

# MAINTENANCE INSTRUCTION

## TRACTION MOTOR OVERHAUL

Traction motor overhaul instructions are presented in seven sections, each under separate cover, and contain detailed instructions to completely disassemble, inspect, overhaul, assemble, and test the traction motor. Refer to Maintenance Instruction M.I. 3904 for general or "running" maintenance of the traction motor and also for procedures to remove the traction motor from the locomotive truck. These instructions apply to Models D19, D29, D29CC, D29CC-7, D29CCBT, D31, and D36 traction motors unless specifically identified. References to Model D29 motors will include Models D29CC, D29CC-7, and D29CCBT.

<u>Section No.</u>	<u>Title</u>
1	Motor Disassembly
2	Bearing Component Inspection
3	Stator Inspection And Reconditioning - Mechanical
4	Stator Inspection And Reconditioning - Electrical
5	Armature Inspection And Reconditioning
6	Armature Overhaul
▶7	Motor Assembly

## SECTION 7 MOTOR ASSEMBLY

### INTRODUCTION

This section provides instructions for assembly of the traction motor. After all component parts have been cleaned, checked, inspected, and painted, the traction motor is ready for assembly.

### BEARING ASSEMBLY

Particular attention must be given to the proper application of grease to the armature bearings. The following precautions should be observed.

1. All assembly parts must be thoroughly cleaned of all foreign material and previous lubricant. All cleaning solvents must be removed and all parts perfectly dry before applying grease. Keep new or remanufactured bearings in their wrappings until application

of grease. The lubricant applied to these bearings, when packaged, is compatible with Shell Cyprina RA Grade 3 grease, therefore, if kept clean, the bearings need not be washed.

2. Shell Cyprina RA Grade 3 grease must be used exclusively and not mixed with other lubricants.
3. Adequate lubrication depends upon precise weight of grease. Too much grease is as detrimental to the service life of the bearing as too little.
4. Cleanliness can be ensured by obtaining grease direct from covered containers by use of a hand or motor driven pump of a type that will not soften or harden ( $\pm 5$  ASTM penetration) the grease during handling. If a pump

\*This bulletin is revised and supersedes previous issues of this number.

is not used, extra precaution must be used to prevent contamination of the grease in the pail or drum. Grease should be handled on a clean piece of oil proof paper.

5. A clean steel bladed spatula or putty knife should be used during intermediate handling of the grease, and for greasing the bearing parts. Use of bare hands should be avoided wherever possible to prevent accidental inclusion of dirt or other contaminants.

## GREASE APPLICATION TO BEARING COVERS, CAP, AND HOUSING

1. Fill all labyrinth grooves in the bearing covers, pinion end bearing inner cap, and commutator end bearing housing flush with Shell Cyprina RA Grade 3 grease, as shown in Fig. 1. This grease need not be measured.



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Fig. 1 - Grease Application To Labyrinth Grooves

2. Weigh the piece of paper that will be used in handling the grease. Weight of paper must be compensated for when weighing grease.
3. For sealed bearings, carefully weigh Shell Cyprina RA Grade 3 grease for specific component and bearing end to be greased. Refer to Service Data for proper quantity.

**NOTE:** Model D19 motors were equipped with a non-sealed grease bearing which requires periodically adding grease. If a D19 is to be reassembled with the additive grease bearing, follow the same procedure and Service Data quantities as for the sealed grease bearings, but use Regal Starfax No. 2 or Lubrico M6 grease. Use either Regal Starfax No. 2 or Lubrico M6 grease, but do not mix.

In service, add 0.284 kg (1 oz) of lubricant every two months or 20,000 miles, whichever ever occurs first.

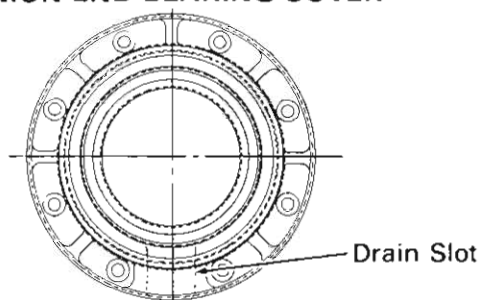
4. Pack grease solidly into the lower 180°-240° (depending on the specified quantity of grease) of the cap, cover, or housing. Keep the ungreased portion at the top of the component. Refer to Fig. 2 to determine the top.
5. Using a spatula or putty knife, roughly form the grease into the approximate desired contour, Fig. 3, and apply correct grease mask as determined from Service Data. The grease arc must be packed without air voids.
6. Rotate grease mask to form proper contour, keeping mask seated as shown in Fig. 4. Several turns may be required to get proper contour. Use spatula or putty knife to fill in low spots with grease from the 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. 5.

## GREASE APPLICATION TO BEARINGS

**CAUTION:** In removing and replacing roller cage assembly from bearing outer race, ensure cage and outer race are handled squarely to prevent gouging or deforming cage bars on the outer race.

On bearings having demountable cages (SKF), Fig. 6, remove roller assembly from outer race and remove inner race.

**PINION END BEARING COVER**

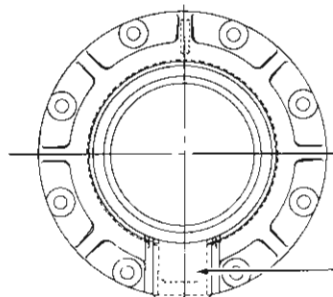


D19, D29, D31, D36

**PINION END BEARING INNER CAP**

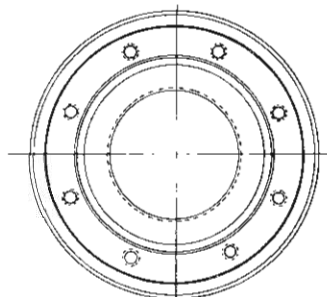


D29, D31, D36

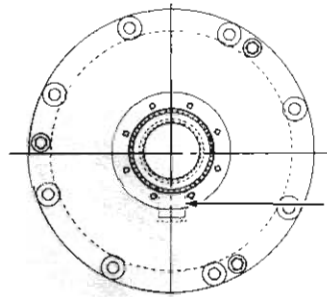


D19

**COMMUTATOR END BEARING HOUSING**

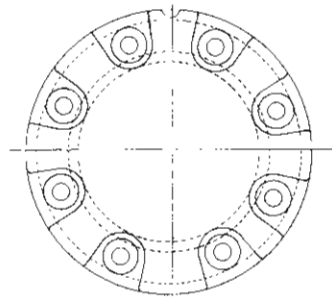


D29, D31, D36

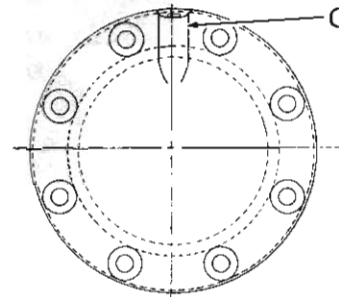


D19

**COMMUTATOR END BEARING COVER**



D29, D31, D36



D19

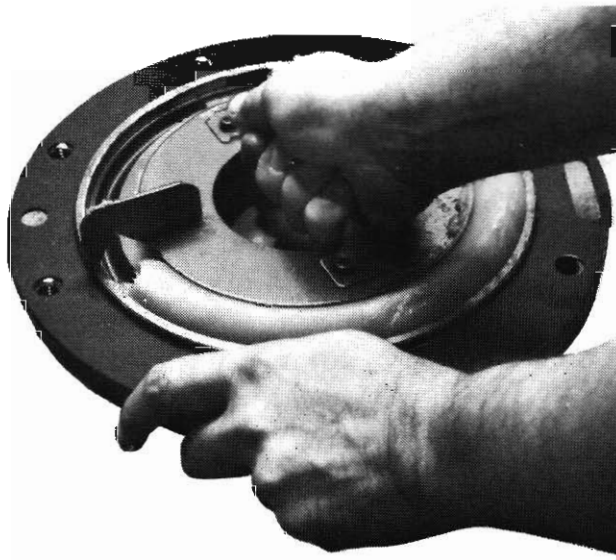
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Fig. 2 - Bearing Covers, Inner Cap, And Housing Position



