



GM Locomotive Group

M.I. 3901 MAINTENANCE INSTRUCTION

D43 TRACTION MOTOR

INTRODUCTION

This Maintenance Instruction contains general or "running" maintenance recommended for D43 traction motors. It includes a procedure for removing a traction motor from a locomotive and various inspections which should be made in such instances. Refer to recommended maintenance intervals specified in the applicable Scheduled Maintenance Program.

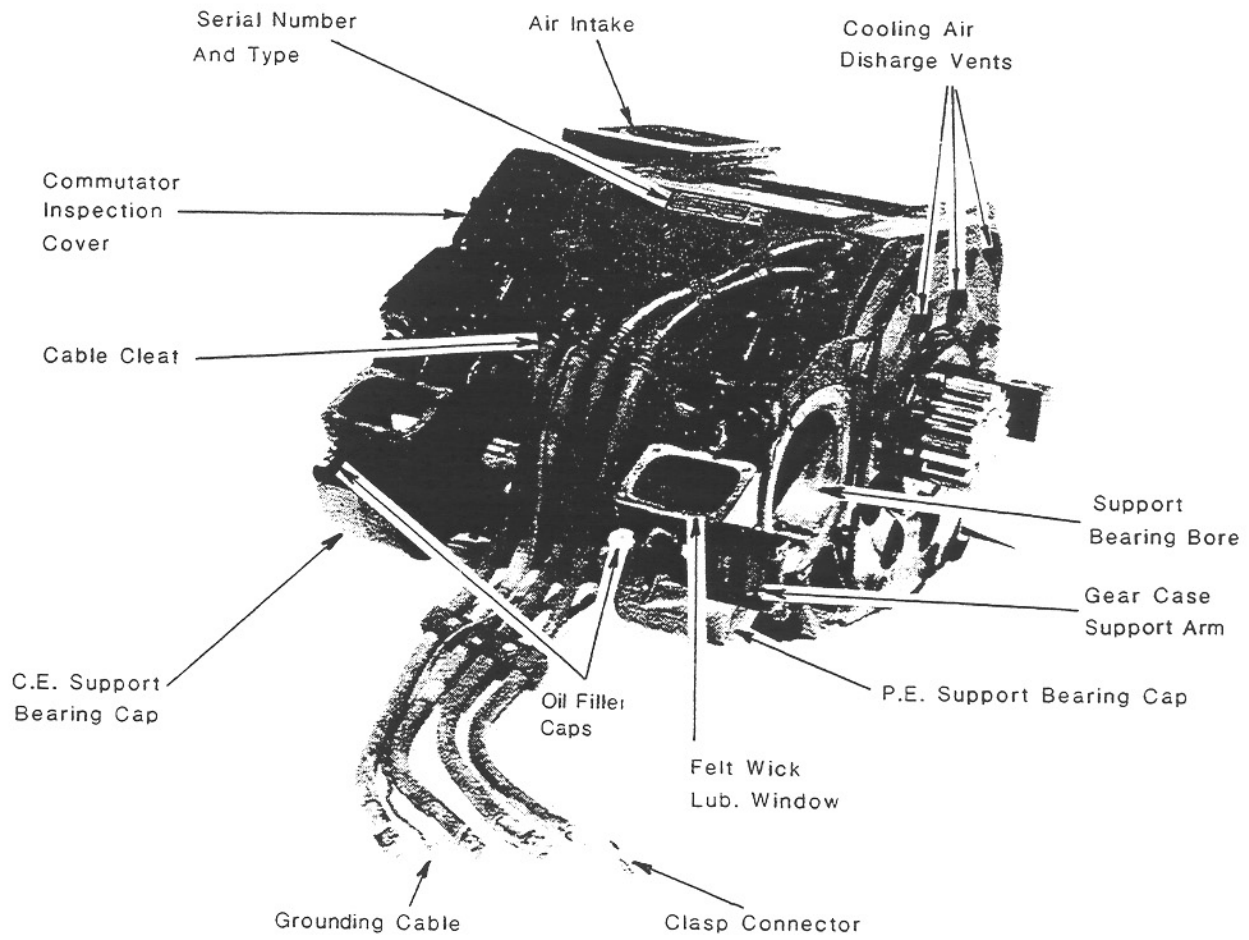


Fig. 1 - Traction Motor

CLEANING

It is essential that the traction motor be kept as clean as possible, both on the inside and outside. Oil and grease soaked dust and dirt should not be allowed to accumulate as this can prove detrimental to insulation and motor performance in general.

Cleaning the outside of the motors can be done by the common method of using a steam jet at the same time the trucks, underframe and fuel tank are washed. If this method is used, the diesel engine must be running at about 450 r/min to force sufficient traction motor blower air through the motors to prevent water or moisture from entering.

The motor interior can be conveniently cleaned by blowing dust and dirt away with compressed air. A large volume of clean, dry compressed air should be used at a reasonable low pressure. Blasts of high pressure air should be avoided due to the possibility of loosening or damaging the protective coating on the insulation.

Clean, dry lintless cloths should be used in conjunction with the air to clean away heavier deposits of dirt, and for wiping the brush holder insulators.

In cases where air and dry wiping cloths prove incapable of removing caked grease and dirt, a stiff brush, soft wood or fibre scrapers may be used. In severe cases it may be necessary to dampen a cloth in solvent such as Shellsol 1626 to loosen and remove imbedded deposits. Every precaution should be taken to keep the solvent off the commutator and copper parts as well as insulated coils and windings.

CAUTION

Adequate ventilation and safety precautions are necessary when handling inflammable fluids such as Shellsol 1626 (flash point 40°C).

Chlorinated hydrocarbon type cleaning solvents are not recommended for use on the equipment because of their effect on the insulation system. They have a tendency to attack semi-cured silicone rubber and to swell ethylene propylene rubber, natural rubber, neoprene and hypalon during extended soaking periods. The vapor state at 72°C (160°C F) attacks uncured silicon rubber within 20 minutes. These solvents and their vapors 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.

COMMUTATOR BRUSH HOLDERS

The D43 motor is equipped with constant pressure spring type brush holders. Spring pressure is pre-set and cannot be adjusted, however, if there is reason to suspect possible loss of spring pressure due possibly to heat caused by a commutator flashover, the spring pressure should be checked. It is difficult to check brush holder spring pressure in place, and it is recommended that the brush holders be removed.

The spring pressure of a new spring with the spring cell in the brush holder should be within 1.8 to 2.3 kg (4 to 5 lbs) at each of the two springs as measured with a spring tension scale at the position shown in Fig. 2.

The spring pressure of a used spring should be a minimum of 1.6 kg (3.5 lbs) when checked at the position shown in Fig. 2.

If the spring pressure of a new or used spring cell with the spring cell in the brush holder is not within tolerance, remove the spring cell from the brush holder and check as shown in Fig. 3. If the spring pressure is not within tolerance, replace the spring cell with a new spring cell.

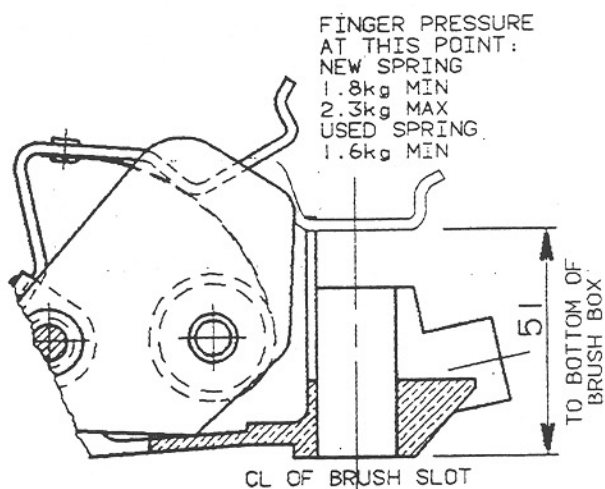


Fig. 2 - Measuring Constant Pressure Brush Holder Finger Pressure (Spring Cell in Place)

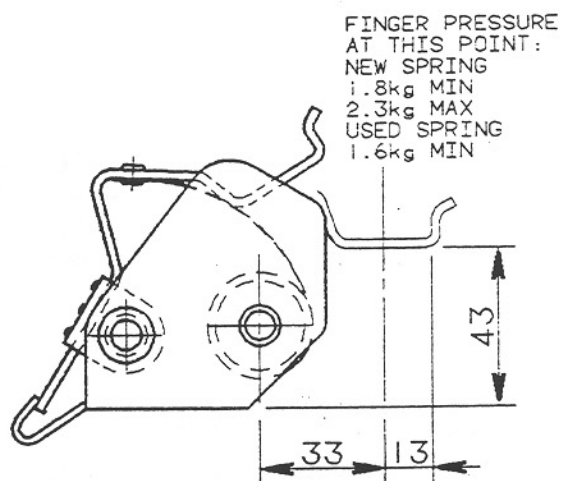


Fig. 3 - Measuring Constant Pressure Brush Holder Finger Pressure (Spring Cell Removed)

The complete brush holder assembly should be checked to ensure the mounting is secure and the cable and shunt connections are tight. The brush holder should be checked and adjusted if necessary to maintain a dimension of 3 mm to 5 mm ($1/8''$ to $3/16''$) between the bottom of the carbonway and the commutator surface.

To ensure proper tightness of brush holders and connections, the following dry torque values should be applied;

7/8"-9 brush holder block bolt -203 to 217 N.m (150 to 160 ft-lbs).

1/2"-13 brush holder cable to brush holder bolt -95 to 102 N.m (70 to 75 ft-lbs).

5/16"-18 brush holder shunt screw -15 to 20 N.m (10 to 15 ft-lbs).

BRUSH HOLDER INSULATOR STUDS

Brush holder insulator studs, Fig. 4, should be kept clean and free of defects. The polyester insulated type brush holder studs are unusually resistant to flashover damage. If flashover damage should occur, these 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.

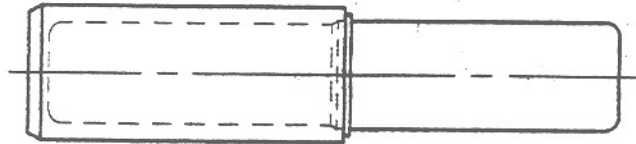


Fig. 4 - Polyester Brush Holder
Insulator Stud

The current model brush holders have a silicone rubber boot which fits over the base of the stud and brush holder, Figure 5.

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

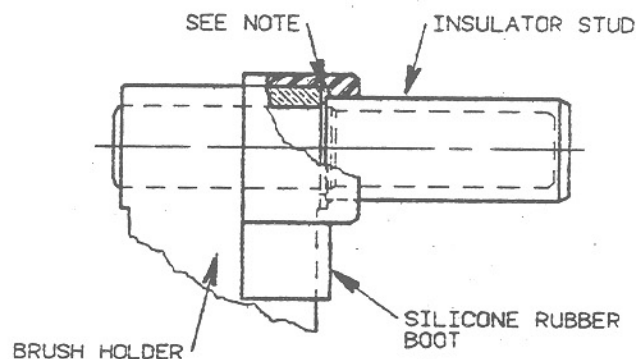
Standard size - 8159003

To be used in new brush holders or when stud holes are within $25.235 \text{ mm} \pm 0.013 \text{ mm}$ ($.9935'' \pm .0005''$).

0.05 mm (.002") Oversize - 8209068

0.20 mm (.008") Oversize - 8219773

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



NOTE.
FILL GAP BETWEEN INSULATOR STUD AND CASTING
WITH A SMALL EXCESS OF SILICONE COMPOUND.
IMMEDIATELY INSTALL SILICONE RUBBER BOOT.
SEATING BOOT IN WET SILICONE COMPOUND
TIGHTLY AGAINST CASTING.

Fig. 5 - Brush Holder Insulator
Stud Installation

CONSTANT PRESSURE BRUSH HOLDER MAINTENANCE

SPRING CELL REMOVAL

When inspection indicates it is necessary to remove the spring cell assemblies from a brush holder, Fig. 7, perform the following:

1. Place brush holder fingers in "cocked" position.
2. Pry lower end of each pin (visible in the holes directly below and at each end of the spindle) slightly upward until pin protrudes from the top of the holder. Pull pin out of hole.
3. Drive spindle out of brush holder to free spring cell assemblies.

BRUSH HOLDER CLEANING

Heavy Cleaning

1. To remove heavy carbon deposits, oil, grease, and severe burn marks, place the brush holders in a tank charged with one part emulsion soak cleaner such as Clifco No. 1 BH or equivalent mixed with four parts of water. Soak the brush holders at room temperature without agitation for 3 to 5 hours depending upon the condition of the brush holder.

CAUTION

Observe safety precautions when handling emulsion soak cleaner and store in a safety-type container. Cleaner as received from supplier has a flash point of 38°C (100°F). Mixed with water, it has no flash point. Rubber gloves should be used when using cleaner to prevent drying out the skin or possible irritation. Keep cover on tank when not in use and while brush holders are soaking.

2. Steam clean brush holders using a steam cleaner such as Dober Chemical Corporation Cleaner 6006 or Turco Chemical Company Steamfas. Operate steam cleaning gun nozzle from 25 mm to 150 mm (1" to 6") from surface being cleaned.

WARNING

Protect skin and clothing while steam cleaning. Operator should wear rubber apron, boots, gloves, and a plastic face shield.

3. Hose off brush holders with clean water.

Light Cleaning

For light cleaning, brush holders should be cleaned by washing a non-toxic solvent such as Shelsol 1626. A solvent with a fast rate of evaporation is preferred.

WARNING

Adequate ventilation and safety precautions are necessary when handling inflammable fluids such as Shellsol 1626 which has a flash point of 40°C.

BRUSH HOLDER INSPECTION AND REPAIR

1. Inspect brush holder terminal lug seat for roughness and rework as required.
2. Check dowel securing the brush holder pins to ensure the casting is peened over at both ends.
3. Remove all arc burns and file off surfaces facing the commutator if metal buildup has occurred.

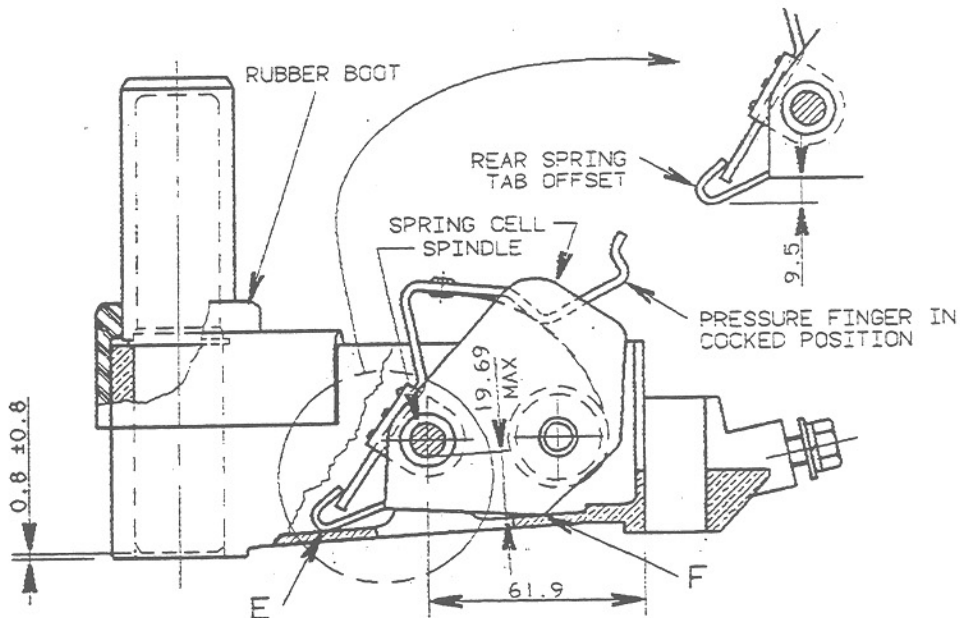


Fig. 7 - Constant Pressure Brush Holder

Carbonways (Brush Slots)

Check carbonways for wear with gauge. Refer to Service Data for gauge part number. The carbonway should be between 15.90 mm (.626") and 16.13 mm (.635") in each brush slot. The short brush slot should be within 42.16 mm to 42.39 mm (1.660" to 1.669"). The long brush slot should be within 84.23 mm to 84.46 mm (3.316" to 3.325").

