly to prevent armature from rolling on pole cores during transportation.

e. Remove wire cables and arbor fixture.

f. Apply coupling disc to main drive coupling using bolts removed at disassembly. Apply Texaco Threadtex lubricant to bolts, install hardened washers and self-locking nuts and torque to 2440 N·m (1800 ft-lbs).

25. Clean and deburr external bolted connections. Connections can overheat if the contact surfaces are not clean, flat, or bolted with sufficient pressure.

26. Assemble strap connections with bolts, plain washers, lock washers, stop nuts, pad, and cable cleats removed in disassembly.

27. Insulate external lead cables with two layers of glass adhesive tape half-overlapped as follows:

Starting leads -
Tape 152 mm (6") from coil connector and extend 25 mm (1") beyond clamp.

Battery leads -
Tape from coil to 25 mm (1") beyond clamp.

Shunt leads -
Tape from splice to 25 mm (1") beyond clamp.

28. Reassembly commutator covers.

29. On generator-alternator assembly, reassemble air box assembly.

NOTE

On older units equipped with compressor coupling, assemble compressor coupling guard assembly.

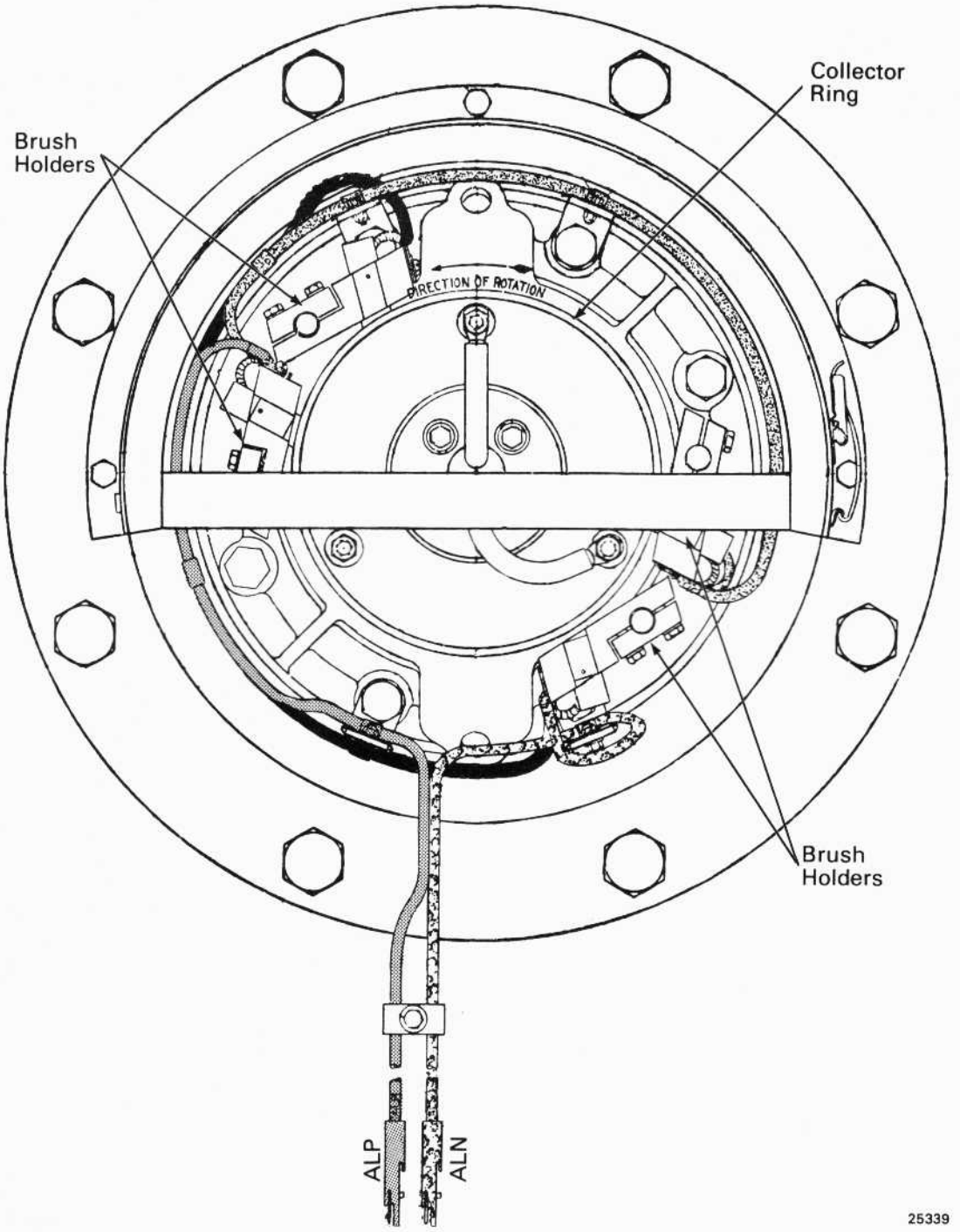