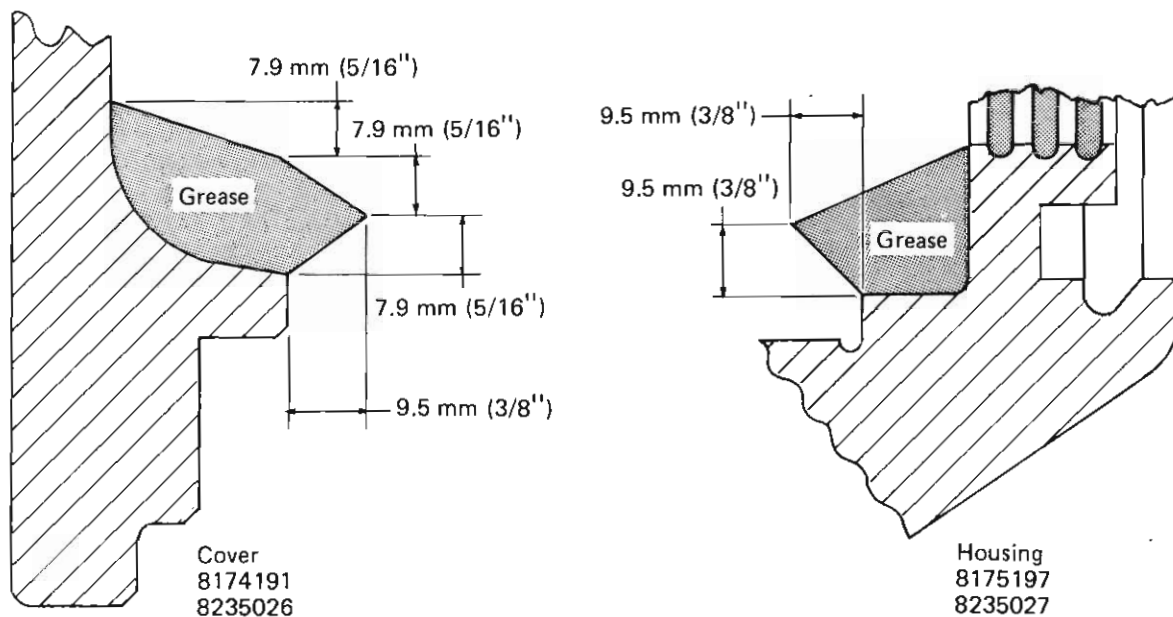
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Fig. 3 - Roughly Formed Grease Contour

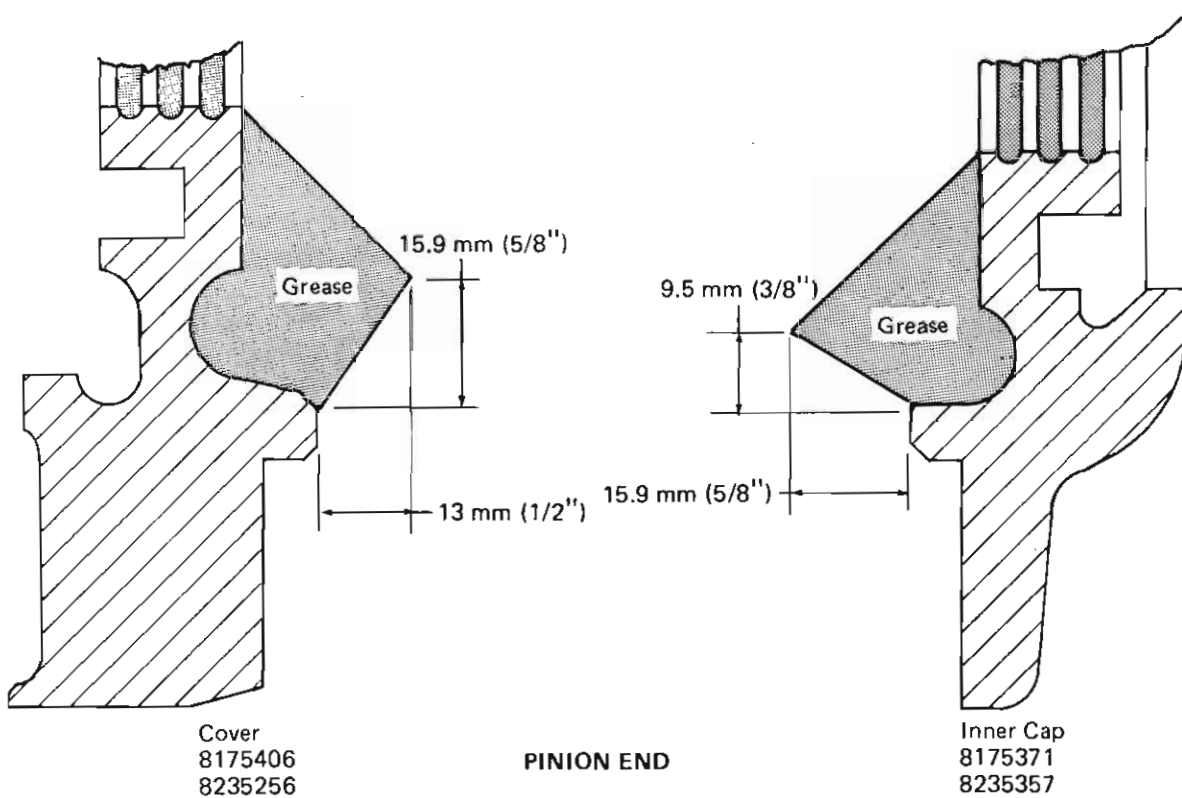


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Fig. 4 - Application Of Grease Mask



COMMUTATOR END



PINION END

Fig. 5 - Grease Contours

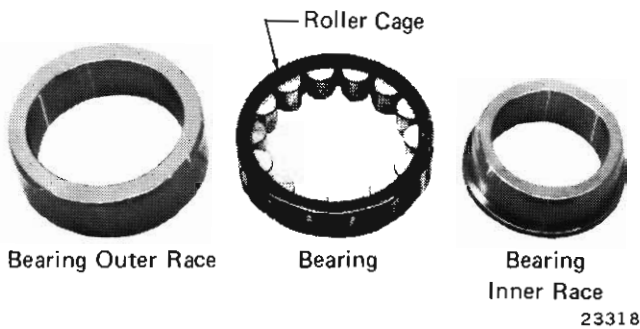


Fig. 6 - Demountable Cage Bearing Assembly

Work half the amount specified for roller cages in Service Data into the outer diameter of the roller cage assembly with a spatula or putty knife, Fig. 7. Coat the rollers and spread grease into the roller pockets. Place a continuous light coat of grease on the outer race roller path before assembling the roller cage to the outer race.



Fig. 7 - Coating Outside Diameter Of Roller And Cage Assembly

On bearings which do not have demountable cages (NDH), work grease uniformly into the bearing outer race. Ensure grease is worked into the roller cage assembly by way of the thin annular space between the outer race flange inside diameter and the cage outside diameter.

Work grease in between the roller ends and the cage end rings on both types of cages.

Apply a continuous light coat of grease on the inner race roller paths before assembling outer race and roller assembly.

Apply a continuous light coat of grease to the roller contact surface on the thrust flange of the commutator end inner race and to the roller contact surface of the commutator end bearing thrust collar prior to final assembly.