NOTE

Brush slots worn beyond acceptable limits cannot be repaired by peening and filing to gauge size. No protrusions are allowed in the brush slots. Some slight gouging in the top of the slot is permissible, providing it does not exceed 10 percent of the surface. Brush holders with excessively worn or damaged slots must be replaced.

SPRING CELL REPLACEMENT

Before replacing spring cell assemblies, inspect brush holder casting and insulator pins. Replace any defective parts with new parts. Repair all defects.

1. Insert the spindle in the spindle hole with the spindle pushed up against the top of the hole. Check the distance from the bottom of the spindle to the inside surface of the bottom web of the brush holder casting, as shown in Fig. 8. If this dimension is greater than 19.69 mm (.775") or if the hole is more than 51 mm (2.00") oversize, the hole must be plugged and relocated.
2. Check rear spring tab to ensure that offset of tab is 9.5 mm (3/8"), Fig. 7. Bend rear spring tab as required. Place brush holder fingers in "cocked" position.
3. Place cell assembly in brush holder spring pocket with fingers centered within 0.8 mm (1/32") of slot "A", as shown in Fig. 8.

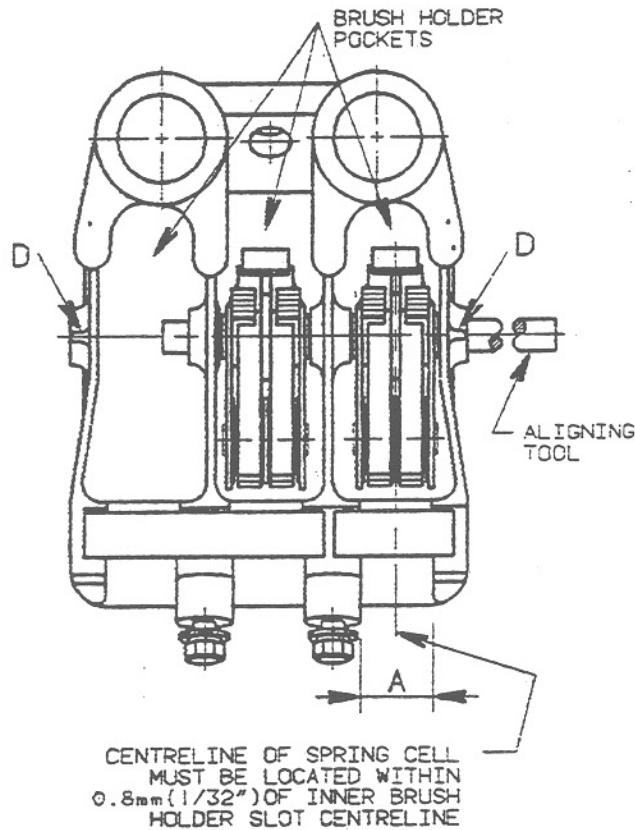


Fig. 8 - Installing Spring Cell in Brush Holder

4. Insert aligning tool through spindle hole and spring cell, Fig. 8. Check alignment of spring cell with finger slot "A" and, if cell is out of line, remove aligning tool and reassemble.
5. Follow same procedure with centre and left-hand cells. After each cell is assembled, recheck the alignment with finger slot "A".

6. When all cells have been installed, drive the aligning tool out of the assembly with the spindle. Continue to drive the spindle through until the spindle is centered in the brush holder.
7. Drill two 3.2 mm (1/8") diameter holes at area "D" of Fig. 8. Insert groove pins at each hole at area "D". Peen casting lightly into each hole to lock pins.
8. Ensure each spring cell is tight in the brush holder. If cells are properly installed, the cells will be held firmly at contact points "E" and "F" of Fig. 7. If required, adjust rear spring tab so that the cells are held firmly at points "E" and "F" when the spindle is driven in place. Points "E" and "F" must have definite contact with holder.
9. After assembly, release brush holder fingers from "cocked" position to prevent handling damage and to prepare assembly for installation.

COMMUTATOR BRUSHES

Currently motors are equipped with a three-wafer resilient pad brush which improves commutation and increases brush life.

Three split type brushes are used in each of the four brush holder assemblies. The brushes should move freely in the brush holder and not be stuck with dirt. This can be checked by lifting the brush pressure spring and raising and lowering the brushes by hand. The constant pressure brush holder springs may be raised by hand and placed in a "cocked" position as shown in Fig. 9.

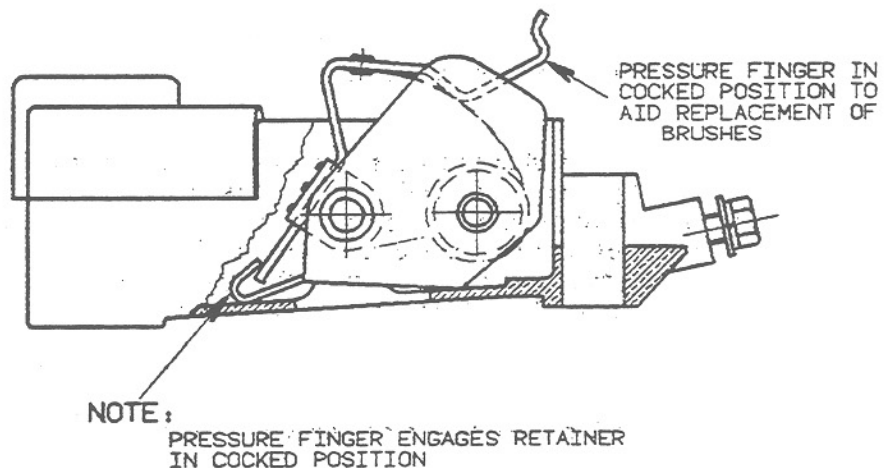


Fig. 9 - Brush Inspection

Carbonways must be smooth and brushes must fit closely so they will not chatter. Brush holders with carbonways worn enough to permit chatter should be replaced. Carefully lower the brush pressure spring over the brush to avoid snapping which is likely to cause the brush to be chipped.

Brushes should be carefully inspected and replaced if found chipped, broken, or worn to the condemning limit. This brush wear limit is easily determined by measuring the height of the brush pressure spring above the brush holder. If the spring is found to be 3 mm (1/8") from contacting the brush holder as shown in Fig. 10, the brush should be replaced.

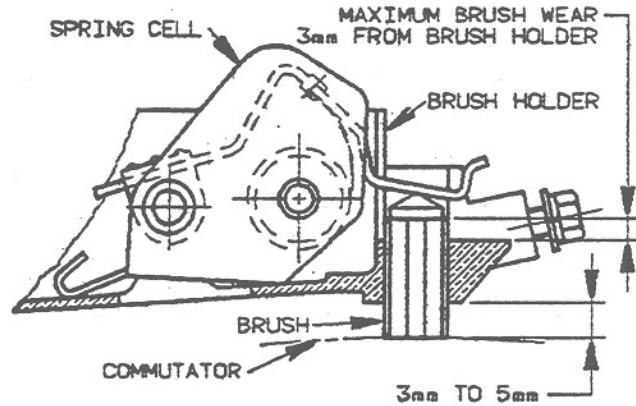


Fig. 10 - Measuring Brush Wear

Brushes may be replaced individually as they wear to their limits, rather than replacing all of them on a motor at one time. Replacement brushes should, however, be of the same type and grade as the ones replaced, since mixing brushes in the same motor can prove to be detrimental to successful operation.

NOTE

Currently motors are equipped with three wafer padded brushes part number 2042250 which are manufactured with a contour at the commutator end of the brush. The brushes do not require sanding.

If old brushes are used, they should be installed in the same position in the brush holder from which they were removed. If brushes lacking the contour at the commutator end of the brush are to be installed, they must be "sanded-in" by wrapping - 1-1/2 turns of medium gauge sandpaper (with abrasive side out) around the commutator before the brushes and rotate the armature until all the brushes are seated. Refer to Service Data for brush type and part numbers.

If new brushes are 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 teflon sleeve and commutator riser. Wipe carbon dust from brush holder insulators.

Brush shunts should not be twisted or braided. The shunt connection to the brush holder should be securely made. Brushes should be replaced if found to have broken shunts, or where tamped shunt connection to the brush is loose.

COMMUTATOR

The commutator is a vital area on the traction motor and 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 expensive repairs become necessary. Such conditions as film stripping, bar burning, high or low bars, high mica or flat spots tend to become more serious with time. When found, the cause should be determined and corrected as soon as possible.

CREEPAGE SURFACES

The creepage area on the teflon sleeve over the string band and TIG welded commutator terminations, Fig. 11, should be thoroughly cleaned with alcohol to remove all traces of carbon.

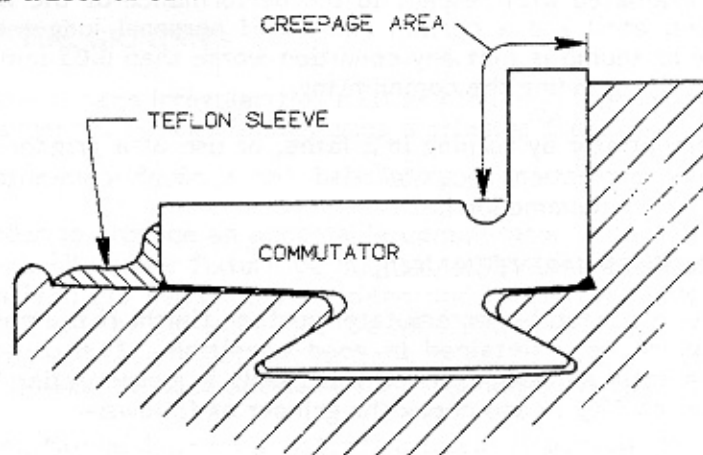


Fig. 11 - TIG Welded Terminations

COMMUTATOR SURFACE CONDITIONS

Frayed brush shunts, highly polished brush to brush box contact surfaces, excessively worn brush pressure arms, broken pressure springs, and rapid brush wear are indications of more than normal brush movement within the brush box and the cause should be determined. With few exceptions, the cause will be found to be commutator surface irregularities. The constant monitoring of the brush problems mentioned above is the best and easiest method of determining when a commutator should be ground.

Road seasoning (repeated heating and cooling of the commutator), standstill burns, and overspeed can cause some slight bar movement to occur. This bar movement, depending on the amount, the number, and location with respect to each other, could trigger conditions detrimental to both the commutator and brushes. A commutator having certain irregularities in profile could operate satisfactorily at lower locomotive speeds, however, when operated at high locomotive speeds, the problem of flashover, brush breakage, and frayed brush shunts may develop. A very rough commutator would have these same conditions occurring at lower locomotive speeds.

A rough commutator may or may not be readily apparent to the eye. Any question as to the condition of the surface can be answered with the use of a dial indicator attached to the motor so the plunger rides on the commutator surface. Be sure the indicator is on one of the brush tracks. Rotate the armature slowly and carefully observe the readings. By merely noting the minimum and maximum readings, a true picture of the commutator surface will not be obtained. The

0.08 mm (.003") runout tolerance (for new or rebuild motors) is not applicable as a measurement of commutator irregularity as the problem of irregularity is not one of machining tolerances but of bar to bar movement. An example of this would be to have readings around the commutator that give a total variation of 0.05 mm (.002"), however, hidden within the 0.05 mm (.002") 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 (.004") the minimum and maximum readings 180° apart is an acceptable commutator whereas the first example, 0.05 mm (.002") 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 the performance of the motor (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 (.002") in a six (6) bar span calls for grinding the commutator.

Resurfacing the commutator by turning in a lathe, or use of a grinder and grinder adapter, is the only correction recommended for a rough commutator. 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. 12 and check the grinder as follows:-

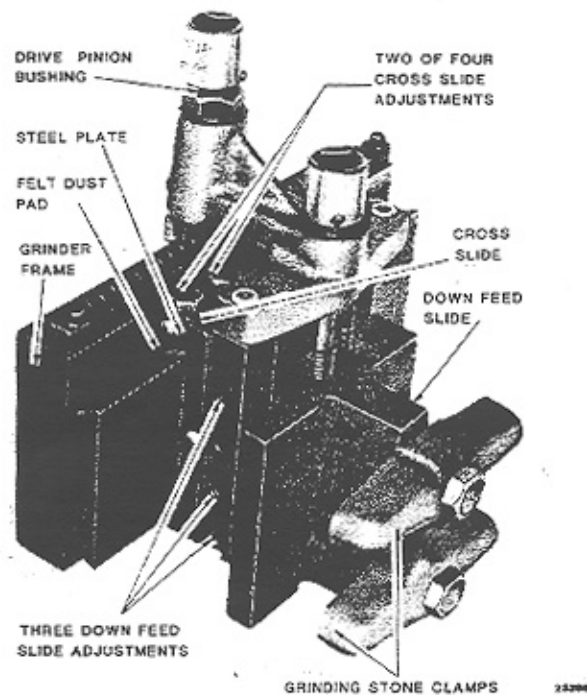


Fig. 12 - Commutator Grinder Adjustments

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 a 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 the either grinding dust trapped 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 any assembled grinder by dipping in a solvent or by using an pressure to blow out dust. The grinder must be completely disassembled to clean.

COMMUTATOR GRINDING

Commutator surface irregularities such as etching, roughness, or slight burning can often be corrected by resurfacing, using a grinding fixture and an adapter.

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 to cause binding. Refer to Commutator Grinder Maintenance Section prior to grinding the commutator.

The grinding can be done on a motor in a truck while under the locomotive by using the following method:-

1. Block all wheels on truck at opposite end of locomotive to one having traction motor commutator ground.
2. If the axle of the wheel set driven by the motor having the commutator ground is equipped with roller journal boxes, proceed as follows to raise the desired wheel set:-
 - a. Apply suitable wooden or steel blocks under the two journal boxes between the pedestal tie bar and the journal box on the wheel set to be raised. These blocks will hold the axle in its original position and eliminate unnecessary raising when the motor is being run. Next apply jacks under the locomotive frame at jacking pads provided and raise one end of the locomotive with truck so the desired wheels are just above the rails.
 - b. An alternate method of raising a pair of wheels is to remove the weight of the locomotive from the truck with jacks, then raise the desired wheel set by placing jacks directly under the journal boxes.
3. If the axle of the wheel set driven by the motor having its commutator ground is equipped with friction type journal boxes, apply suitable wooden or steel blocks under the two journal boxes between the pedestal tie bar and journal box on the wheel set to be raised. Then apply jacks under the locomotive frame at jacking pads provided and raise one end of the locomotive with truck so that the desired wheels are just above the rails. Next jack CAREFULLY under traction motor axle bearings until they take the weight of the axle and wheels only. Block all raised parts with exception of wheel set being worked on.

GRINDER ADAPTER INSTALLATION

1. Remove the bolt securing the brush holder cable to the top brush holder. Remove the bolt securing the top brush holder clamp block and remove brush holder.
2. Tape the copper lug of the lead which was disconnected from the brush holder so it will not short against motor frame.
3. Install the adapter in the top brush holder position and secure it with the brush holder clamp block and bolt as shown in Fig. 13. Refer to Service Data for grinder adapter part number.

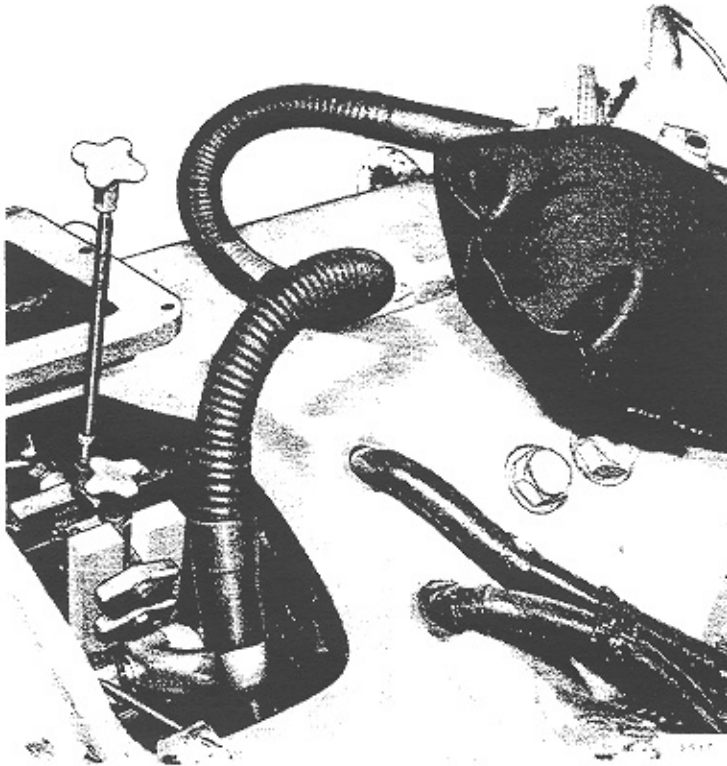


Fig. 13 - Grinder Installation

GRINDER INSTALLATION

1. Install alignment bar on the grinder down feed slide. Check the alignment bar contact to the feed slide for zero clearance with a thickness gauge. Refer to Fig. 14. Any clearance at either side of the alignment bar contact surface indicates the bar is not parallel to the grinder. Refer to Service Data for alignment bar and grinder part numbers.