Fig.42 – Collector Ring Brush Holder Cable Connections

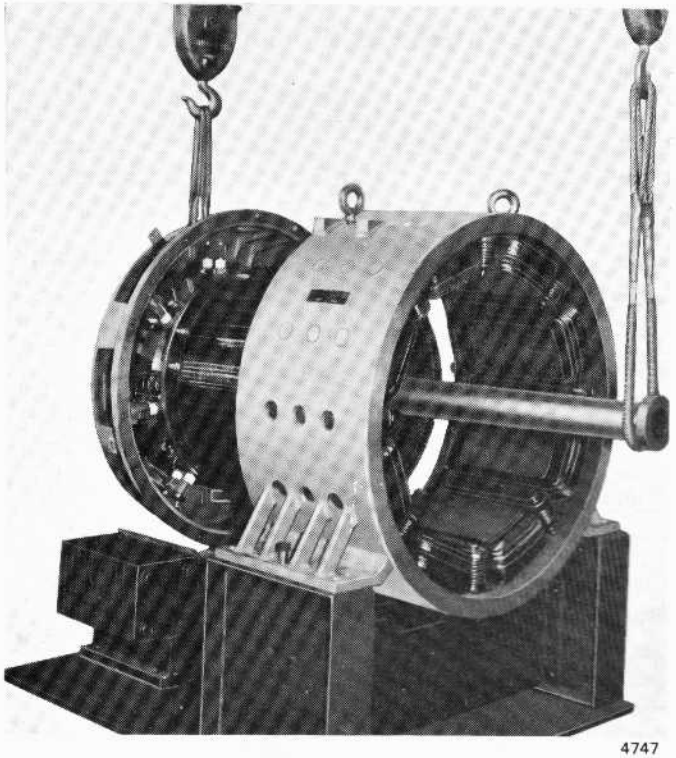

Fig.43 – Installing Generator Armature Assembly

HIGH POTENTIAL TEST

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 1000V 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 on 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	900 volts
High voltage wiring and high voltage equipment	1000 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 GENERATOR INTO LOCOMOTIVE UNIT

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

Before a generator is installed, check and clean the mounting plates. Ensure 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. Ensure 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 with mounting compound to the fitting surfaces. Check that bolt holes in couplings are clean and smooth.

Apply 2-3/16" 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 its coupling fits into the beveled groove in the engine coupling disc.

Check all coupling bolts to see that they are smooth and clean. Place a little 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. Tighten base bolts to torque as specified in Service Data.