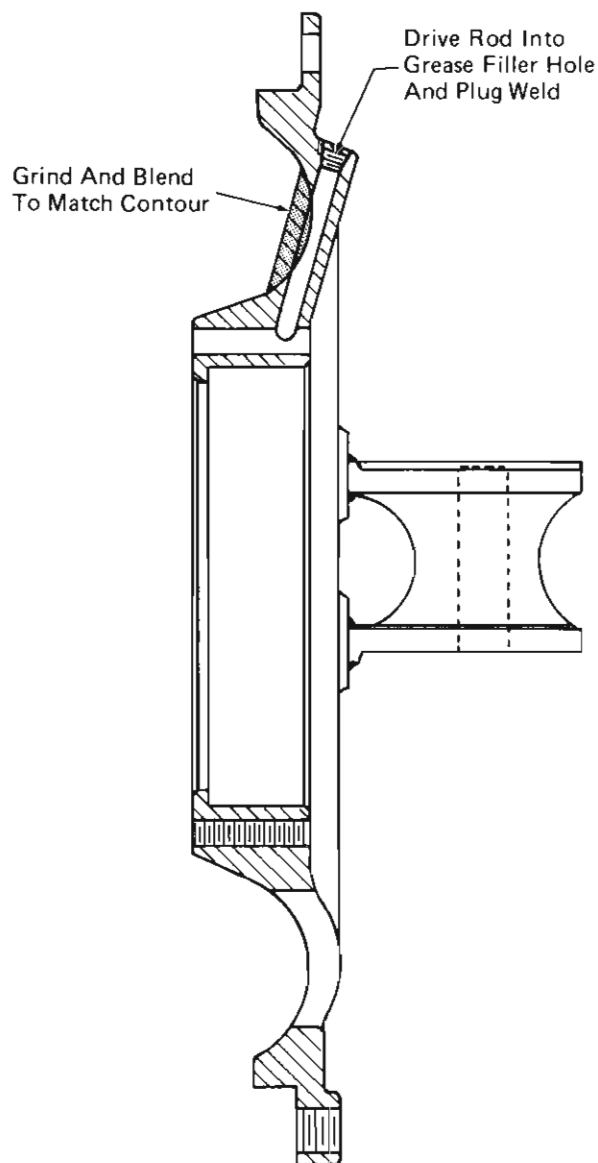
## D19 BEARING HOUSING MODIFICATION TO ACCOMMODATE D29 ARMATURE

If a D29 armature is to be used for a D19 assembly, a difference in armature length will require rework of the pinion end bearing housing. The D29 armature is longer and adequate clearance must be obtained for the armature coils at the pinion end. Modify the pinion end bearing housing as follows.

1. Plug the grease filler hole in the bearing housing, Fig. 8, using a 11 mm x 114 mm (7/16" x 4-1/2") steel rod. Drive rod into grease filler hole until it bottoms.
2. Plug weld the steel rod to the bearing housing at the outer grease filler hole opening.
3. Grind away the raised area as shown in Fig. 8. Blend this area to match the inner contour of the bearing housing. Clean the housing thoroughly to remove all grinding dust.

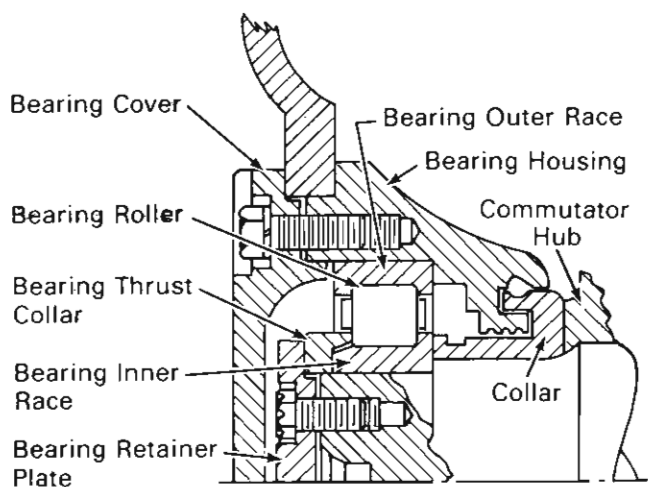
## BEARING ASSEMBLY TO ARMATURE

1. Place the armature in a horizontal position on a cradle, supporting the armature on the core section only.
2. Clean shaft diameters and ensure pinion end threads are not damaged. Remove any grit or dust from retaining plate bolt holes on the commutator end of the shaft.
3. Ensure bearing parts are clean. Refer to Figs. 9 and 10 for proper location of bearing assembly.
4. Heat the bearing parts to be shrunk onto the shaft by suspending parts in SAE 50 oil (with a safe flash point) at a temperature of 115°-125° C (240°-260° F). The oil container should have a false perforated bottom which will prevent direct transmission of heat from the heating unit to the bearing parts. Wipe oil off all bearing parts with a clean bound-edge cloths before applying to shaft.



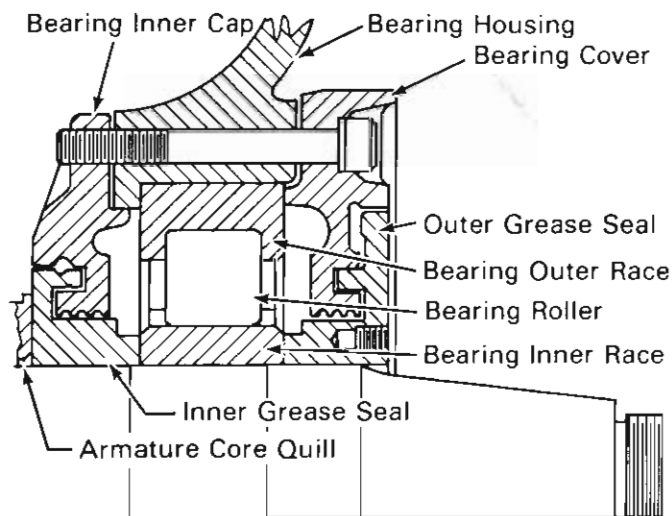
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Fig. 8 - D19 Pinion End Bearing Housing Modification To Accommodate D29 Armature



23181

Fig. 9 - Commutator End Bearing Assembly



23180

Fig. 10 - Pinion End Bearing Assembly

**CAUTION:** Do not use a torch, induction heater, brazing tongs, or any uncontrolled heat. Direct heating of bearing parts will warp or metallurgically upset the parts.

**NOTE:** Use a brass tube large enough to fit over the shaft to hold bearing parts in place.

5. Shrink commutator end collar onto shaft in proper position, Fig. 9. Ensure collar is tight against commutator hub. Rotate collar while holding in place to prevent collar from seizing the shaft in a cocked position.
6. Shrink pinion end inner grease seal onto shaft in proper position, Fig. 10. Ensure seal is tight against armature core quill. Rotate seal while holding in place to prevent seal from seizing the shaft in a cocked position.
7. Shrink the commutator end and pinion end inner bearing races onto shaft with the serial number facing out. Push each race against the previously applied part and turn inner race; at the same time, exert pressure to hold mating surfaces together. Continue turning inner race under pressure until piece seizes to the shaft. Ensure bearing inner races are not distorted, misaligned, or out of position. Remove all traces of oil from the races.
8. Using a suitable bearing press, completely support the face surface of the pinion end outer roller bearing race and press bearing into the bearing housing, Fig. 11. Keep bearing level and not cocked in bore. If bearings have been in service previously, install bearings so that the former top of the

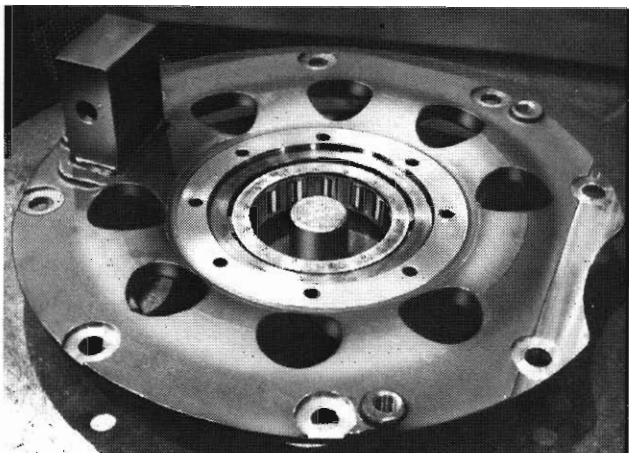


Fig. 11 - Bearing Pressed Into Pinion End Bearing Housing 23322

outer race (before bearing was removed from the housing) is assembled in a position  $90^\circ$  to either side of the housing top.