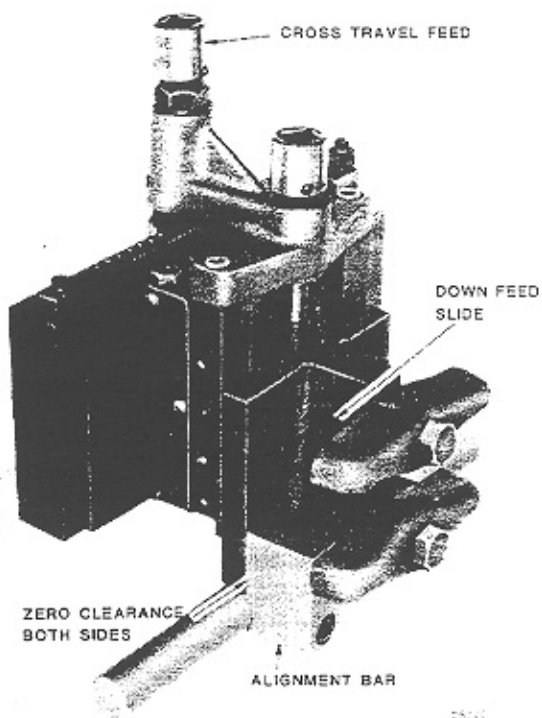


Fig. 14 - Commutator Grinder Alignment Bar Installation

2. Install the grinder with the alignment bar on the adapter as shown in Fig. 14.
3. Position the motor armature so that the alignment bar will contact approximate centre 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 (.003") of paralleling the commutator bar.
4. Remove the alignment bar from the grinder and install two grinding stones. Use finish grade 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.

GRINDING

The supply voltage to the traction motor can be a DC welding machine (or other source of DC electrical energy.) The desired motor r/min for the grinding operation is approximately 1500 r/min. A satisfactory surface finish can be obtained at a reduced r/min, but the grinding time will be lengthened. Do not use a speed below 1000 r/min.

NOTE

Commutator can be ground by utilizing locomotive power. Contact Clyde Service Department for details.

1. Disconnect all four traction motor leads of the motor to be worked on, and tag the leads so they can be reconnected in their original position. Connect the motor leads to rotate the armature in a clockwise direction as viewed from the commutator end. Incorrect rotation (counterclockwise) could cause the grinding stones to chatter on the commutator. Connect the traction motor leads as follows:-

Connect the positive supply lead to the "AA" lead of the motor.

Connect the "A" and the "F" leads of the motor together.

Connect the negative supply lead to the "FF" lead of the motor.

NOTE

Brushes that are used in the motor for grinding operation will have particles of grinding stone, dust, and copper imbedded in the surface that rides on the commutator. These particles can cause rapid deterioration of the commutator surface if the contaminated brushes are not removed from the motor. It is recommended that if the brushes in a motor are of sufficient length to continue service after the commutator is ground, they should be removed from the motor before grinding is begun and then reinstalled after completion of the operation. Ensure brushes are marked so that they can be reinstalled in their original position. Brushes that are near the condemning limit for length should be used in the motor for the grinding operation.

2. Start the motor and feed the grinding stones into the commutator slowly, using the downfeed handle until light contact is made. Proceed to grind the commutator by feed the stones not more than 1/8 turn of the downfeed 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 downfeed 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

Feed the grinding stones down more than 1/8 turn of the downfeed handle will result in a 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-burring 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.

3. 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 adapter.
4. With the armature rotating, clean the outer end of the commutator bars with a small piece of grinding stone.
5. Remove and discard the brushes used in grinding operation.

6. Thoroughly clean the motor 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.
7. 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.

8. When the depth of the mica undercut between copper bars is less than 1.2 mm ($3/64$ "), use commutator slot file, Fig. 15 to undercut the mica to proper depth. Do not exceed the undercut maximum depth of 2 mm ($5/64$ ").

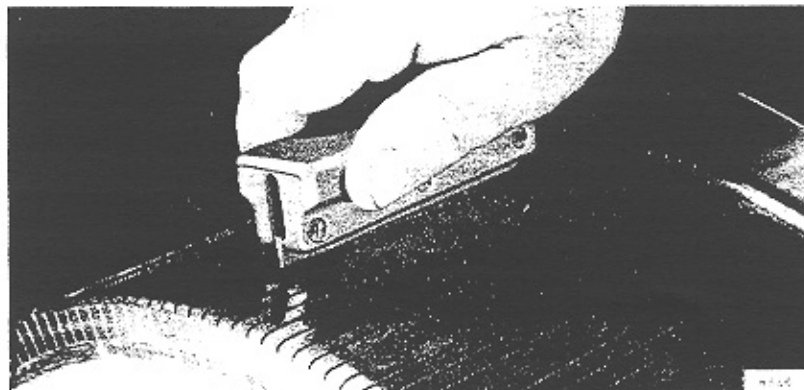


Fig. 15 - Cleaning Commutator Slots

9. 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.
10. 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.
11. 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.
12. Reconnect cables and install inspection cover. Check motor for proper rotation before returning locomotive to service.

NOTE

If the commutator has been damaged to such an extent that the grinding process proves ineffective, the motor will have to be removed and the commutator turned in a lathe.

ARMATURE BEARINGS

NOISE TEST

Each time a traction motor is removed from a locomotive truck it should be operated so that a noise check can be made for faulty armature bearings. Performing this test will serve as a means of detecting faulty bearings thus preventing such a motor from operating in service where it would likely result in a road failure.

The power source and cable connections for this test are the same as described previously for rotating the armature during commutator grinding. The armature speed should be brought up to about 1500 r/min and then the power shut off to allow the armature to coast to a standstill. Carefully listen and try to determine the source of any noise that might be considered unusual. Experience and comparison with other motors will help distinguish a faulty bearing from a normal one.

SEALED GREASE LUBRICATED BEARINGS

Unless otherwise specified by the customer, all traction motors are manufactured with sealed grease lubricated armature bearings. A specific type of grease is used. The amount and method by which it is applied is carefully controlled.

A sectionalized nylon insert is installed in the pinion end bearing cover to prevent an excessive amount of grease from being moved into the rollers by slumping action caused by vibration. This reduces "churning" of the grease which in time causes the grease fibres to become soft and susceptible to purging. These factors should permit the motor to be operated without further bearing attention to the motor overhaul period specified in the applicable Scheduled Maintenance Program.

GEAR CASE AND GEARS

The gear case houses the traction motor pinion and mating axle gear, protecting them from dirt or damage and also carries the gear lubricant. The case is made of two close fitting halves with seals to provide complete contact and closure.

The gear case is equipped with plastic seals at the axle bore. These seals have integral 360° gutters and running clearance type labyrinth seals that fit around the axle on either side of the gear. Seals engage the gear case side sheets by means of a circumferential groove. Metal-backed felt seals are installed at the pinion bore and string covered cotton cording is used in the parting line channels of the upper gear case half.

The inspection opening and grease filler cap is located at the axle end of the upper and lower halves of the case. This makes it more convenient for inspecting gears, checking and adding lubricant.

The caps are sealed by mating machined surfaces without the need of gaskets. The top filler cap contains a magnet which maintains pressure against the flanges around the gear case filler opening, assuring a positive sealing action, See Fig. 16a. The lower filler cap may be easily removed or applied by depressing the leaf spring, using tool as shown in Fig. 16b.

LUBRICATION

Inspection of gear cases should include checking for lubricant leaks. Excess lubricant will be discharged through the drain slot of the traction motor gear seal during the first few thousand miles of operation and is no cause for concern. Prolonged leakage at any other point, however, should be corrected.

Refer to the applicable Schedule Maintenance Program for the recommended interval of gear case inspection and the type of lubricant to be used. Frequent gear case grease level inspections should be made using such intervals as a guide until the maximum mileage between lubrication intervals can be determined for the specific type of service encountered.

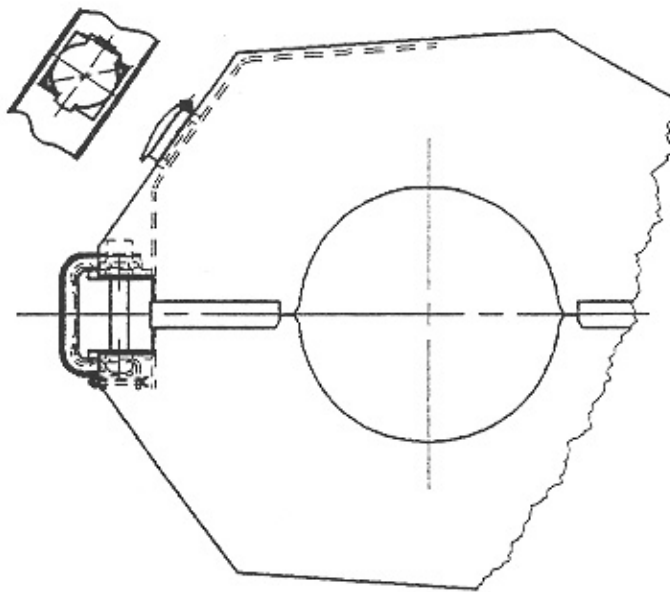


Fig. 16a - Top Filler Cap



Fig. 16b - Filler Cap Removal Tool

The need for lubricant can be readily determined observing the condition of the gear teeth through the gear case inspection opening. Gear teeth appearing dry or having bright spots indicate that grease should be added. Gear lubricant should be maintained at sufficient depth to allow the full tooth to dip into grease. 0.9 kilogram (approx. 2 pounds) of recommended lubricant should be added when such inspection indicate the need.

Measurements of lubricant level should be made after a locomotive comes in from a run and allowed to stand without moving for at least a half hour. This will allow time for the grease to dry to the bottom of the case and cool.

GEAR CASE INSPECTION WHEN REMOVED

When a gear case is removed from a traction motor/wheel axle assembly, the case should be cleaned and qualified prior to reassembly to ensure that only those gear cases which are capable of satisfactory performance will be reused. Refer to Maintenance Instruction M.I. 1520 for gear case inspection, repair, and seal application procedures.

GEAR CASE REASSEMBLY

1. Prior to reassembling the gear case, check the following:-
 - a. Ensure the drain slot between the seals is open to ensure against contamination of support bearing oil with gear lubricant. Grease entering the support bearing would clog and glaze the lubricator wick making it inoperative.

NOTE

Current plastic seals are positioned with split line at the 6.00 o'clock position to align drain slot on inboard side of seal with drain duct on inboard side of lower gear case half. Locating keys are used at the 12.00 o'clock position on the upper gear case half to engage slots in seals to prevent outboard seal from rotating with wheel hub.

- b. Ensure lubricating oil has been generously applied to the pinion felt seals.
2. Assemble gear case to the traction motor/wheel axle assembly. Tighten the mounting bolts and torque to 1 220 N.m (900 ft.lbs). Apply lockwire. Failure to properly tighten the bolts can result in excess wear caused by vibration on the support bearing cap and pinion end bearing cover supporting arms.

NOTE

In some applications (at customers request) huck bolts may be fitted in lieu of threaded bolts.

3. Charge gear case with recommended lubricant as specified in Service Data. It is important that the recommended lubricant (see Maintenance Instruction M.I. 1756) be used, since substitutes may have poor oxidation stability and tend to solidify in extended service.
4. After an initial trip, check gear case condition and lubricant level. Check level through lower fill opening to ensure a full tooth dip into lubricant. Add lubricant as required. Thereafter, inspections should be made at intervals specified in the applicable Scheduled Maintenance Program.

MOTOR SUPPORT BEARINGS

The traction motor has three suspension points in the truck. Two are provided by the support bearings which connect one side of the traction motor to the wheel axle. The third point is provided by two lugs on the motor frame that contact the top and bottom of the nose support assembly on the truck frame. This nose suspension thus arrests the upward or downward movement of the motor depending on direction of rotation when power is supplied.

The support bearings are of the split type and "hour glass" design. A half of each bearing assembly is inserted in the motor frame while the mating half is installed in the support bearing cap. Both halves are machined together and are identified by a serial number. The bearings are thus matched and must be kept together and installed in sets. The commutator end and pinion end bearing assemblies of the current narrow window type are interchangeable.

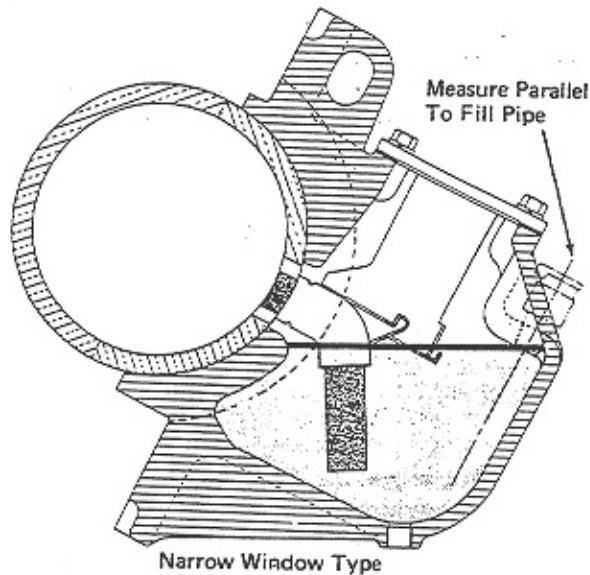
SUPPORT BEARING LUBRICATION

Lubrication of traction motor support bearings is provided by a felt wick inserted in the oil reservoir in each bearing cap. A spring loading arrangement keeps the wicks firmly in contact with the wheel axle through an opening in the bearing.

A narrow window traction motor support bearing cap and support bearing arrangement has been in use since the introduction of the D43 traction motor. The narrow window provides increased oil capacity and larger bearing surface as well as an improved wick lubricator, Fig. 17.

The oil level in the support bearing cap should be checked at intervals specified in the applicable Scheduled Maintenance Program. The level is determined by inserting a clean steel rule or rod properly marked into the oil filter hole. Accurate measurements can be obtained only if the rule or rod is inserted parallel to the pipe as shown in Fig. 17.

Refer to Maintenance Instruction M.I. 1756 for recommendations on the type of lubricating oil specified for support bearings, adding as needed to maintain desired level.



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Fig. 17 - Motor Support Bearing Oil Level

If inspection shows that water is present in the oil reservoir, it should be drained before the unit is returned to service. The wick should also be removed and inspected. Refer to Step 13 of Felt Wick Lubricators paragraphs. Replace unsatisfactory wicks.

FELT WICK LUBRICATORS

Felt wick lubricators should be carefully inspected at wheel turning time, or more frequently if service dictates. Cleaned and re-qualified wicks should be installed as directed by applicable Scheduled Maintenance Program, preferably prior to a winter season.

1. Scrape all dirt from cover plate and remove all old gasket material.
2. Clean cover plate and metal carrier in all purpose lubricating oil. Refer to Service Data for oil part number.

3. Inspect the felt wick lubricators. Wicks with excessive edge rounding, taper, wear, or with hardened, glazed, or burned contact surface, should be replaced with new felt wick lubricators. Normal service tends to pack the upper portion of the wick, which is permissible unless the wick can no longer absorb oil.
4. Clean the felt wick lubricators using all purpose lubricating oil heated to a temperature between 49-60°C (120-140°F). Scrape wick face with putty knife (without digging), clean with a soft bristled brush, or rub wick with an oil soaked rag to remove surface dirt layer. Refer to Service Data for oil part number.

CAUTION

Do not use kerosene, petroleum spirits, chlorinated solvents, or any other solvent to clean felt wicks because the solvent fails to remove embedded dirt and because of the difficulty in removing the cleaning agent. Deposits of these products may result in diluting oil film during operation.