SERVICE DATA

SPECIFICATION

AIR GAP (Nominal)

Main Poles	6.35 mm (.250")
Interpoles	7.32 mm (.288")
Alternator	3.96 mm (.156")

GENERATOR BRUSH HOLDERS

Number Of Brush Holder Arms	8
Clearance - Bottom Of Brush Holder To Commutator	3 mm +1.6, -0.0 (1/8" +1/16, -0)

GENERATOR BRUSHES

Number Of Brushes (per arm)	4 Sets (split)

Brush Type	Brush Grade	Part Number
Two Wafer	DE8	8307806
Two Wafer	AC127	9334438

Size Of Brush	16 mm (split) x 33 mm x 65 mm (5/8" (split) x 1-5/16" x 2-9/16")
Wear Limit (long side)	40 mm (1-9/16")
Spring Tension	1.8 kg to 2 kg (4 to 4-1/2 lbs)
Low Limit (worn brush)	1.6 kg (3-1/2 lbs)

ALTERNATOR BRUSH HOLDERS

Number Of Brush Holders	4
Clearance - Bottom Of Brush Holder To Collector Ring	3 mm +1.6, -0.0 (1/8" +1/16", -0)

ALTERNATOR BRUSHES

Number Of Brushes	4

Brush Type	Brush Grade	Part Number
Solid	PL-AY	8271183

Size Of Brush	9.5 mm x 19 mm x 38 mm (3/8" x 3/4" x 1-1/2")
Wear Limit (long side)	16 mm (5/8")

COMMUTATOR

Diameter (New)	685.8 mm ±1.6 (27″ ±1/16)
Minimum Diameter	666.8 mm (26-1/4″)
Neck Width (New)	22 mm ±0.8 (7/8″ ±1/32)
Minimum Neck Width	17.5 mm (11/16″)
Mica Groove Depth	1.6 mm to 2.4 mm (1/16″ to 3/32″)
Mica Groove Width	0.76 mm (.030″)

RESISTANCE IN OHMS AT 75° C (167° F)

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

$$\text{resistance at } 75°\text{ C} = \frac{\text{measured resistance x } 309.5}{234.5 + \text{temperature of item being tested in °C}}$$

Armature	0.00676 to 0.00650
Armature (1-11)	0.00341 to 0.00355
Shunt Field	
Models D15 and D15A	106.4 to 110.8
Other Models	71.3 to 74.3
Battery Field	
Models D15 and D15A	1.188 to 1.236
Other Models	1.117 to 1.163
Starting Field	0.00514 to 0.00536
Interpole (commutating field)	
Models D15 and D15A	0.00398 to 0.00414
Other Models	0.00405 to 0.00421
Differential Field	0.000898 to 0.000934
Alternator (slip ring to slip ring)	3.03 to 3.27
Alternator (phase to phase)	0.02054 to 0.01916
Maximum Allowable Variation Between Any Two Phases	0.00015

BEARING ASSEMBLY

Outer Diameter	259.999 mm +0.000, -0.036 (10.2362″ +.0000, -.0014)
Bearing Bore	120.000 mm +0.000, -0.020 (4.7244″ +.000, -0.0008)
Bearing Width	86.00 mm +0.00, -0.13 (3.3858 +.0000, -.005)
Internal Clearance Before Assembly	
SKF Bearing	0.10 mm to 0.15 mm (.004″ to .006″)
Link Belt Bearing	0.10 mm to 0.18 mm (.004″ to .007″)
Internal Clearance After Assembly	0.064 mm (.0025″) Minimum
End Play Clearance (after assembly in generator housing)	4.8 mm (3/16″)
Stator End Housing Bore	279.969 mm +0.03, -0.000 (11.0224″ + .001, -.000)
Bearing Housing Sleeve	
Outer Diameter	280.096 mm +0.000, -0.025 (11.0274″ +.0000, -.0010)
Sleeve Bore (Unassembled)	260.088 mm +0.03, -0.00 (10.2397″ +.001, -.000)
Sleeve Bore (After Press-In)	260.088 mm to 260.012 mm (10.2397″ to 10.2367″)
Sleeve Width	109.80 mm ±0.13 (4.323″ ±.005)
Sleeve Out-Of-Round Maximum Tolerance	0.05 mm (.002″)

Bearing Lubricant Capacity ±7 g (1/4 oz)

Bearing	369 g (13 oz)
Bearing Cover	425 g (15 oz)
Bearing Cap	425 g (15 oz)