9. Ensure grease is applied to the bearings before assembling bearings and housings to the armature.
10. Assemble pinion end inner bearing cap, Fig. 10, which has been previously greased to the armature side of the pinion end bearing housing. Apply a new gasket between the inner bearing cap and the bearing housing.

**NOTE:** When assembling the inner bearing cap to the pinion end bearing housing on a D19 motor, eight cap screws and washers are used to secure the inner bearing cap to the bearing housing. On D29 and D36 motors, through bolts are used to secure the inner bearing cap and bearing housing.

11. On D29, D31, and D36 bearing housings, install two locating studs long enough to secure inner bearing cap to bearing housing. On D19 bearing housings, install four bolts equally spaced to secure inner bearing cap to the bearing housing.
12. Assemble a new outer gasket and bearing cover to the other side of the bearing housing. Do not apply grease to the cover at this time.
13. Apply a light coat of bearing grease to the bearing inner race of the shaft. Install the pinion end housing assembly to the armature by carefully moving the assembly over the shaft.

**CAUTION:** Do not force or cock the rollers over the bearing inner race. Any marking or scuffing will affect the life of the bearing.

14. Assemble armature turning fixture to the commutator end of the shaft, and lifting eye to the pinion end of the shaft. Protect commutator by placing a piece of heavy fishpaper around the brush surface of the commutator. Hold fishpaper in place with a piece of tape.

## COMMUTATOR END BEARING AND BEARING HOUSING ASSEMBLY TO STATOR

1. Ensure commutator end bearing housing is greased.
2. Using a suitable bearing press, completely support the face surface of the commutator end outer roller bearing race and press bearing into the bearing housing, Fig. 12. Keep bearing level and not cocked in bore. If bearings have been in service previously, install bearings so that the former top of the outer bearing race (before bearing was removed from housing) is assembled in a position  $90^\circ$  to either side of the housing top.

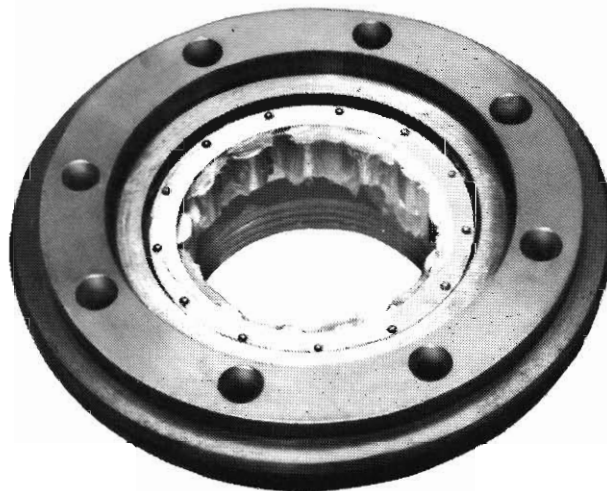


Fig. 12 - Bearing Pressed Into Commutator End Bearing Housing 23323

3. On a D19 motor, hold the commutator end bearing in position with a bearing positioning fixture. Apply assembly to the outside of the commutator end stator bore face and secure with eight bolts.

4. On a D29, D31, or D36 motor, the commutator end bearing housing is assembled to the inside of the commutator end stator bore face, Fig. 9. Position bearing housing and hold in place temporarily with a bearing positioning fixture. Ensure bearing housing is flush with stator bore face so bearing will not be cocked. Misalignment will prevent the inner bearing race from entering the outer bearing race and roller assembly when armature is lowered into stator and will prevent proper bearing alignment during assembly.

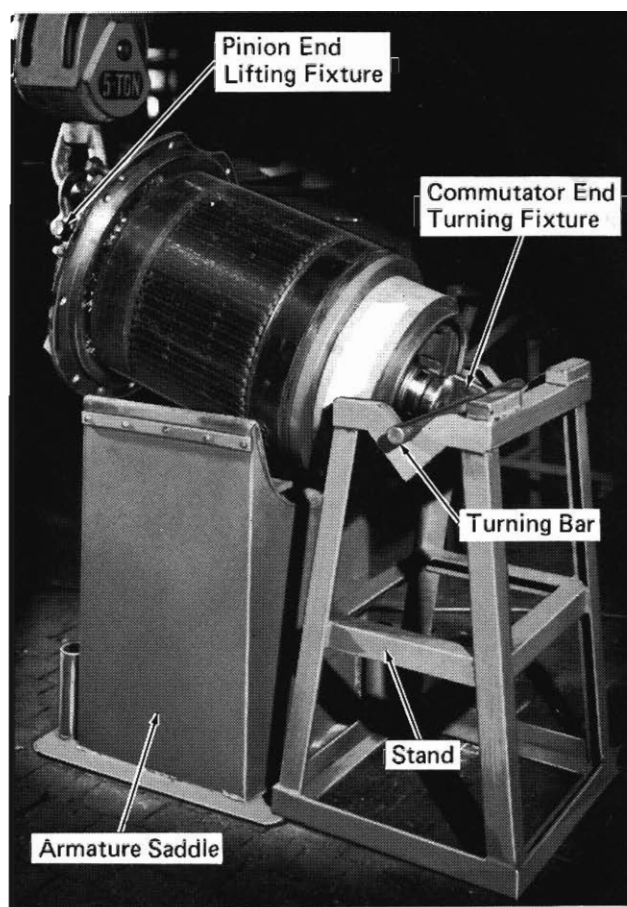
## ARMATURE INSTALLATION AND ALIGNMENT

Ensure stator has been cleaned, inspected, and repaired, and has brush holders installed.

1. Place the stator on a stand with the commutator end down. Refer to Service Data for stand part number. Ensure stator is level with sufficient clearance between the commutator end of the stator and the base to remove bearing guide from the end of the shaft after armature is lowered into the stator.
2. Position brush holders all the way back against the brush holder blocks to allow clearance for the commutator.
3. Using a stand and crane similar to Fig. 13, lift the armature to a vertical position, commutator end down. Remove the turning bar when armature is free of stand.
4. Remove the commutator end turning plate from the shaft and assemble fiber bearing guide to the commutator end of the shaft. Move the armature in position over the stator.

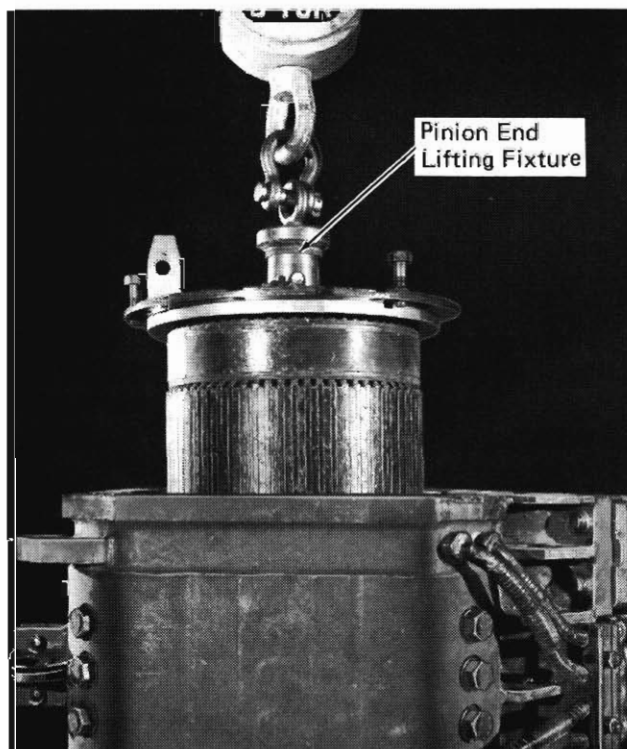
**WARNING:** Do not get hands between the armature and parts of the stator while guiding armature through stator.