5. Check wick by applying oil and squeezing sides of wick face to cause oil to pool on wick face. Observe how rapidly oil is absorbed back into the wick. If a pool of oil remains on the surface of the wick or is absorbed slowly, it is an indication that the wick surface is clogged by glazing or wear. Wick should be replaced with a new wick.
6. The wick contact surface should be free of major irregularities. Slight depressions are permissible provided the depressions do not extend the full length of the wick.
7. Check contact surface of the wick with a straightedge. If any depression exceeds 3 mm (1/8") or if a regular "saw-tooth" pattern is observed, replace with a new wick.
8. The wick should be replaced when contact surface has worn down to within 6 mm (1/4") of the metal wick carrier. The wick should also be replaced with a new wick when the felt has elongated the rivet holes and is loose in the carrier.
9. Visually inspect the metal wick carrier assembly for warping, distortion, or cracks. Replace carrier if required. Check carrier pins and pinholes. Replace parts if worn more than 0.30 mm (.012") over a new assembly.
10. Check narrow window support bearing lubricator spring pressure by placing a weight on the wick assembly as shown in Fig. 18. The check should be made with the wick saturated with oil and all sliding parts cleaned and lubricated. The support bearing lubricator springs should be able to raise a 0.9 kg (2 lb) weight placed on the contact surface after the wick is depressed.

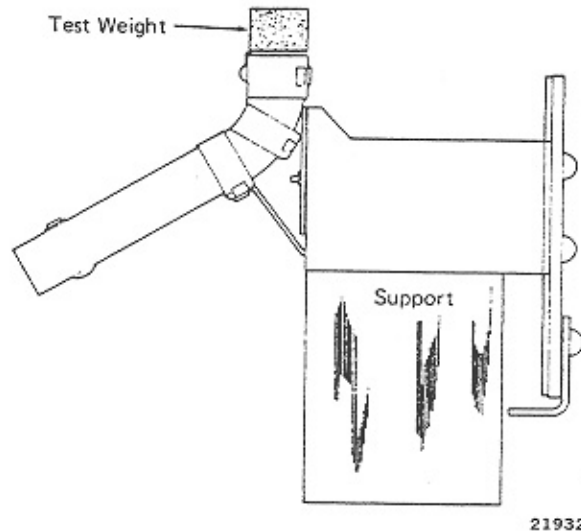


Fig. 18 - Testing Window Wick Lubricator Spring

NOTE

Used wicks must be thoroughly cleaned and impregnated with oil prior to use. New wicks must also be impregnated with oil prior to use.

New replacement wicks are normally oil impregnated prior to shipment from the factory for application without further preparation. However, if wicks have become dry in storage, resoak as instructed in Step 12.

11. Soak wicks for a minimum of 20 minutes in all purpose lubricating oil at room temperature or 10 minutes in oil heated to 71°C (160° F). Wicks should not be allowed to touch the bottom of the container when soaking in a heated tank.

Allow wicks to drain for 10 minutes to facilitate handling and installation. Use care to keep wicks clean while handling.

12. If there is evidence that water has been absorbed into the wick, remove moisture as follows:-
 - a. Submerge wicks in oil heated to 104°C (220° F) for 8 hours.
 - b. Allow to cool, while submerged in oil, until oil cools to room temperature.
 - c. Remove wick from tank and allow to drain for 24 hours before use.

NOTE

Electro-Motive recommends that the wicks be cleaned and soaked using a wick lubricator cleaning machine, if available.

There are many advantages in using a wick lubricator cleaning machine. The machine can be installed adjacent to the area where the wick lubricators are removed, preventing damage to the felt wick and the slides of the carrier due to handling, mistreatment, and water or dirt accumulation. The cleaning machine can also be used for soaking and storage of the wicks. The wick lubricators can be stored in the cleaning machine until just prior to installation.

CLEANING AND SOAKING FELT WICK LUBRICATORS WITH MACHINE

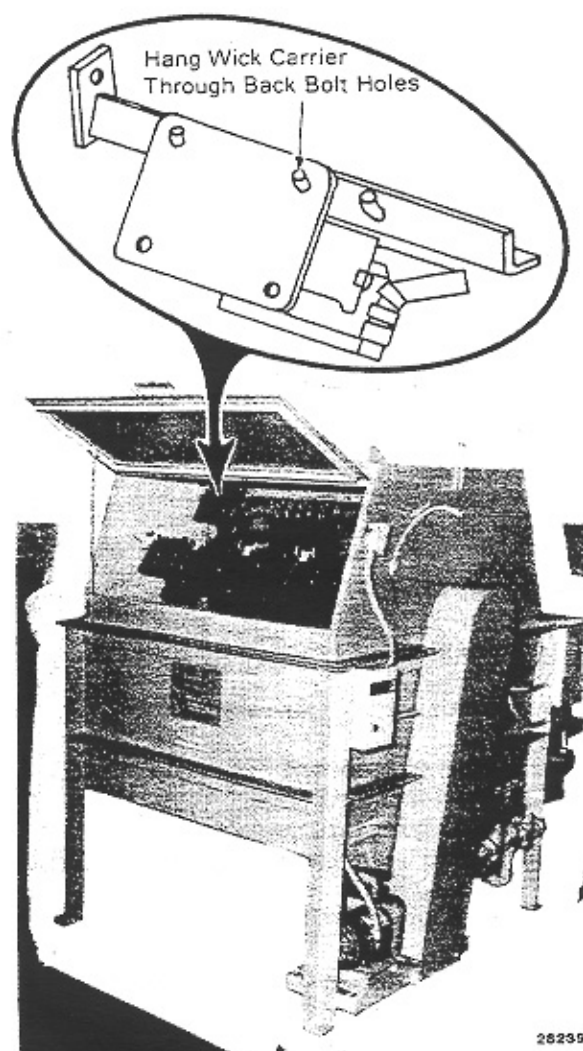
NOTE

Initial road dirt should be removed prior to cleaning operation. Refer to Inspection paragraphs concerning cleaning.

1. Place wick lubricator and carrier in "ferris wheel" cleaning tank as shown in Fig. 19.
2. Allow wicks to rotate in cleaning tank for 4 hours or more at a temperature of 60°-71° C (140°-160°F). Repeat initial cleaning and continue rotating wicks in cleaning tank if wicks are excessively dirty.
3. Submerge wicks in new oil prior to using.

NOTE

Wick cleaning machine can be used to store and soak wicks.



28239

Fig. 19 - Wick Lubricator Cleaning Machine

REMOVING MOTOR SUPPORT BEARINGS

1. Run the locomotive over a pit.
2. If the bearing to be removed is on the gear side, it will be necessary to remove the gear case safety straps and drop the lower half of the gear case.
3. If the bearing to be removed is on the commutator end, remove the dust guard by removing clamp.
4. Drain the support bearing cap lubricating oil.

WARNING

When removing the support bearing cap, ensure cap is supported by crane or properly blocked. When bolts are removed, the cap may drop suddenly, causing personal injury.

5. Take out the four support bearing cap bolts.
6. Remove the support bearing cap. If the cap sticks, it can be loosened by tapping the cap.
7. Remove the axle shield and the lower half of the support bearing.
8. Remove the seals by extending the seal spring and removing spring from notch in seal.
9. To remove the upper half of the support bearing, jack the motor frame high enough to relieve the weight on the bearing and to free it from the key. Then revolve the upper half around the axle until it can be slipped off. If bearing sticks in the frame it can be knocked loose by driving down on the flange with a hammer and wooden block.

SUPPORT BEARING INSPECTION

Bearing shells should be carefully inspected and replaced or returned to service depending on the following conditions.

1. Do not reuse bearing in which:-
 - a. The wear pattern extends beyond the window.
 - b. The assembled diametrical clearance exceeds 1.17 mm (.046").
 - c. The assembled lateral clearance exceeds 5 mm (3/16").
 - d. The maximum axle diameter reduction exceeds 1.6 mm (1/16"). Refer to Replacement Support Bearings paragraphs which follows.
 - e. There is evidence of babbitt shelling, overheating, or fatigue cracks.
2. Remove foreign particles imbedded in the babbitt.
3. Check condition of flange lubricators. If flange lubricators are worn, contaminated, or damaged, replace with new lubricators.

4. Check condition of seals and seal springs. If worn or damaged, replace with new seals.
5. Reused bearings should be free of nicks and scratches. Scrape local areas lightly with a flat scraper and polish with fine abrasive coated screen or crocus cloth.

Select the best quality bearings for use at the P.E. since it is most heavily loaded.

Before replacing bearing that show signs of having been overheated, the cause should be determined and corrected. The following points should be checked:-

1. Insufficient lubricating oil in the support bearing cap.
2. Use of improper or contaminated lubricating oil.
3. Insufficient bearing clearance.
4. Misalignment of bearing shells.
5. Dirt or other foreign substances working into the bearing.
6. Wick lubricator surface fouled with dirt, or glazed.
7. Damaged or improperly operating wick lubricator assembly.
8. Poor motor support bearing surface finish at axle journal. Refer to Maintenance Instruction M.I. 1518.

In the event that the bearing has run extremely hot, it is likely that the axle bores have been distorted and the traction motor heated sufficiently to cause damage to the frame, bearings and field windings. Suspicion of any of these items having occurred will necessitate removal of the motor for thorough inspection. Particular attention should be paid the motor armature bearings as the heat may have dissipated the grease. Traction motor removal is covered later in this bulletin.

REPLACEMENT SUPPORT BEARINGS

To accommodate worn or undersize axles, motor support bearings are available with 0.8 mm, and 1.6 mm (1.32", 1.16") undersize bores. These bearings have standard size flanges. Bearings are also available with standard bores and 0.8 mm (1/32") oversize flange thickness which may be used to keep within the lateral measurements specified in this bulletin. To prevent inadvertently applying such bearings, the flanges are stamped with the oversize designation and painted red. An oversize bearing flange may be used on one axle with a standard or another oversize bearing flange in order to obtain the proper lateral dimension. Refer to Table for available support bearings.

D43 - 203 mm (8") Lined

PART NO.	BORE	FLANGE
9557784	Standard	Standard
9557785	0.8 mm (1/32") Undersize	Standard
9557786	1.6 mm (1/16") Undersize	Standard
9557787	Standard	0.8 mm (1/32") Oversize

Current traction motors are equipped with FELT LOCK twin seal support bearings. The bearings, Fig. 20, retain the four groove, dual seal features (seals on inboard and outboard sides) of former bearings, Fig. 21, and include an improved flange lubricator design that requires no adhesive during installation.

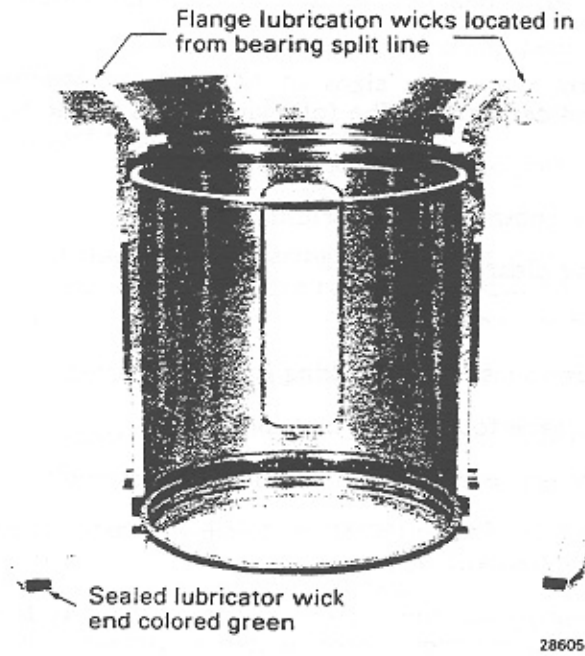


Fig. 20 - Current Design Felt-Lock Dual Seal Support Bearing

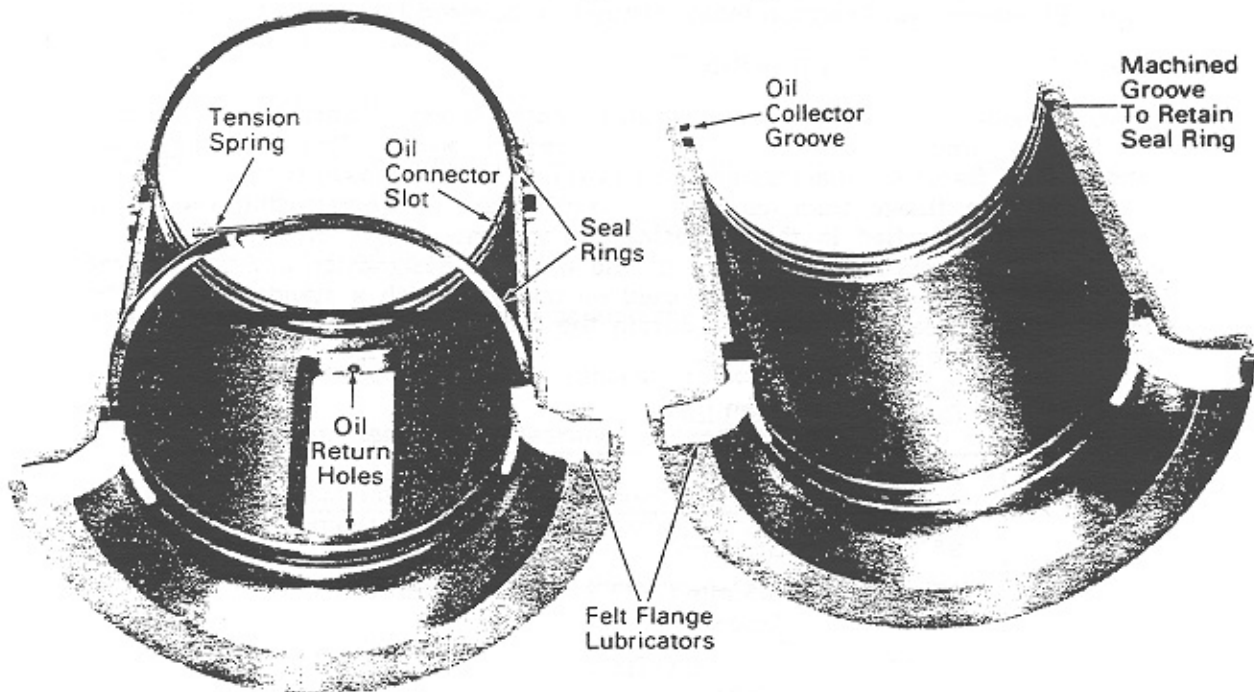


Fig. 21 - Previous Design Dual Seal Support Bearing

As with previous dual seal bearings, sealing is accomplished by nylon rings that clip onto and rotate with the axle in circumferential grooves machined in the bearing. Oil that would normally flow out of the bearing ends is retained by the seal rings and pumped back to the reservoir through a drilled passage from the seal groove to the wick window. The dual seal bearing FELT-LOCK flange lubricator wicks are fitted into grooves located in front the bearing split line. These lubricators are not interchangeable with the plain bearing flange lubricators used with D29 Support bearings. The FELT-LOCK lubricator wick extends out to the bearing flange O.D. The end is sealed to prevent absorption of water or entry of dirt.

The Oil seal rings must be installed before the lower or window half of the bearing is assembled. After the upper bearing half and axle are in place, the seal ring, which is flexible, is spread and threaded into the seal groove and a tension spring is extended and snapped into place. Do not clip the seal rings around the axle before the upper bearing is in place.

SUPPORT BEARING CAPS

The support bearing caps are machined and line bored to size when mounted on the traction motor with a 0.20 mm (.008") shim inserted between the cap and motor frame. When the motor is mounted in a truck, shim is removed, Fig. 22, thus a 0.20 mm (.008") clamp fit or squeeze to the axle bearing shells.

Line boring of the caps to the motor frame is necessary to secure the accuracy of bearing fit required. The caps are not interchangeable with each other on a given motor or with caps of other motors. To ensure that they are matched to the proper motor and location, they are stamped with a serial number matching the motor frame number.

Support bearing caps that have been removed should be thoroughly washed in a suitable solvent. After cleaning and drying, the cap may be tested for leaks by painting the outside with chalk dust mixed with water. When dry, fill with kerosene and allow to stand for one hour, then observe for leaks.