EQUIPMENT LIST

	Part No.
Commutator Grinder	8355891
Commutator Grinder Adapter	8195928
Commutator Grinder Alignment Bar	8210141
Grinder Vacuum Cleaner Blower, 115V AC-DC	8210140
Grinder Vacuum Cleaner Blower, 230V AC-DC	8210956
Nozzle And Mounting Rods	8210142
Bag Hose And Hose Connection	8210139
Grinding Stones, Finish Grade – 2 Required	8201791
Grinding Stones, Medium Grade – 2 Required	8496921
Brush Seater Stone (Chalk Stone)	8204957
Aluminum Oxide Paper, 220 Grit – 178 mm x 46 m (7″ x 50 yd) roll, 2 m (7 ft) per generator	
Commutator Brush Tension Scale	8415805
Commutator Brush Spring Lifter	8140868
Dial Indicator Support Rod	8122000
Bearing Alignment Stud	8159226
Bearing Alignment Guide	8060275
Hydraulic Bearing Puller	8173948
Manual Bearing Puller	8168577
Commutator Slot File Assembly	8238905
Replacement File	8217142
Generator Lifting Shackle – Includes Pin (2 Required)	8072353
Shackle Base (2 Required)	8097939
Shackle Base Bolt (48 Required), 1″-14	272563
Shackle Base Bolt Lockwasher, 25 mm (1″)	121326
Pyrometer	8364533
Grease Contour Mask, Bearing Cap And Cover	8276637
Collector Ring Grinder Assembly	8260844
Collector Ring Grinder Kit	8279712
Grinding Stone, Coarse	8280602
Grinding Stone, Finish	8260843
Stator End Housing Holding Fixture	*File No. 753
Armature Shaft Arbor Fixture	*File No. 754

*File number represents facility drawings that are available (at no charge) from EMD Service Department. These drawings include construction details of tooling that can be manufactured.

MATERIAL

	Part No.
Twine, Torpedo 1.6 mm (1/16″ diameter)	
0.2 kg (1/2 lb) ball	8192837
23 kg (50 lb) spool	8122563
Tape, Vinyl, 33 m (36 yd) roll	8192816
Tape, Glass Adhesive, 33 m (36 yd) roll	8395904
Enamel, Gray Locomotive	8106297
Cloth, Empire, 46 m (50 yd) roll	8116923
Caulking Compound, 1 litre (1 qt)	8133954
Solder, Hi-Temp 2.76 mm (0.109″) diam., approx. 32 kg (70 lb) spool	8160923
Solder, Tin Base (No. 8 wire, approx. 23 kg (50 lb) spool	8225761
Solder, Sil-Fos	8129496

Solder Flux, 0.5 kg (1 lb)	8122570
Brazing Flux, Low-Temp, 0.5 kg (1 lb)	8116442
Molykote Lubricant	
0.473 liters (1 pint) aerosol	9316707
0.473 liters (1 pint) paste	9517921
Neoprene, Liquid, 3.79 litre (1 gal)	8213281
Varnish, Black Air Drying	
1 litre (1 qt.)	8061114
4 litres (1 gal.)	8122347
208 litres (55 gal.)	8116521
Enamel, Red Air Drying	
1 litre (1 qt.)	8061130
19 litres (5 gal.)	8048876
Bearing Lubricant, Esso Unirex N2	
13.61 kg (30 lb)	9507146
54.43 kg (120 lb)	9507147
Thread Lubricant, Texaco Threadtex	8307731

*Varnish, Electrical Insulating – Modified Polyester Y-432 (Sterling Varnish Co.)

Thinner Solvent For Above Varnish

*Chevron No. 1300 Solvent

*Thompson – Hayward Chemical Company No. 2026 Solvent

**Xylol Thinner

An alternate thinner solvent may be blended using the following materials:

*Mineral Spirits (Rule 66 Type Thinner) 80%

*Butyl Acetate – Technical Grade 20%

NOTE: The above blend is required because the varnish sets up in the tank when mineral spirits thinner is used alone. Butyl acetate prevents this.

*To be used where compliance with pollution control regulations is required.

**Xylol may be used as a substitute thinner, however, Xylol DOES NOT comply with pollution control regulations.