5. Center the armature over the pinion end bore and slowly lower the armature assembly into the stator, Fig. 14. Carefully guide the commutator past the coils and brush holders and the fiber bearing guide through the bearing. Lower armature until pinion end housing contacts the stator bore.
6. While supporting armature assembly with the crane, position pinion end so that bolt holes line up with the holes in the stator, and install bolts and washers.



9304

Fig. 13 - Raising Armature To Vertical Position



9303

Fig. 14 - Lowering Armature Into Stator

NOTE: Support arm on pinion end housing should be positioned opposite the axle bore of the stator.

7. Release crane tension sufficiently while tightening bolts to draw housing into bore evenly and slowly to prevent damage to bearings.

8. Remove bearing guide from commutator end of shaft. Place the motor in a horizontal position at a convenient height. Place motor so that the pinion end will be 51 mm (2") higher than the commutator end of the motor to keep lateral movement of armature in one direction when indicating bearings.

9. With motor properly positioned, torque pinion end bearing housing bolts to 542 N·m (400 ft-lbs). Check rotation of armature. Armature should rotate freely.

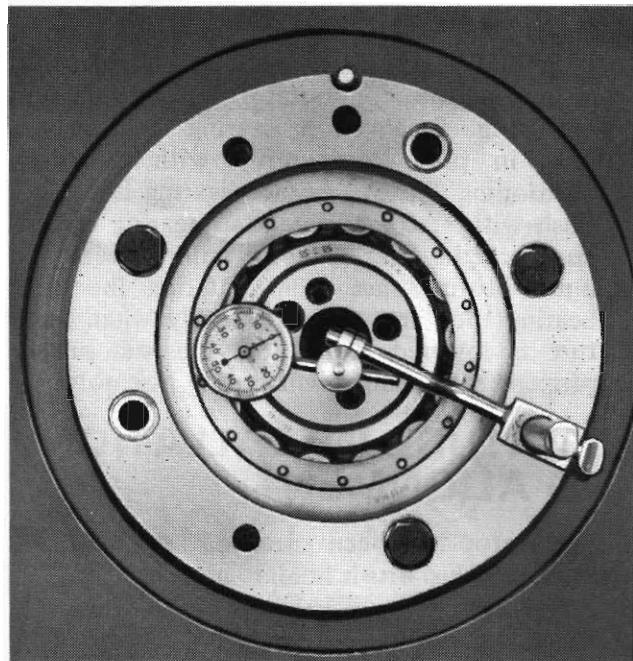
10. Remove pinion end bearing cover. Check internal radial clearance between bearing race and rollers by passing a feeler gauge blade under each unloaded roller at one point. The minimum internal clearance at the pinion end bearing is 0.064 mm (.0025").

11. Clamp an indicator to the pinion end frame in the same manner as shown for the commutator end in Fig. 15. Check the face runout of the bearing inner race. Maximum runout should not exceed 0.03 mm (.001") total indicator reading. If runout exceeds 0.03 mm (.001"), the inner race must be realigned. Usually this will require removing armature assembly from the stator, removing the inner race and bearing assembly from the armature, and then checking the runout on the face of the inner seal. The runout of the inner seal should not exceed 0.013 mm (.0005") total indicator reading.

NOTE: If rework is required on the pinion end bearing, it is advisable to check out commutator end bearing prior to dismantling pinion end. If necessary, corrections can be made to both ends while the armature is removed.

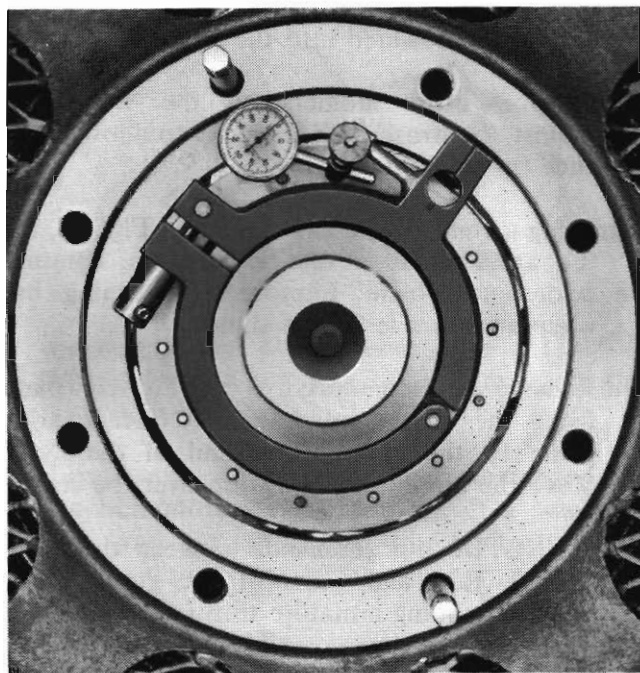
12. Clamp an indicator to the shaft of the pinion end, Fig. 16. Check the face runout of the bearing outer race. Maximum runout should not exceed 0.05 mm (.002") total indicator reading.

13. Apply grease to the pinion end bearing cover. Refer to Grease Application To Bearing



9225

Fig. 15 - Indicating Commutator End Inner Race



9226

Fig. 16 - Indicating Pinion End Outer Race

Covers, Cap, And Housing section. Refer to Service Data for grease mask part number and grease quantity.

14. Inspect bearing cover gasket. If damaged, install a new gasket. Install pinion end bearing cover. Secure cover to bearing housing with eight bolts and washers. Tighten bolts until washers are flattened.

NOTE: On D29, D31, and D36 motors, do not remove guide pins from bolt holes until one or more bolts have been inserted.

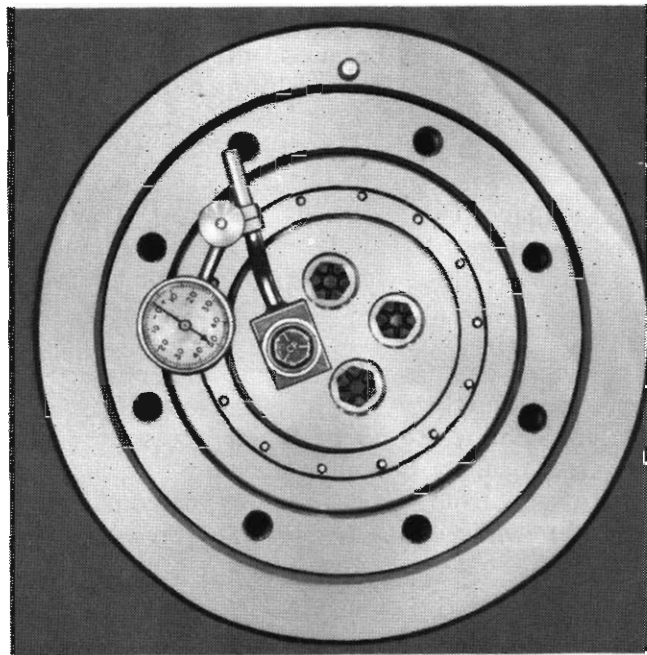
Torque bolts to 54 to 61 N·m (40 to 45 ft-lbs) evenly in a 1-3-5-7-2-4-6-8 sequence.

15. Remove outer grease seal from hot oil, wipe clean, and apply to pinion end of shaft, Fig. 10. Exert pressure on seal until seal cools sufficiently to seize on shaft.
16. Check commutator end internal radial clearance between bearing inner race and rollers by passing a feeler gauge blade under each unloaded roller at one point. The minimum internal clearance at the commutator end bearing is 0.038 mm (.0015").

17. Clamp an indicator to the commutator end frame as shown in Fig. 15. Check the face runout of the bearing inner race. Maximum runout should not exceed 0.03 mm (.001") total indicator reading. If runout exceeds 0.03 mm (.001"), the inner race must be realigned. Usually realignment will require removing armature assembly from the stator, removing inner race and bearing assembly from the armature, and then checking the runout on the face of the inner seal. The runout of the inner seal should not exceed 0.013 mm (.0005") total indicator reading.