INSTALLING MOTOR SUPPORT BEARINGS

1. Make certain all parts are clean, particularly the bearing shells, seats, axles and caps.
2. Check bearing serial numbers, as they must be installed in matched sets.
3. Apply recommended lubricating oil on the inside diameter of bearing shells. Bearing shell flanges should contact their mating surfaces on the motor frame to prevent possible lateral movement.
4. Ensure proper motor support bearing cap bolt and washer combination is used.

A 76 mm (3") axle cap bolt, 8242193, and hardened steel flat washer, 8495681, should be used in all locations.

If the mounting face on the axle is galled, the face should be welded and machined to the dimensions of Fig. 22.

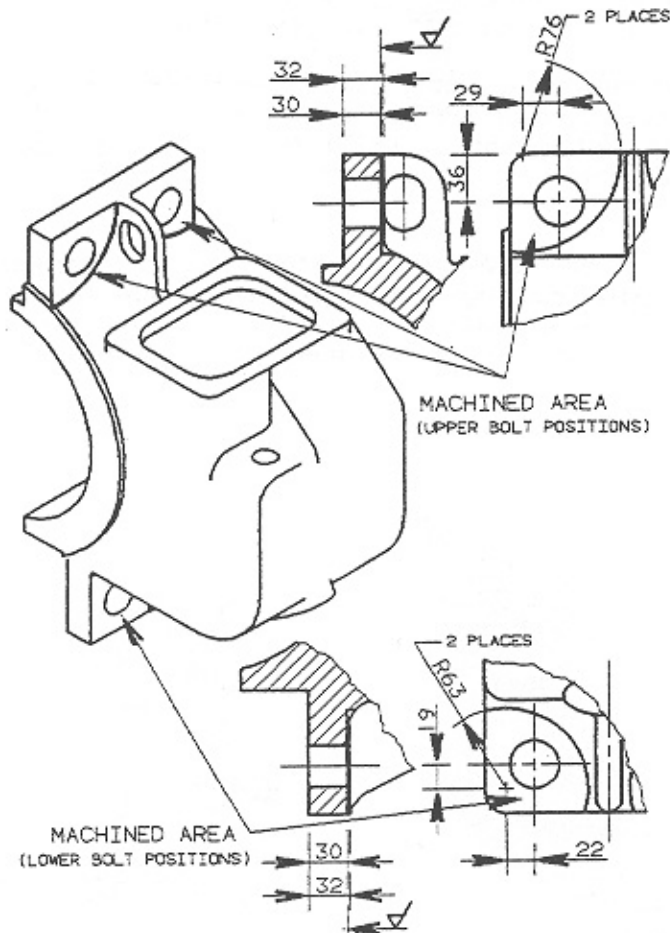


Fig. 22 - Support Bearing Cap Mounting
Spot Face Remachining

5. The serial number on the support bearing cap and motor frame should correspond and the cap face must line up properly with the motor frame. Apply axle shield, apply cap straight as rocking will distort splines and pinch the bearings. After proper washers are installed, lubricate threads and under bolt heads with Texaco Threadtex. Tighten bolts to 1491-1627 Nm (1100-1200 ft-lbs). Ensure cap is not cocked in the motor frame. Lockwire adjacent pairs of bolts.
6. Measure lateral and radial clearance as shown in Fig. 23.

To measure radial clearance, position traction motor with nose suspension sufficiently downward to place support bearing window at top dead centre position. Insert narrow feeler gauge to a depth of 25 mm to 51 mm (1" to 2") between the centre of one of the longer edges of the support bearing window and the axle.

7. Apply the previously soaked felt wick lubricator assemblies. Pour oil over felt wicks, filling reservoir to proper level with recommended lubricating oil per Maintenance Instruction M.I. 1756.
8. Install gear case and axle dust guard.

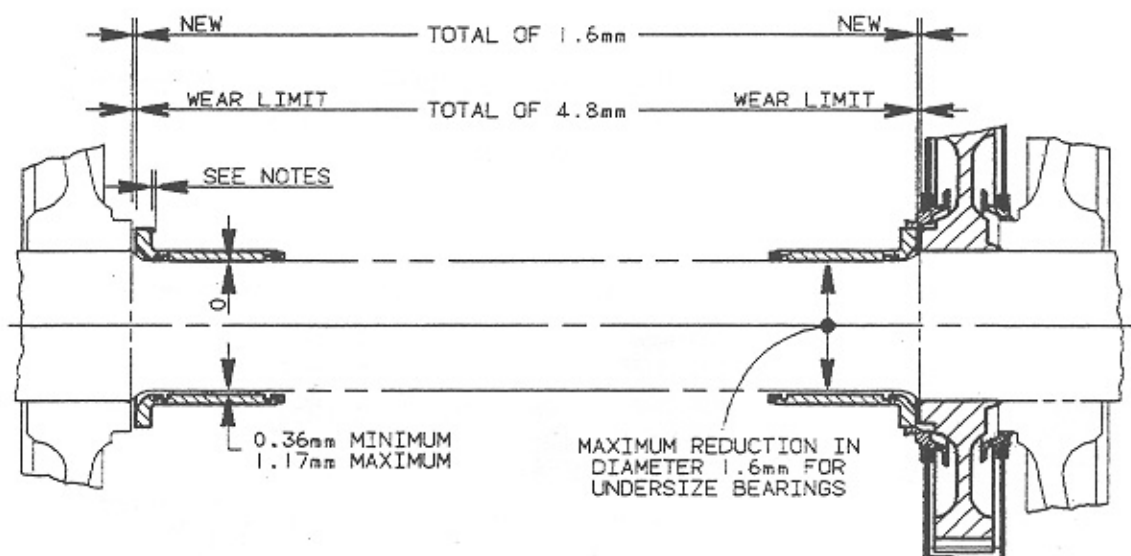


Fig. 23 - Support Bearing Clearances

CHECKING SUPPORT BEARING ALIGNMENT

To check support bearing alignment, use new standard size support bearings. Install the proper support bearing caps and tighten bolts snugly. Apply the mandrel through, both axle caps (wicks removed) as shown in Fig. 24 and rotate it by hand. Misalignment will be indicated if the mandrel binds and does not turn freely. The cause should be determined and corrected before placing such a motor in service. Refer to Service Data for file number of mandrel which can be manufactured for checking alignment. The drawing is available from EMD Service Department (at no charge) and includes construction details to manufacture the mandrel.

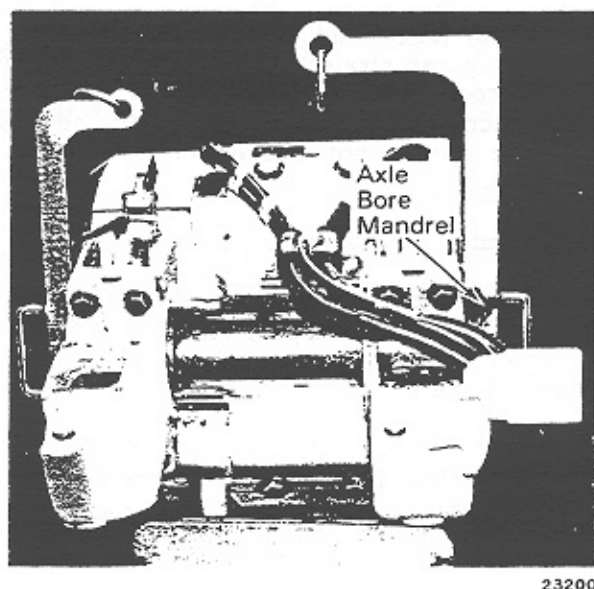


Fig. 24 - Application of Mandrel

AXLE SHIELD

The axle shield shown in Fig. 25 fits over the axle between the two support bearing caps and serves to prevent dirt from entering the bearing surfaces. It is installed prior to the installation of the bearing caps.

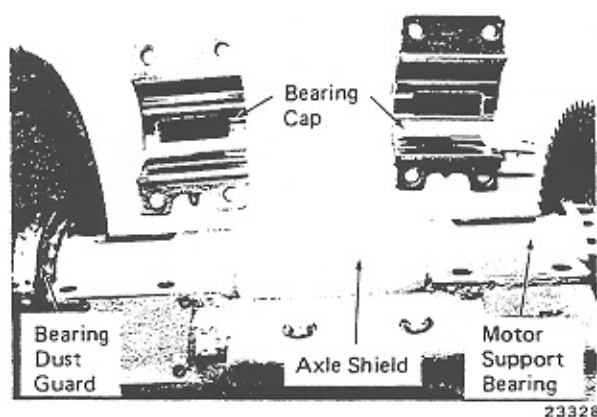


Fig. 25 - Dust Guard and Axle Shield

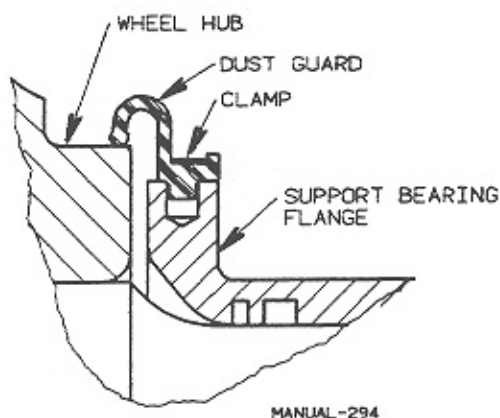


Fig. 26 - Dust Guard Installation

DUST GUARD

A moulded rubber dustguard and clamp, Fig. 26, is installed over the commutator end axle bearing flange and the wheel hub to keep dirt and grit out of the support bearing. Check the moulded rubber dust guard for signs of wear, cracks or deterioration before assembly. Replace dust guard with a new dust guard if required.

Install the dust guard with the mounting lugs located in the support bearing flanges and the opening located towards the bottom of the traction motor (toward the rail).

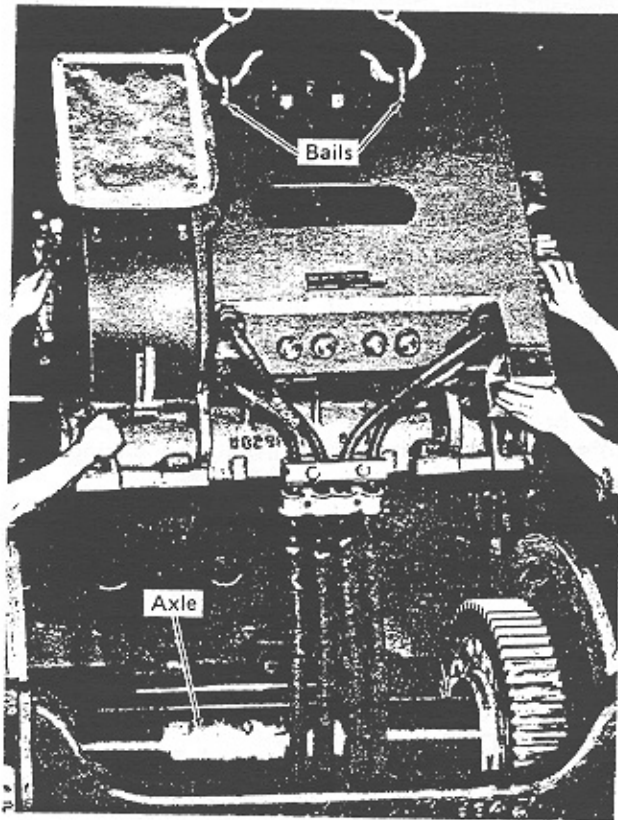
TRACTION MOTOR REMOVAL**REMOVAL OF WHEELS AND MOTOR ASSEMBLY FROM TRUCK WITH TRUCK UNDER LOCOMOTIVE**

1. Remove cleats holding motor leads to underframe.
2. Loosen and slide traction motor connector covers along the motor leads.
3. Disconnect all of the motor lead connectors, taking care to see that all leads are plainly marked so there will be no difficulty in identifying them when they are reconnected.
4. Remove the flexible air duct on commutator end of motor.
5. Remove brake rigging from wheels to be dropped.
6. Block truck with jacks on both ends.
7. Remove the pedestal tie bar from both sides of truck on wheels to be removed.
8. Remove bottom pin keeper which holds motor nose in place on the nose suspension assembly as follows:-
 - a. Place a jack under motor frame and compress the motor suspension assembly.
 - b. After compressing the suspension pack, place horseshoe shaped washers between the top spring holder and the heads of the spring holder bolts.
 - c. Block under the traction motor before removing jack.
 - d. Remove the bottom pin keeper which holds suspension assembly in place. Be sure to remove the pins which hold the spring holder and springs to truck frame.
 - e. Remove the rubber suspension assembly by sliding it out from between motor and truck.
9. The motor and a pair of wheels are ready to be removed from the truck with a drop table.

REMOVAL OF TRACTION MOTOR FROM TRUCK WITH TRUCK REMOVED FROM LOCOMOTIVE

1. Remove cleats holding motors leads to underframe.
2. Slide the insulating tubes covering connections along the motor leads.
3. Disconnect all of the motor lead connectors, taking care to see that all leads are plainly marked so there will be no difficulty in identifying them when they are reconnected.
4. Traction motor is now free and can be removed with truck.
5. Remove the dust guard on the commutator end by removing clamp.
6. Remove the bolts that secure the gear case.
7. Pull out gear case clips.

8. The lower half of the gear case will drop down and the upper half can be lifted off.
9. Remove the support bearing cap bolts, the caps, the axle shield and the outside bearing shell. Remove the seal(s) by extending the seal spring and removing spring from notch in seal.
10. Remove the bolts on the motor side of the flexible air duct.
11. Remove bottom pin keeper which holds motor nose in place on the nose suspension assembly. Refer to Removal of Wheels and Motor Assembly from Truck with Truck under Locomotive procedure, Step 8.
12. Lift the motor out of the truck with a crane hooking the lifting chains into the bails on the nose side of the motor frame. Fig. 27. Rotate the motor around the axle sufficiently so that the lower lip of the support bearing housing will clear the axle and lift vertically out of the truck. Do not allow the inside bearing shell to fall to the floor.



NOTE

Traction motor pictured is not correct model, but is used to show proper removal setup.

23325

Fig. 27 - Removing Traction Motor

NOTE

When mounting or removing a traction motor from a truck, or while handling in the shop, be sure that the pinion protector is applied. Care should always be taken to prevent the pinion from accidentally striking some object, since due to the weight of the motor it is possible to damage the pinion as well as the commutator end bearing assembly on armature shaft.

TRACTION MOTOR NOSE SUSPENSION

Each time power is applied to the traction motors the torque reaction tends to rotate the motor on its bearings. This movement of the motor is arrested by heavy lugs on the motor frame coming in contact with the top and bottom of a nose suspension assembly that is fastened to the truck frame bolster.

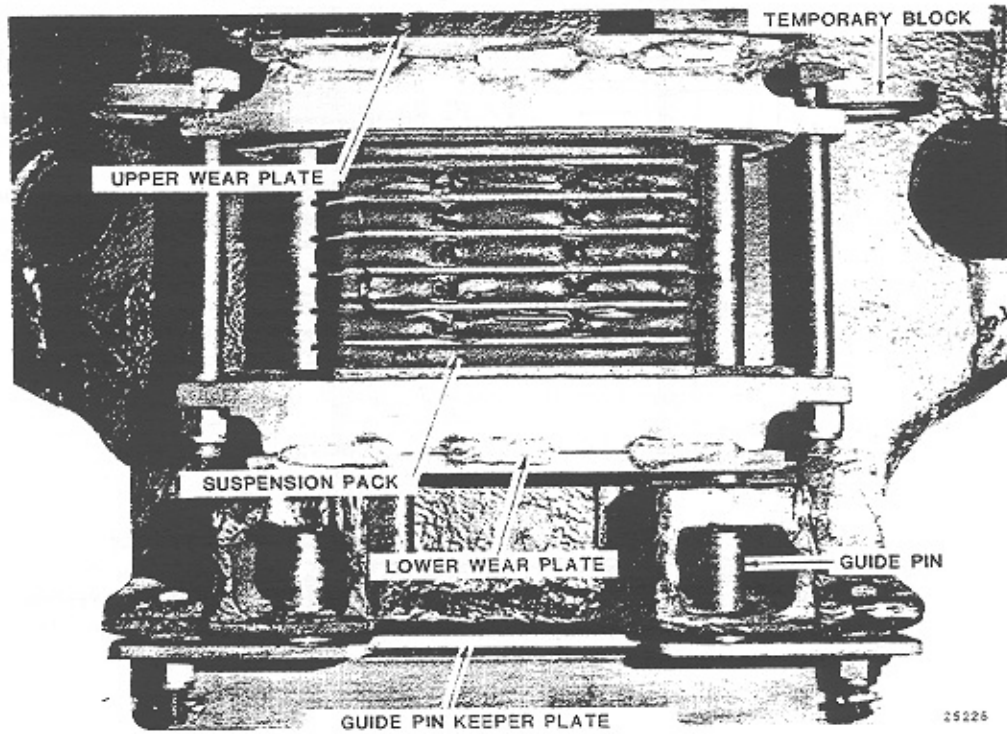


Fig. 28 - Traction Motor Nose Suspension Assembly

Current traction motors are equipped with a nose support guide pin that is longer and completely fills the upper guide hole in the truck frame as shown in Fig. 29.