18. Install thrust collar and retaining plate to commutator end of shaft. Insert four cap screws and torque to 68 to 75 N·m (50-55 ft-lbs). Remove one of the screws in shaft and assemble indicator, using screw removed as shown in Fig. 17. Runout of outer race should not exceed 0.038 mm (.0015") total indicator reading.

19. With the indicator in position for checking runout of the commutator end bearing outer race, Fig. 17, check the armature end play. Take up all the armature end movement in one direction toward the commutator end by pressing on the pinion end lifting fixture (applied to shaft) with a 458 mm to 610 mm (18" to 24") steel bar. Set the indicator at zero and pull the shaft toward the pinion end until the shaft comes to a definite stop. Movement on the indicator from zero position will indicate the amount of end play. End play movement should be between 0.132 mm to 0.353 mm (.0052" to .0139"). Do not force movement on the shaft. Excess pull on the bar will give a false indication.



9224

Fig. 17 - Indicating Commutator End Outer Race

20. Remove indicator and replace cap screw in end plate. Torque cap screw to 68 to 75 N·m (50-55 ft-lbs).
21. Apply grease to commutator end cover. Refer to Grease Application To Bearing Covers, Cap, And Housing section. Refer to Service Data for grease mask part number and grease quantity.
22. Assemble greased cover and new gasket to commutator end bearing. Install cap screws and torque to 54 to 61 N·m (40 to 45 ft-lbs) in a 1-3-5-7-2-4-6-8 sequence. Do not lubricate cap screw threads.

NOTE: If a D19 motor has been assembled with either Lubrico M6 or Regal Starfax No. 2 grease, the quantity and method is the same as for sealed grease application. However, it will be necessary to have external lubricating tubes on both ends. The tubes are not necessary for sealed grease lubrication and grease filler holes should be plugged. Refer to D19 Bearing Housing Modification To Accommodate D29 Armature of this section for procedure to plug holes.

23. Remove protective paper covering the commutator and adjust the brush holders so they will clear commutator surface 3 to 5 mm (1/8" to 3/16"). Torque brush holder clamping bolts to 203 to 217 N·m (150 to 160 ft-lbs). Ensure lug terminals are positioned properly.

24. Install brushes to brush holders. If old brushes are to be used, they should be installed in the same position in brush holder from which they were removed. When new brushes are installed, they must be "sanded in" by wrapping 1-1/2 turns of medium gauge sandpaper (with the abrasive side out) around the commutator before the brushes are applied. Install brushes and rotate armature until all the brushes are seated.
25. If new brushes were sanded in, remove sandpaper and blow out carbon dust with clean, dry compressed air at reduced pressure. Use a clean, dry, bound-edge cloth to remove carbon from string band and commutator riser while manually rotating the armature. Wipe carbon dust from brush holder insulators.
26. Visually inspect the commutator surface and creepage surface for damage or dirt. Rework as required. Refer to Section 5.
27. Connect brush shunts to brush holders. Torque bolts to 15 - 20 N·m (10 - 15 ft-lbs).
28. Apply and secure axle caps to traction motor frame. Ensure proper axle cap bolt and washer combination are used:

Axle cap bolt 8300107 and plate washer (dog eared) 8300066 should be replaced by axle cap bolt 8135061 and lockwasher 8135054. The new lockwasher is much thicker than the old washer so the new bolt is 6 mm (1/4") longer.

Also available is a hardened steel flat washer 8495681 as a replacement for lockwasher 8135054. Flat washer 8495681 has a larger and smoother seating area which results in a higher clamp load. The new flat washer is directly interchangeable with the lockwasher. If the mounting spot face on the axle is galled, the spot face should be welded and machined to the dimensions of Fig. 18.

The new bolt has class 3 threads instead of class 5 threads, eliminating the interference fit.

Axle cap nut 8300147 should be used with the new bolt 8135061. The new nut allows for a class 3 tolerance rather than a class 5 tolerance. The change is minor and the old nut can be used with a new bolt.

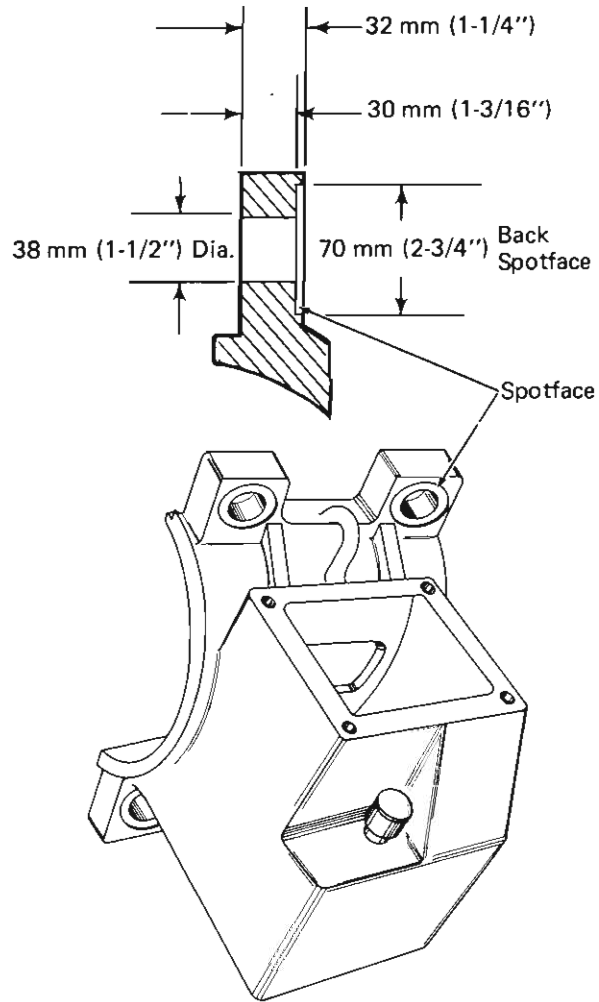


Fig. 18 - Axle Cap Mounting  
Spot Face Remachining

22500

Current Model D29 frames have a 1-3/8"-7 thread for the axle cap bolts, eliminating the nut. A 76 mm (3") bolt 8242193 is used.

29. Ensure axle cap serial number corresponds to traction motor frame number. If a new axle cap was line bored to the traction motor frame, ensure the frame number is stamped on the axle cap.
30. Remove pinion end lifting fixture from armature shaft.

## PINION APPLICATION

It is essential that the pinion is properly mounted on the armature shaft to ensure it is fit with the proper tightness. Apply the pinion as follows:

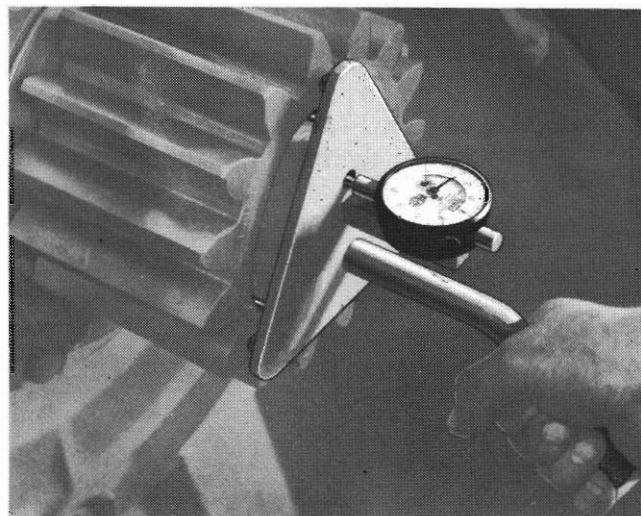
1. Remove any burrs or scoring on armature shaft or in pinion bore by honing or cleaning away with Arkansas stone (novaculite) or Grade 240 abrasive cloth.

2. Clean threads on armature shaft with a wire brush, or if threads are damaged, run on a thread chasing die. Apply retaining nut to shaft to check for proper fit.
3. Thoroughly clean pinion bore and tapered end of armature shaft where pinion will be mounted. The slightest bit of lint or dirt will hinder pinion application.
4. Check the contact between the pinion and shaft taper as follows:
  - a. Apply a thin, even coat of Prussian (nondrying) bluing compound to the pinion bore with the fingers. A cloth should not be used since heavy deposits of bluing will not allow a true indication of fit.
  - b. Place the pinion on the shaft carefully, avoiding undue rubbing. With the pinion held snug on the shaft, rotate pinion approximately one-eighth turn and back. Remove the pinion carefully and inspect the amount of bluing transferred to the shaft and the areas of contact.

It is necessary that the pinion is in firm contact with the small end of the armature shaft taper. A 50% contact is expected, but if the two tapers are at opposite extremes of tolerance, it is required that the pinion is in firm contact with at least 20% at the small end of the armature shaft taper. The large end of the bore should not contact unless a line-to-line contact is obtained throughout the bore.

- c. If correction is required, polish the shaft with Arkansas stone (novaculite) or Grade 240 abrasive cloth.
  - d. Thoroughly clean and remove all traces of bluing from the shaft and pinion with a solvent and wipe dry with clean, disposable tissues.
5. With armature shaft and pinion at room temperature, lightly mount pinion on shaft to ensure proper alignment. Withdraw pinion about 13 mm (1/2") and then using both hands, push firmly in place as far as it will go. Ensure pinion is mounted squarely on shaft.

6. Measure and record pinion position with respect to the shaft with a micrometer depth gauge, Fig. 19.



6527

Fig. 19 - Measuring Pinion Advance

7. Mark the points of measurement on the pinion, then mark the end of the shaft and pinion to retain the same angular relationship when re-applying and for final installation.
8. Remove pinion. If this proves difficult, small steel wedges may be used between the pinion and the frame. To prevent damage to the bearing housing, a strip of copper should be placed between wedge and housing.
9. Repeat Step 5, using the mating marks previously made to ensure proper relationship of pinion and shaft.
10. Apply micrometer depth gauge to markings and again measure and record pinion position on the shaft. Compare readings to those previously taken in Step 6. A minimum of two such readings should be made to determine variations, if any, in readings. To be acceptable for final mounting, successive cold readings should not vary more than 0.05 mm to 0.08 mm (.002" to .003").

If variation exceeds these limits, again carefully clean pinion bore and armature shaft to eliminate all possibility of dirt or contamination. If the variation is as much as 0.25 mm (.010"), the pinion fit to armature shaft must be checked by bluing and corrections made by lapping. It is necessary that the pinion is in firm contact with at least 20% at

the small end of the armature shaft taper. The large end of the bore should not contact unless a line-to-line contact is obtained throughout the bore.

11. When cold mounting variations are within limits, the pinion may be heated with an induction heater, Fig. 20, for final mounting. Heat and mount the pinion as follows:

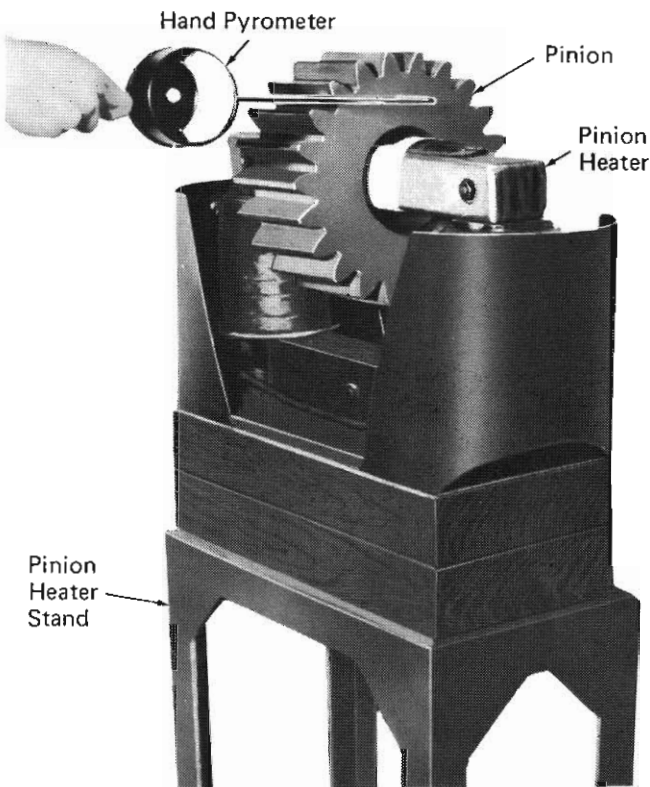


Fig. 20 - Induction Heater

4069

**NOTE:** In Step a, the use of liquid cleaner on the shaft and pinion bore increases the friction or holding power between the pinion and the shaft, preventing most pinion slippage. The liquid cleaner should not be used on a larger pinions as it will make pinions extremely difficult to remove.

The effectiveness of liquid cleaner is reduced after extended storage. Cleaner stability is at least 6 months if stored at temperatures below 24° C (75° F). Reduced stability will result if the cleaner is stored at higher temperatures.

- a. When applying 15-tooth and smaller pinions to the armature shaft, the bore of the pinion must be brushed clean and liquid cleaner applied liberally with a clean brush. After approximately 15 seconds (the liquid cleaner must not be

allowed to dry), use clean paper towels to carefully wipe the cleaner out of the bore, being careful not to touch the surface with the hands. Protect the pinion bore surface with a clean paper towel. Refer to Service Data for liquid cleaner part number.

Just before pinion application (in Step c), liberally apply liquid cleaner to the shaft and allow to set for 15 seconds and wipe off cleaner with clean paper towels. Do not allow shaft or pinion surface treated with liquid cleaner to be exposed to dirt or oil and do not touch with the hands.

- b. Heat pinion to the temperature specified in the Service Data. Check temperature at various points on the pinion with a hand pyrometer. Take readings **ONLY** when current to the induction heater is turned off. Pinion temperature should **NEVER** exceed 190° C (374° F).

**NOTE:** Since a change of 1° C is equivalent to a change of 1.8° F, a 121° C rise in temperature is therefore equivalent to a rise of 218° F.

As an example of proper heating, assume the shaft temperature is 24° C (75° F). The pinion should then be heated to obtain 145° C (293° F), which is the desired 121° C (218° F) rise in temperature over that of the shaft.

- c. When pinion is heated to the proper temperature, mount the hot pinion on the shaft in the same position used for the cold mountings.
- d. Measure pinion position with respect to the shaft with a micrometer depth gauge. Refer to Service Data for proper pinion advance. If pinion advance is not within limits specified in Service Data, the pinion will have to be removed and all preceding steps repeated after parts have cooled to room temperature.
- e. Place the pinion retaining nut into the cup lockwasher.

**NOTE:** In Step f, reused pinion retaining nut should be checked for flatness prior to assembly, using a straightedge and feeler gauge. The dish, if any, should be noted so an additional 0.10 mm (.004") dish can be determined in Step f.

- f. After final correct mounting of the heated pinion, quickly tighten the pinion retaining nut (with cup lockwasher) before the shaft and pinion temperatures equalize. Check for tightness of the nut 10 minutes after application, by measuring nut dish 6.4 mm (1/4") from inside the chamfer, using a straightedge and feeler gauge. A minimum dish of 0.10 mm (.004") is necessary. If nut face dish is less than 0.10 mm (.004"), the nut must be re-tightened. A minimum dish of 0.08 mm (.003") is required when nut face is checked cold.
- g. Secure the pinion retaining nut by staking the cup lockwasher into the two notches in the pinion and stake the cup lockwasher into two notches of the retaining nut.

## SUPPORT BEARING OIL FILLER CAP

Current traction motor models have an improved oil filler cap 9333024 replacing oil filler cap 8319096. During overhaul it is recommended that the old cap be replaced with the new cap.