To install the new pin requires the removal of the small metal cover plate that is welded over the upper guide pin hole. The cover plate can be removed by air carbon arc gouging and grinding. Ensure the circumference of the guide pin hole is free of projections. The new pins should be applied in pairs.

The wear plates on the suspension assembly are subjected to severe shocks and tremendous pressures, causing them to wear, resulting in free movement between the traction motor frame and the suspension assembly. As this free movement increases, due to wear, the severity of the shocks increases, especially if the wheels slip or during rapid changes of torque, such as applying sand during a slip.

It is recommended that wear plates be periodically reconditioned to ensure not more than 6 mm (1/4") free movement in the traction motor nose suspension to obtain maximum cushioning effect.

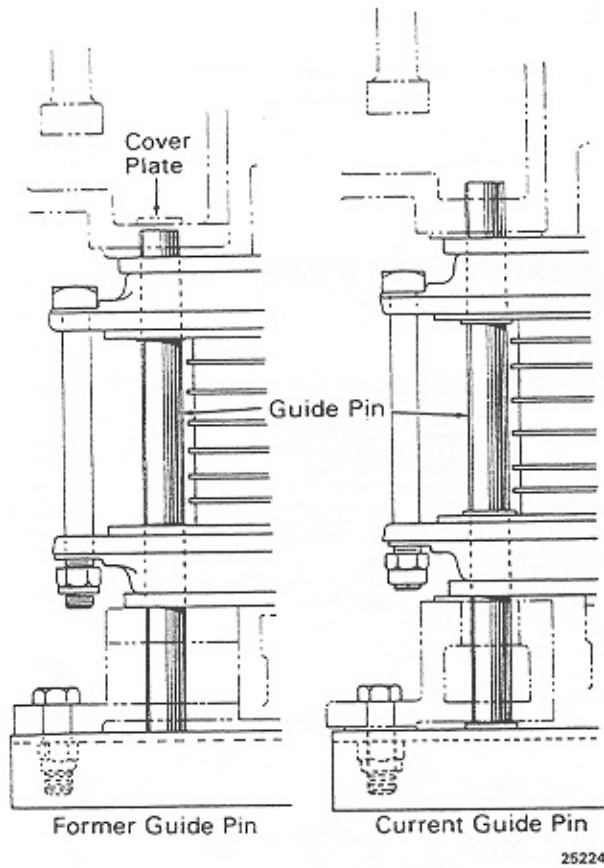


Fig. 29 - Traction Motor Nose Support Guide Pin

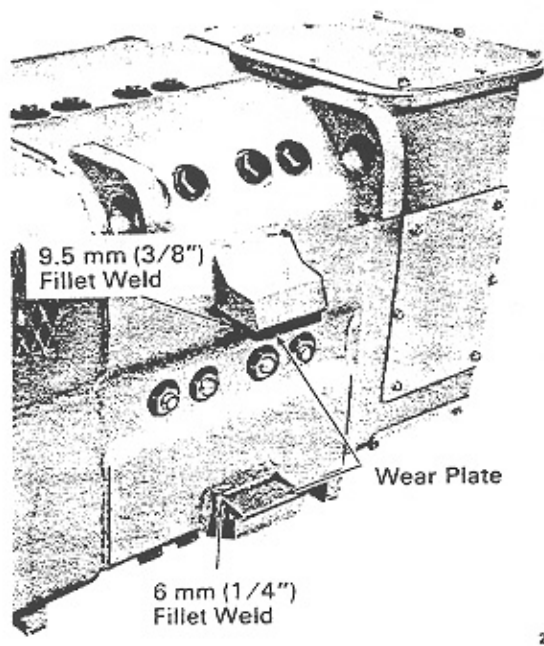


Fig. 30 - Traction Motor Nose Suspension Wear Plates

Traction motor frame assemblies are equipped with manganese steel nose suspension wear plates, Fig. 30.

The nose wear plates on the motor suspension noses are welded in place. When a wear plate has worn 2.4 mm (3/32") off its original thickness it should be replaced. Refer to Nose Suspension Lug and Wear Plate Inspection and Replacement Procedure and Wear Plate Welding Procedure which follows. When motor suspension pack wear plates have worn 1.6 mm (1/16") maximum, the plates should be replaced. There should be no wear on the vertical face of the truck transom supporting lugs. If there is, it indicates the lateral clearance in the journal boxes is too great and the journal boxes should be shimmed. Refer to journal box manufacturers instructions for setting lateral clearances.

NOSE SUSPENSION LUG AND WEAR PLATE INSPECTION AND REPLACEMENT PROCEDURE

If the distance between wear plate and lower suspension lug machined surface is more than 307.18 mm (12-3/32"), refer to Fig. 31 and perform the following procedure.

1. Check the lower suspension lug dimension from horizontal centreline of motor. If dimension is greater than limits of Fig. 31, area should be milled to dimension of Fig. 31 and a 6.35 mm (.250") wear plate welded to suspension lug. Refer to Wear Plate Welding Procedure which follows. It is not necessary to maintain the 45° chamfer on lower suspension lug as shown in Fig. 31, but maintain the 375 mm (14-3/4") dimension from vertical centreline of motor as shown in Fig. 31.
2. If the lower suspension lug is within tolerance, the 19.05 mm (.750") upper suspension lug wear plate must be replaced. If upper suspension lug is undersize, build up with weld and re-machine to dimension of Fig. 33. Use only A.W.S. E-7016 stick electrode. Refer to Wear Plate Welding Procedure which follows.

NOTE

Upper suspension lug is not a normal wear area, but if for any reason such as a loose wear plate pounding the lug, the suspension lug must be welded and re-machined.

WEAR PLATE WELDING PROCEDURE

The proper preparation of motor frame surface is very important to successful application of the wear plates. The frame surface must be smooth and flat. Remove any weld beads or high spots. If the nose bracket face dimension is not within tolerance of Fig. 31, the surface must be welded and remachined. Perform the following procedure to install wear plates if required.

1. Position wear plates on frame and hold in place with a hydraulic jack which exerts a force of 4.5 to 7.3 tonnes (5 to 8 tons).
2. Check wear plate fit to frame with a 0.08 mm (.003") shim. Shim should not enter more than 13 mm (1/2") at any point between the frame and the pad. Excess gap can cause weld to fatigue.
3. Weld wear plates to frame using E-Fe-Mn-A welding electrode. Ensure good penetration is obtained on both the frame and the wear plate.
4. Allow weld to cool for a few minutes before removing jack. Check the plate fit to frame with a 0.08 mm (.003") shim.
5. Check the distance between the wear plates. The distance should be a nominal 306.70 mm (12.075").

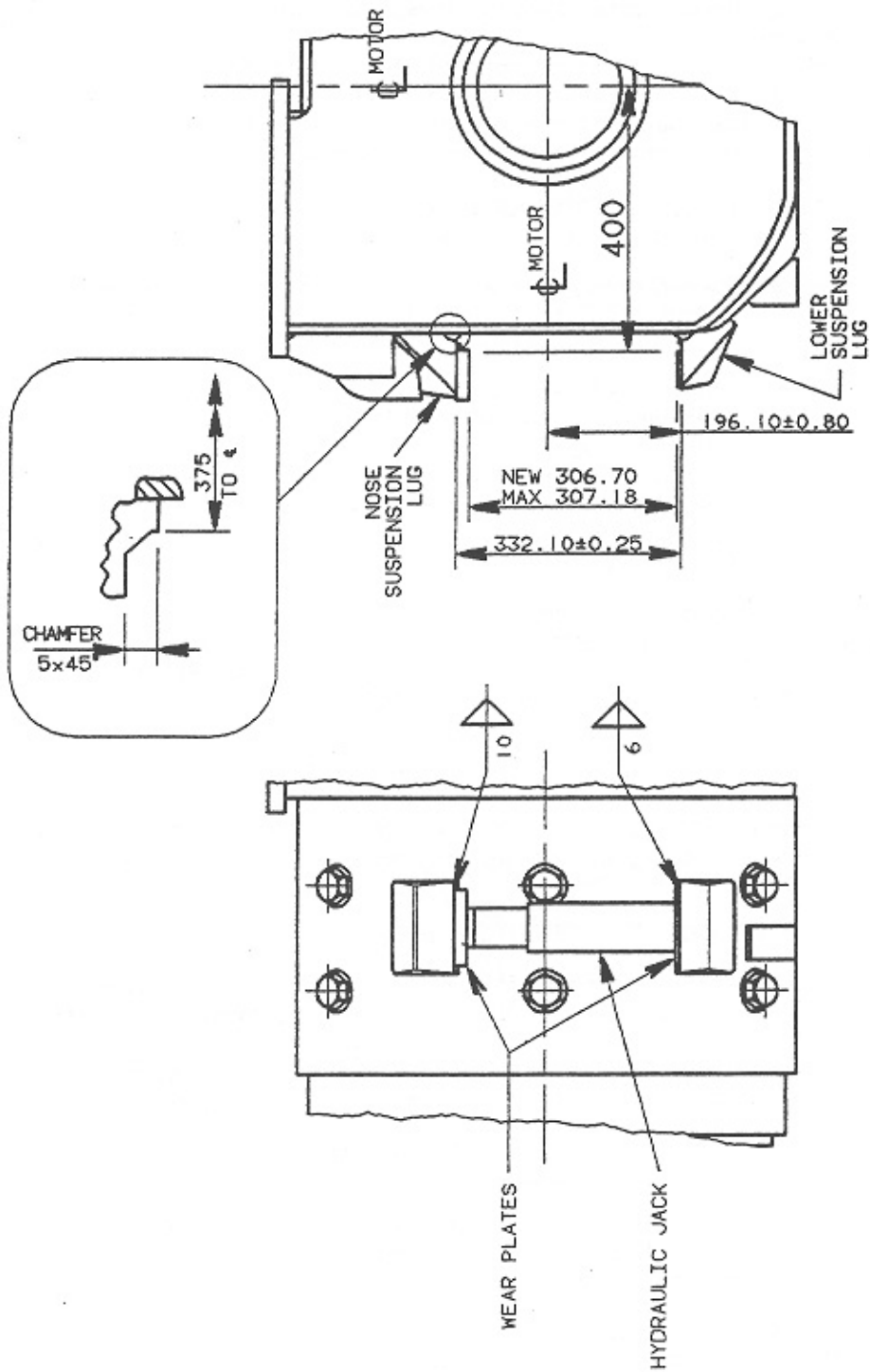


Fig. 31 - Nose Suspension Lugs and Wear Plates

PINIONS

The pinion mounted on the traction motor armature shaft is carburized, which provides an extremely hard outer surface yet retains a desired soft core. The number of teeth on the pinion and mating axle gear determine the locomotive gear ratio. Various gear ratios are available to suit specific locomotive service requirements. Pinions will vary from 12 teeth to 25 teeth depending upon installation.

PINION REMOVAL

Pinions are heated and shrunk onto the shaft to provide the fit necessary to withstand the strain imposed in operation. The pinion is either removed by pulling off with a hydraulic puller or by "floating-off" by means of hydraulic pressure.

Refer to Service Data for special equipment required for pinion removal. The pinion is removed as follows:

PINION REMOVAL WITH HYDRAULIC PULLER

1. Remove the nut from end of armature shaft with a retaining nut wrench and handle, Fig. 32, or with an air impact wrench.

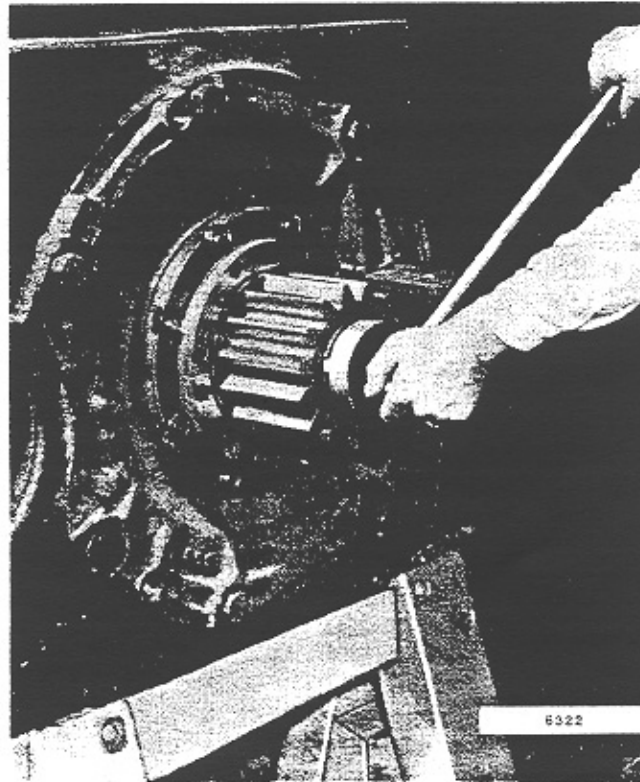


Fig. 32 - Removing Pinion Retaining Nut

2. Clean threads in pinion and in pulling pilot.
3. Apply spacer between the end of the armature shaft and the ram of the puller to protect the shaft from possible damage.
4. Install threaded pilot and hydraulic puller assembly, Fig. 33, using a suitable hoist. The threaded pilot should enter the threaded portion of the pinion to its complete depth so threads will not strip.

WARNING

Remove hoist before attempting to pull pinion. Pinion release suddenly and if left suspended on hoist, can swing violently.

Clear area in line with pinion to avoid damage to equipment or injury to personnel when pinion releases.