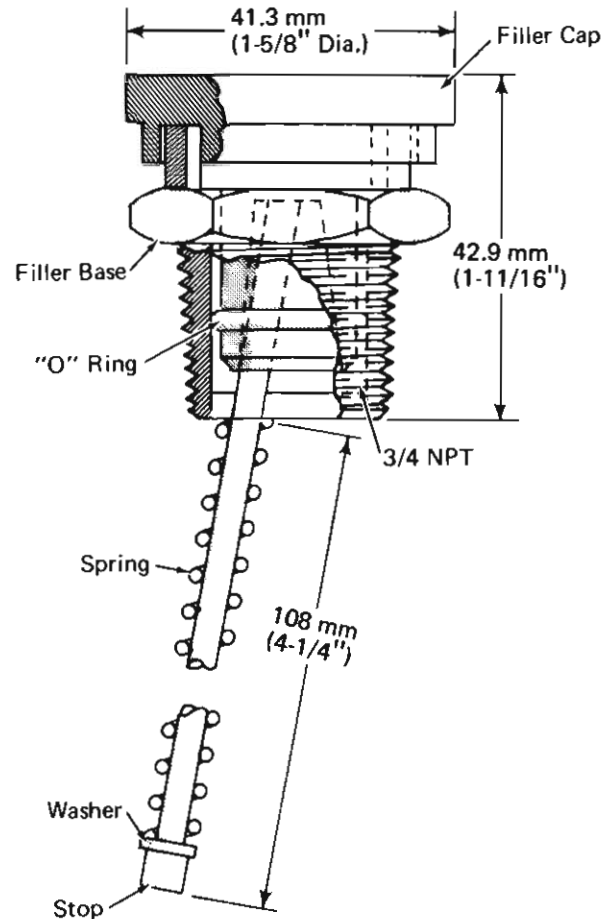
The old cap consists of a threaded metal base and a hinged flip top. The hinged top is susceptible to broken hinges and leakage.

The new cap, Fig. 21, consists of a cap held firmly in place with a coil spring. The cap requires no maintenance and will last much longer than the old cap.

Both caps have 3/4" NPT thread for installation and are directly interchangeable.

## BEARING RUN

Run the traction motor at 1500 RPM. Measure bearing temperature on bearing covers at 15 minute intervals. Continue bearing run until bearing temperature rises over ambient have not increased by more than 1° C in each of two successive 15 minute intervals. Run motor a minimum of 1-1/2 hours. The bearing temperature rise shall not exceed 25° C on the commutator end bearing or 35° C on the pinion end bearing.



22531

Fig. 21 - Support Bearing Oil Filler Cap

During run, also check for noise or roughness, which could indicate faulty assembly (misalignment of bearings), dirty bearings, or armature unbalance.

After completion of bearing run, visually inspect the commutator and wipe off any carbon dust from the creepage surface.

## FINAL INSPECTION AND STORAGE

Inspect the felt seals on the inspection covers. Replace seals with new seals if required before installing covers. Ensure top cover clamp is holding securely.

If motor is to be stored before using, cover all air vent openings and apply protective coating to all exposed machined surfaces.

# SERVICE DATA

## SPECIFICATIONS

### BRUSH HOLDERS

Number Of Brush Holders	4
Clearance To Commutator	3 - 5 mm (1/8" - 3/16")
Spring Pressure	
Coil Spring Type (at each finger)	4 - 5 kg (9 - 11 lbs)
Minimum Completely Worn Brush	3 kg (7 lbs)
Constant Pressure Type	
New Spring (at each finger)	1.8 - 2.3 kg (4 - 5 lbs)
Used Spring (at each finger) Min.	1.6 kg (3.5 lbs)

### BRUSHES

Coil Spring Type Holder	
Two wafer, flat top	
54 mm x 44 mm x 16 mm	
(2-1/8" x 1-3/4" x 5/8")	
Grade DE-5	8203773
Constant Pressure Type Holder	
Three wafer, notched top	
57 mm x 44 mm x 16 mm	
(2-1/4" x 1-3/4" x 5/8")	
Grade AC-35	8367716
Three wafer, common rubber top	
57 mm x 44 mm x 16 mm	
(2-1/4" x 1-3/4" x 5/8")	
Grade DE-5	8430993
Two wafer, notched top	
57 mm x 44 mm x 16 mm	
(2-1/4" x 1-3/4" x 5/8")	
Grade DE-5	8290119

### PINION APPLICATION

	Pinion Advance	Approximate Temperature Rise Above Shaft Temperature
14 to 18 teeth	1.40 mm ± 0.13 mm (.055" ± .005")	121° C (218° F)
19 to 21 teeth	1.27 mm ± 0.13 mm (.050" ± .005")	110° C (198° F)
22 and 25 teeth	1.14 mm ± 0.13 mm (.045" ± .005")	99° C (178° F)

### BEARING LUBRICANT QUANTITY ± 7 g (1/4 oz)

	PINION END		COMMUTATOR END	
	Kilograms	Ounces	Kilograms	Ounces
Cover	0.198	7	0.099	3-1/2
Inner Cap	0.142	5		
Housing			0.071	2-1/2
Roller Cage O.D.	0.035	1-1/4	0.014	1/2
Roller Cage I.D.	0.035	1-1/4	0.014	1/2
	0.410	14-1/2	0.198	7

**TORQUE VALUES**

	<u>N·m</u>	<u>Ft-lbs</u>
<b>D19 Traction Motor</b>		
C.E. Cover to Bearing Housing . . . . .	54-61	40-45
P.E. Cover and Cap to Bearing Housing . . . . .	54-61	40-45
C.E. Bearing Housing to Frame . . . . .	203-210	150-155
P.E. Bearing Housing to Frame . . . . .	217-230	160-170
Brush Holder Clamping Bolt . . . . .	203-217	150-160
Brush Holder Terminal Bolt . . . . .	14-20	10-15
C.E. Bearing Retainer to Armature Shaft . . . . .	68-75	50-55
Axle Cap to Frame (See Note 1.) . . . . .	1491-1627	1100-1200
<b>D29, D29CC, D31, &amp; D36 Traction Motors</b>		
C.E. Bearing Cover to Bearing Housing (See Note 2.) . . . . .	102	75
P.E. Cover and Cap to Bearing Housing . . . . .	54-61	40-45
P.E. Bearing Housing to Frame . . . . .	542	400
Brush Holder Clamping Bolt . . . . .	203-217	150-160
Brush Holder Terminal Bolt . . . . .	14-20	10-15
C.E. Bearing Retainer to Armature Shaft (See Note 2.) . . . . .	68-75	50-55
Cable Cleat Mounting Bolts . . . . .	203	150
Axle Cap to Frame (D29, D31, and D36) (See Note 1.) . . . . .	1491-1627	1100-1200
Axle Cap to Frame (D29CC) (See Note 1.) . . . . .	576-644	425-475

NOTES: 1. Lubricate threads, washer, and washer face of bolt with Texaco Threadtex.

2. Tightening sequence to be a minimum of three passes.

**EQUIPMENT LIST**

	<u>Part No.</u>
<b>Grease Masks</b>	
Commutator End Bearing Cover . . . . .	8276636
Commutator End Bearing Housing . . . . .	8261578
Pinion End Bearing Cover . . . . .	8276639
Pinion End Inner Cap . . . . .	8261579
Lifting Eye Bolt, Pinion End . . . . .	8067122
Turning Plate, Commutator End . . . . .	8067147
<b>Commutator End Bearing Positioner</b>	
D19 . . . . .	8204634
D29, D31, D36 . . . . .	8291908
Bearing Guide, Commutator End . . . . .	8204633
Dial Indicator . . . . .	8088245
Rethreading Die, Armature Shaft . . . . .	8050721
Die Holder . . . . .	8050722
Brush Spring Lifter . . . . .	8140869
Depth Gauge, Pinion Advance . . . . .	8160273
Dial Indicator . . . . .	8258484
Heater, Pinion (induction type) . . . . .	8041446
Coil, Induction Heater . . . . .	8075956
Bar, Top Cross . . . . .	8097840
Pyrometer, Hand Held . . . . .	8364533
Pinion, Retaining Nut Wrench . . . . .	8127529
"T" Handle . . . . .	8127528