5. Pump hydraulic puller to build up pressure and remove pinion from shaft.

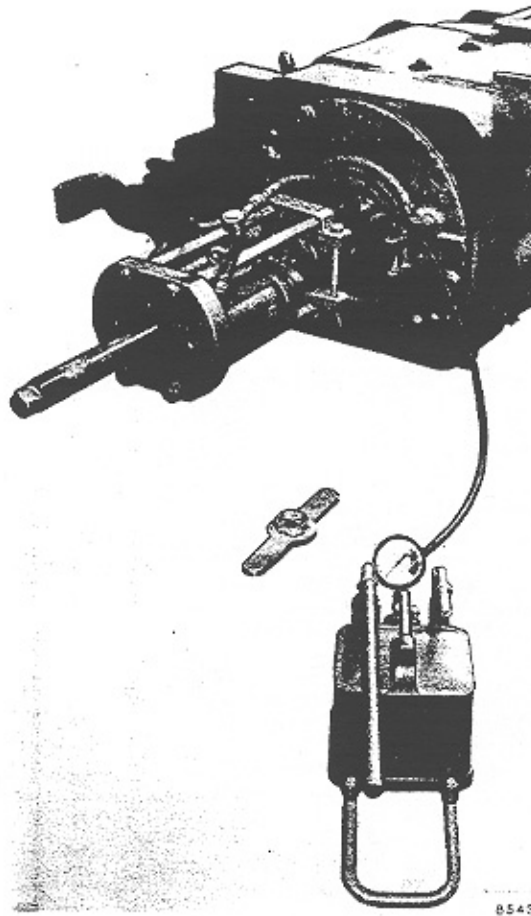
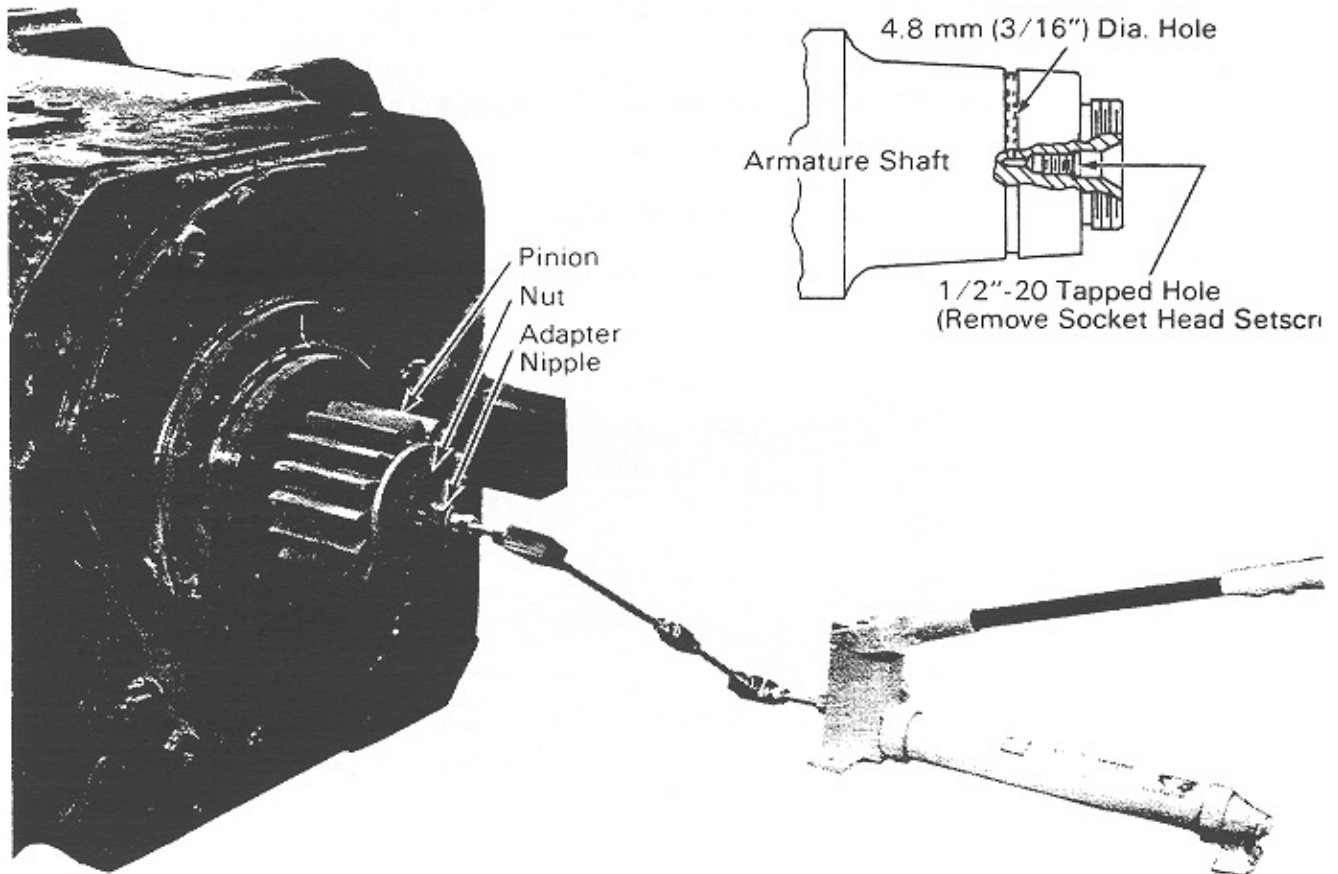


Fig. 33 - Hydraulic Pinion Puller

PINION REMOVAL BY FLOAT-OFF METHOD

The float-off method of pinion removal can be used on armature shafts which are manufactured with a groove around the shaft taper which is connected by drilled passages to a 1/2"-20 tapped hole in the centre of the shaft, as shown in the inset of Fig. 34. The pinion is removed by applying high pressure oil through the drilled passages to the inside of the pinion bore, which results in the pinion being released from the shaft.

**NOTE**

- 1 Remove 3/8" NPT adapter from pump port and connect gland nut directly to pump port.
- 2 Before connecting adapter nipple to shaft, loosen nut approximately one turn.

2

Fig. 34 - Float-Off Pinion Removal

Refer to Service Data for the hydraulic pinion removal kit part number. The pinion is removed as follows:

1. Loosen the nut on the end of the armature shaft with a retaining nut wrench and handle, Fig. 34, or with an air impact wrench approximately one turn, or 3.18 mm (1/8").

WARNING

Retaining nut must remain on the armature shaft when attempting to remove pinion. Pinion will release suddenly which could cause personal injury and damage to pinion removal equipment if nut is not in place.

2. Clean the centre of the armature shaft and remove 1/2"-20 socket head setscrew. Ensure the threads and pressure fitting seat are clean.
3. Screw the hydraulic pump adapter nipple into shaft and tighten to 35-40 N.m (25-30 ft-lbs). Do not overtighten as this will damage the shaft seat.

4. Connect hydraulic pump gland nut (with sleeve) to the pump port as shown in Fig. 34. Close valve on pump and operate pump lever to build up pressure. When pump pressure becomes great enough, pinion should be released from armature shaft and should move off against the pinion retaining nut.

If the pinion is frozen to the shaft and will not release, a hydraulic puller may have to be used as an aid to removing pinion. Apply hydraulic pressure to shaft and apply pulling force simultaneously.

5. Remove equipment, remove pinion retaining nut, remove pinion and replace setscrew in the end of the armature shaft and tighten to 16.9 N.m (150 in.lbs).

NOTE

Setscrew has nylon plug insert in threads to retain torque. Typical minimum breakaway torques to qualify screw for reuse should be 2.5 N.m (22 in.lbs) after the first time off or 1.7 N.m (15 in.lbs) after the fifth time off.

PINION APPLICATION

It is essential that the pinion be properly mounted on the armature shaft to ensure it is fitted with the proper tightness.

The shaft and the pinion should be at room temperature, approximately 21°C (70°F). A maximum of 5.5°C (10°F) temperature differential between the shaft and the pinion should be allowed.

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 with Grade 320 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 (non-drying) bluing compound to the pinion bore by hand. 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 make 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 make firm contact with at least 20% at the small end of the armature shaft taper. The large end of the bore should not make 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 with Grade 320 abrasive cloth.
 - d. Thoroughly clean and remove all traces of bluing from 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 12.7 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. 35.

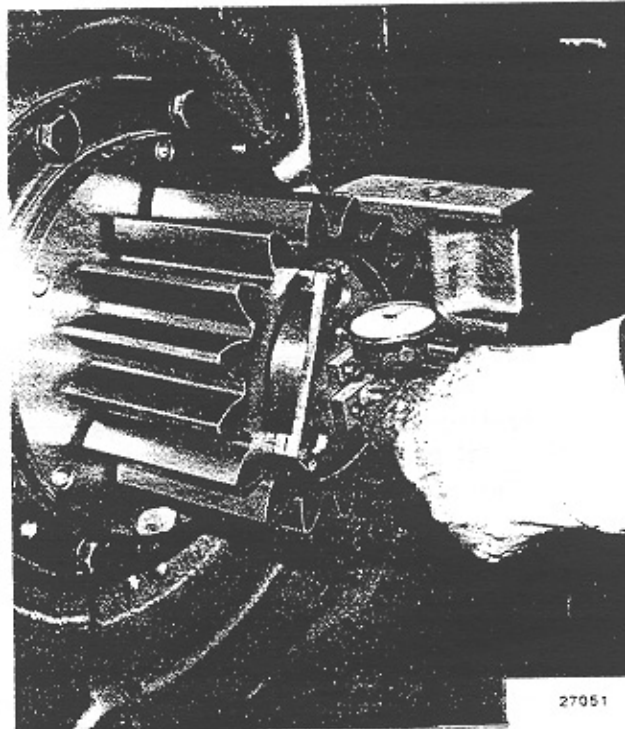


Fig. 35 - Measuring Pinion Advance

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 reapplying 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 make firm contact with at least 20% at the small end of the armature shaft taper. The large end of the bore should not make contact unless a line-to-line contact is obtained through the bore.

11. When cold mounting variations are within limits, the pinion may be heated with an induction heater, Fig. 34, for final mounting. Heat and mount the pinion as follows:

NOTE

In Step a, following 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 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 9 months if stored at temperatures below 24°C (75°F). Reduced stability will result if the cleaner is stored at higher temperatures.

WARNING

Avoid excessive or prolonged inhalation of liquid cleaner mists or dust. Avoid eye contact and repeated or prolonged skin contact. Liquid cleaner can cause eye and skin irritation.

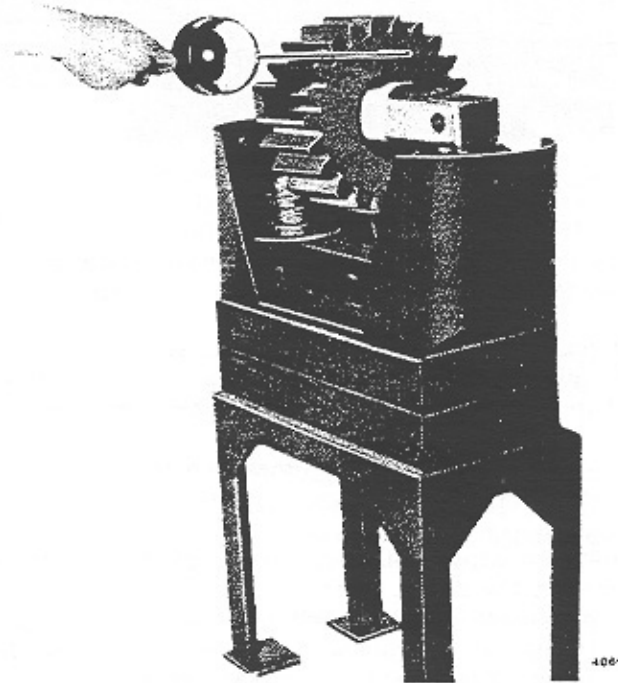


Fig. 36 - Induction Heater

- a. When applying 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 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, then wipe off cleaner with clean paper towels. Do not allow shaft or pinion to be exposed to dirt or oil and do not touch with hands.

- b. Heat pinion to the temperature specified in 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 232°C (450°F).

As an example of proper heating, assume the shaft temperature is 24°C (75°F). The pinion should then be heated to obtain 213°C (415°F), which is the desired 189°C (340°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 following, 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 retightened. 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.

EXTERNAL LEAD AND CONNECTOR INSPECTION

1. Cable insulation should not be damaged, frayed, or worn. Carefully check areas where cables are clamped or subjected to abrasion.
2. Contact area of connectors should be free of protruding nicks and burrs. The connectors should have a smooth, flat surface.
3. There should be no broken strands of cable at point of entry into connector. On early model motors with soldered connectors, inspect solder at top of the connector for cracks or visible solder distress. On current motors with crimped connectors, ensure connector is firmly crimped to the cable by bending cable and pulling connector.
4. Check grommets for deterioration, cracks, wear. Ensure grommets are not loose in frame.
5. The condemning limit of the external cable length without lugs is 1168 mm (46") minimum. The condemning length of the external cable length with lug is 1253 mm (49-5/16") minimum, measured from the outside edge of the cable clamp to the tip of the connector. Lead lengths are not to vary more than 38 mm (1-1/2") between the longest lead and the shortest lead, but never shorter than the condemning limit.

EXTERNAL LEAD AND CONNECTOR REPAIR

1. If the motor does not have a grounding cable, Fig. 1, install cable as follows. Refer to Service Data for grounding cable and heat shrinkable tubing part numbers.
 - a. Attach grounding cable as shown in Fig. 37.
 - b. Ensure external lead cable is dry and free of oil, grease, foreign matter, and sharp edges.
 - c. Position three sections of heat shrinkable tubing as shown in Fig. 37
 - d. Apply heat to heat shrinkable tubing using a heat gun. Apply heat to the centre of the tubing and work toward one end. Apply heat again to the centre of the tubing and work toward the opposite end. This procedure will assure an equal distribution of the longitudinal shrinkage. Apply heat only long enough to allow tubing to assume contour of the cable. Application of additional heat will serve no useful purpose.

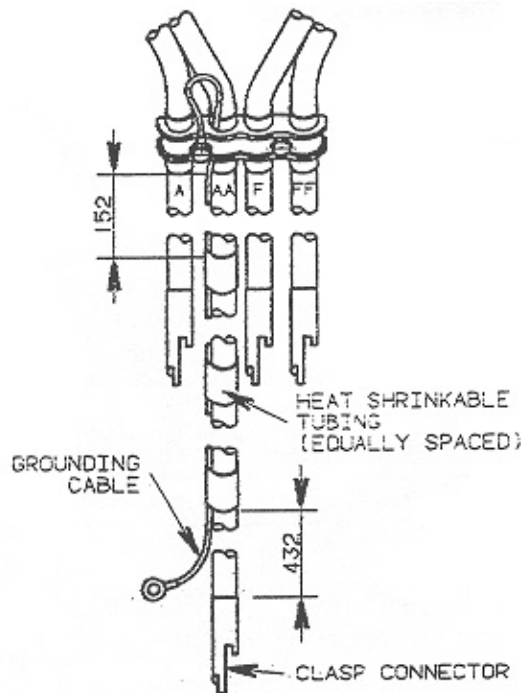


Fig. 37 - External Lead Grounding Cable Application

2. Nicked or damaged insulation may be repaired with heat shrinkable tubing. A deep nick in the insulation can be cleaned with alcohol and filled with RTV compound prior to applying the heat shrinkable tubing. Refer to previous Step 1d for heat shrinkable tubing application procedure. Refer to Service Data for RTV compound part number.
3. If cable grommets are deteriorated, cracked, worn or loose in the stator frame, replace with new grommets and seal with caulking compound. Refer to Service Data for caulking compound part number.

CRIMPING CLASP CONNECTORS TO CABLE LEADS

Current D43 traction motors have the clasp connectors crimped to the motor leads. If the connectors and/or motor leads are to be replaced on any early or current model D43 motor, EMD recommends that only crimp type connectors be used to facilitate application and improve connection.

If the following procedure, operating of an AMP, Inc. electro-hydraulic crimping tool, Fig. 38, is used with clasp connectors supplied by AMP, Inc. If another type of crimping tool is used (which can accomplish equivalent results), this procedure can be used as a guide.

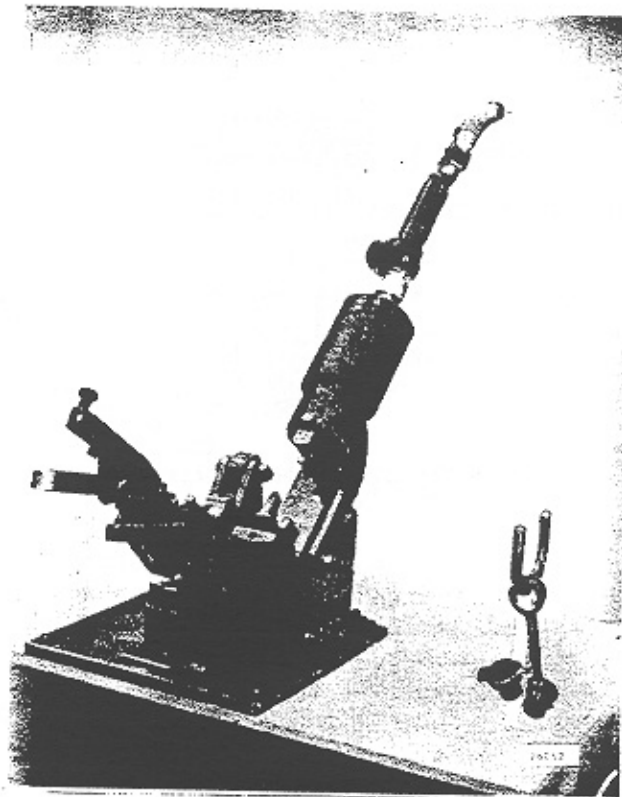


Fig. 38 - Amp, Inc. Electro-Hydraulic Crimping Tool

The crimps are to be made at a 45° angle to the flat face of the clasp connector. The crimps are to be made between the crimp marks on the connector barrel.

1. Strip 44-47 mm (1-3/4" to 1-7/8") of insulation from clasp connector end of cable. Ensure cable is clean and not frayed.
2. Apply clasp connector to the end of cable. Ensure cable is bottomed against the shoulder of the connector.
3. Position clasp connector in crimping machine, as shown in Fig. 39. Ensure end of clasp connector is up against the first stop for the fixture.
4. Swing the holding block over onto the connector and lock in place as shown in Fig. 40.
5. Operate crimping machine and make the first crimp in the clasp connector, Fig. 41.
6. Unlock holding block and position clasp connector against the other stop for the second crimp, Fig. 39. Operate crimping machine and crimp as shown in Fig. 41.
7. Check clasp connector crimps. The thickness of the finished crimps should be between 15.04 and 15.67 mm (.592" - .617"). A properly crimped clasp connector is shown in Fig. 42.

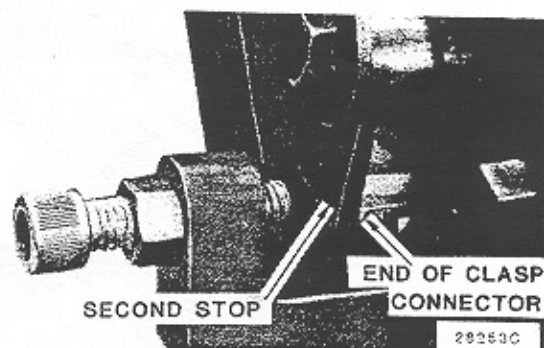
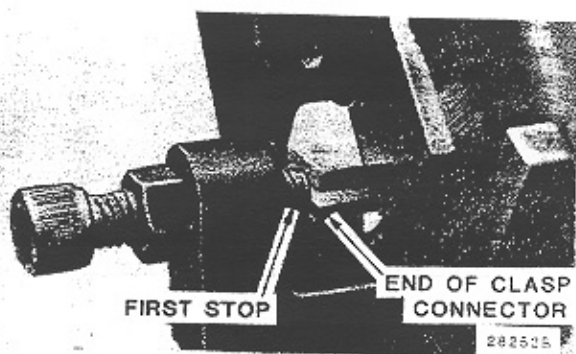
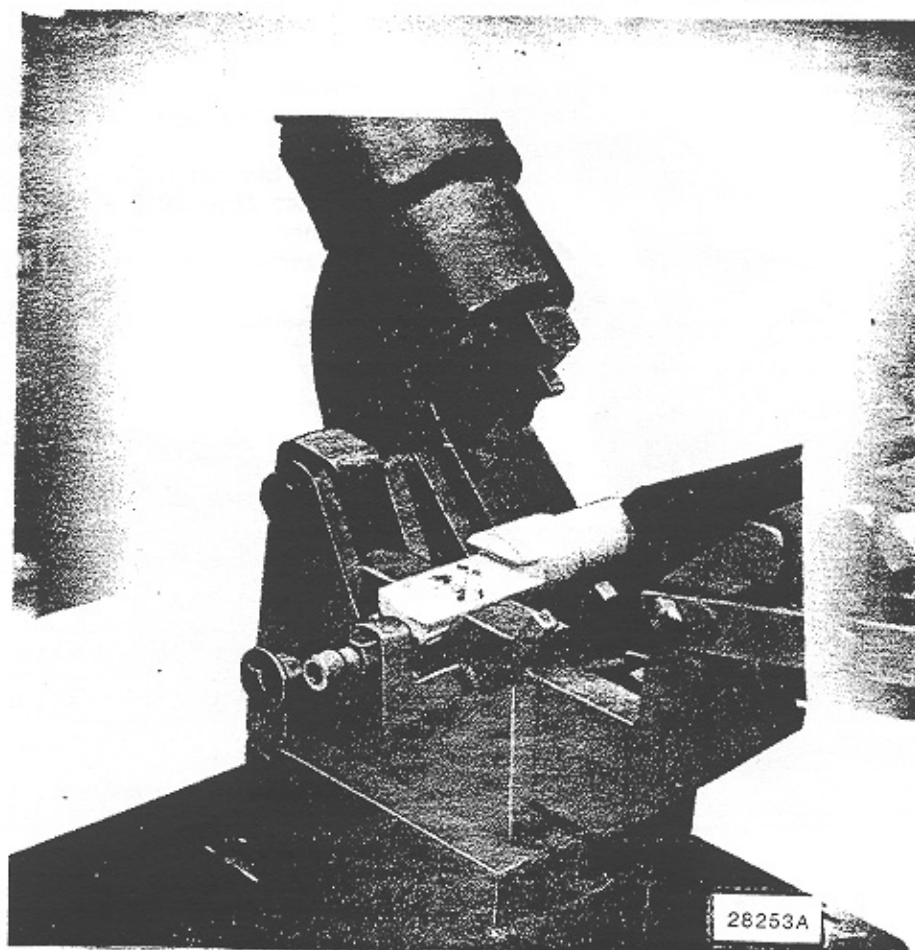


Fig. 39 - First and Second Crimp Positions

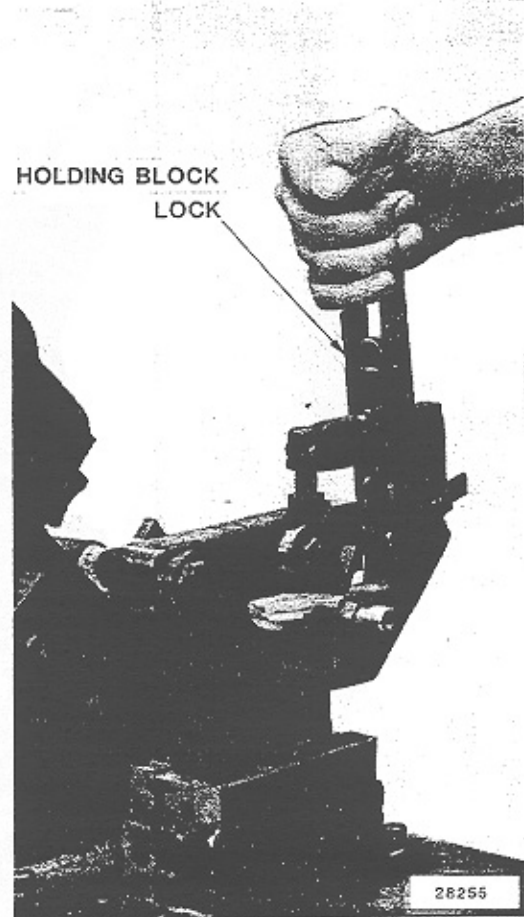


Fig. 40 - Locking Clasp Connector in Position

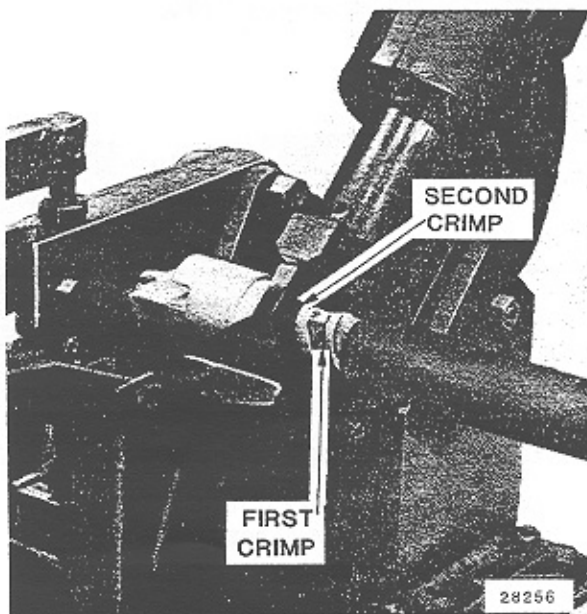


Fig. 41 - Crimping Clasp Connector

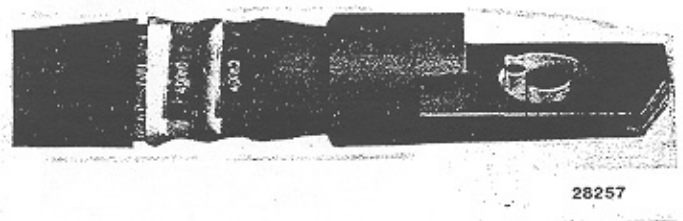


Fig. 42 - Properly Crimped Clasp Connector

SOLDERING CLASP CONNECTORS TO CABLE LEADS

If a crimping tool is not available, D43 series traction motors can have clasp connector 8109922 soldered to the cable using a high temperature solder (89.5% lead, 10% tin, 0.5% antimony).

Solder the clasp connector to the cable as follows:

1. To remove the old soldered clasp connector from cable, heat the connector with a 2500 watt capacity thermo-grip pliers to the point where the solder melts to free the connector. Remove the connector. Refer to Service Data for thermo-grip pliers part number.
2. Heat the new connector with the thermo-grip pliers to the point where solder melts. Flux and tin the inside of the connector.

NOTE

If a solder pot is available, tin and heat inside of connector by slowly pouring hot solder back and forth between the ladle and the connector. Solder the connector by placing connector into a holding fixture, apply heat with the thermo-grip pliers, and pour solder from ladle into the connector.

3. Heat the cable end with the thermo-grip pliers. Flux and tin cable end.
4. Insert connector into a holding fixture and apply heat with thermo-grip pliers. Fill the connector barrel 1/2 to 3/4 full of solder.
5. Insert tinned cable end slowly into barrel of connector. Fill connector to the top edge. Maintain an even temperature and compensate for shrinkage as the solder cools. Remove thermo-grip pliers. Allow cable and connector to air cool. DO NOT QUENCH.

NOTE

If completed solder joint shows any sign of visible solder distress, joint should be ultrasonic tested. A joint exhibiting more than 25% void or unbonded area is considered to be defected.

If insulation near the lug splits as a result of rework, apply heat shrinkable tubing over the split.

SUPPORT BEARING MOISTURE SEAL

Railroads experiencing accumulation of moisture in support bearing oil reservoirs can relieve the condition by applying a bead of RTV silicone compound at the traction motor support bearing cap split line and at the edges of the axle shield as indicated in Fig. 43.

During severe weather, water with entrapped dirt can enter the traction motor axle cap bearing area from behind the support bearing flange, where a gap of up to 0.13 mm (.005") is possible at assembly. The moisture migrates around the back side (seating area) of the support bearing into the axle cap wick window and accumulates in the bearing oil reservoir.

Silicon rubber sealant 8366747 (RTV) is applied between the support bearing flange back side and the traction motor frame and axle caps. The sealant forms a circular seal in addition to the seal at the axle cap split lines and the axle shield. The additional sealant greatly reduces the possibility of moisture and dirt entry, thereby contributing to increased lubricating wick and support bearing life.

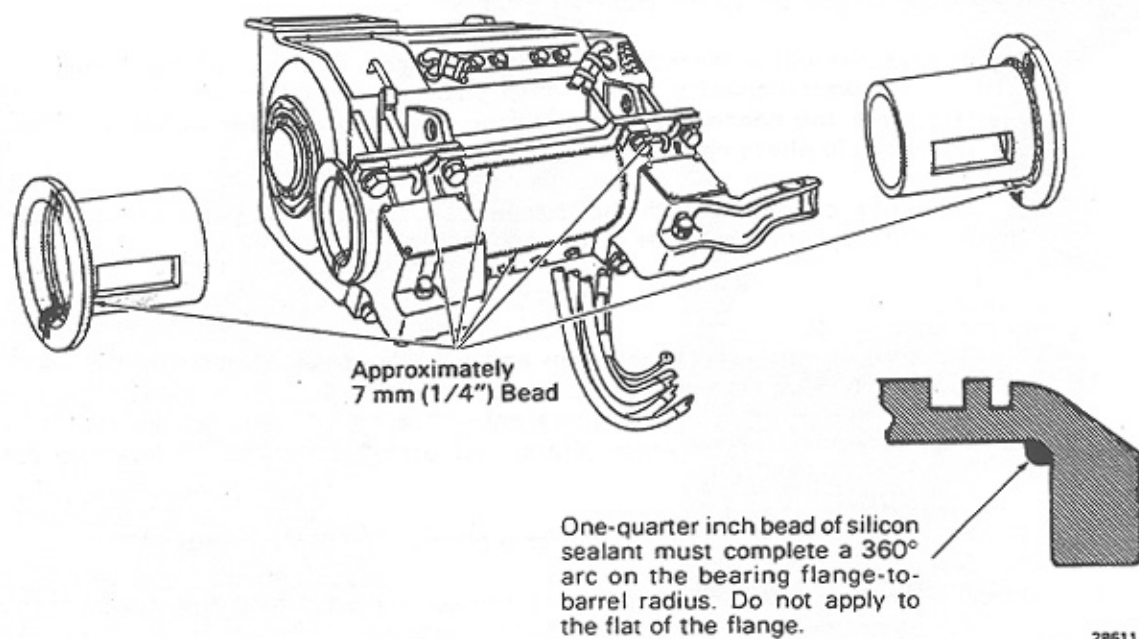


Fig. 43 - Application of Silicon Rubber Sealant

Oil residue must be removed from all sealing surfaces by wiping with a solvent before applying sealant. The sealant between the support bearing flange and motor frame must be applied at assembly of the bearing to the frame. A 7 mm (1/4") bead must complete a 360° arc on the bearing flange-to-barrel radius, Fig. 45.

CAUTION

Application of sealant directly to the flat of the flange can interfere with seating of the bearing in the frame and prevent an acceptable flange-to-frame gap (0.13 mm (.005") maximum).

The other seams and split lines are sealed after the traction motor is mounted on its axle, and the axle shield and caps are secured.

The bead of sealant must cover both metal surfaces and completely cover the parting lines of the axle shield. Particular attention must be given to the parting line above the top support bearing cap bolts where water is most likely to enter. If necessary, a pointed tool can be used to press sealant into the parting line area.

SUPPORT BEARING OIL FILLER CAP

D43 traction motors have an improved oil filler cap 9333024. The cap, Fig. 44, is held firmly in place with a coil spring. The cap requires no maintenance and will last much longer than the old cap.

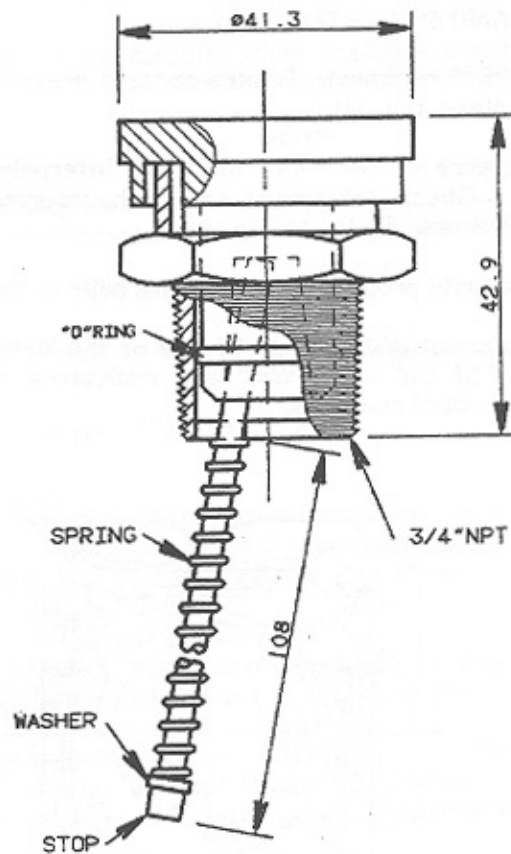


Fig. 44 - Support Bearing Oil Filler Cap

CHECKING TRACTION MOTOR ROTATION

When installing traction motors, it is important to verify that cable connections have been properly made by checking motor rotation. Failure to do so may result in serious damage to the motors and generator if connections have been improperly made.

The direction of motor rotation can be readily determined by observing the nose suspension when power is applied. The motor frame is restrained at this point by the nose suspension assembly, yet upward or downward movement, depending on motor rotation, may be observed.

When rotation of all motors has been determined to be correct, the locomotive may be returned to service.

ELECTRICAL TESTS

STATOR RESISTANCE AND POLARITY CHECK

1. Install brush holders if removed. Ensure contact areas between brush holders and terminals are clean and tight.
2. Measure the resistance of the main field and interpole coil circuits with a Kelvin bridge. Check temperature with thermocouple probe and potentiometer as follows. Refer to Fig. 47.
 - a. Place thermocouple probe onto one of the coils in the stator.
 - b. Connect the current and potential leads of the Kelvin bridge to the "FF" and "F" cables of the stator and take resistance readings of the main field circuit. Record readings.

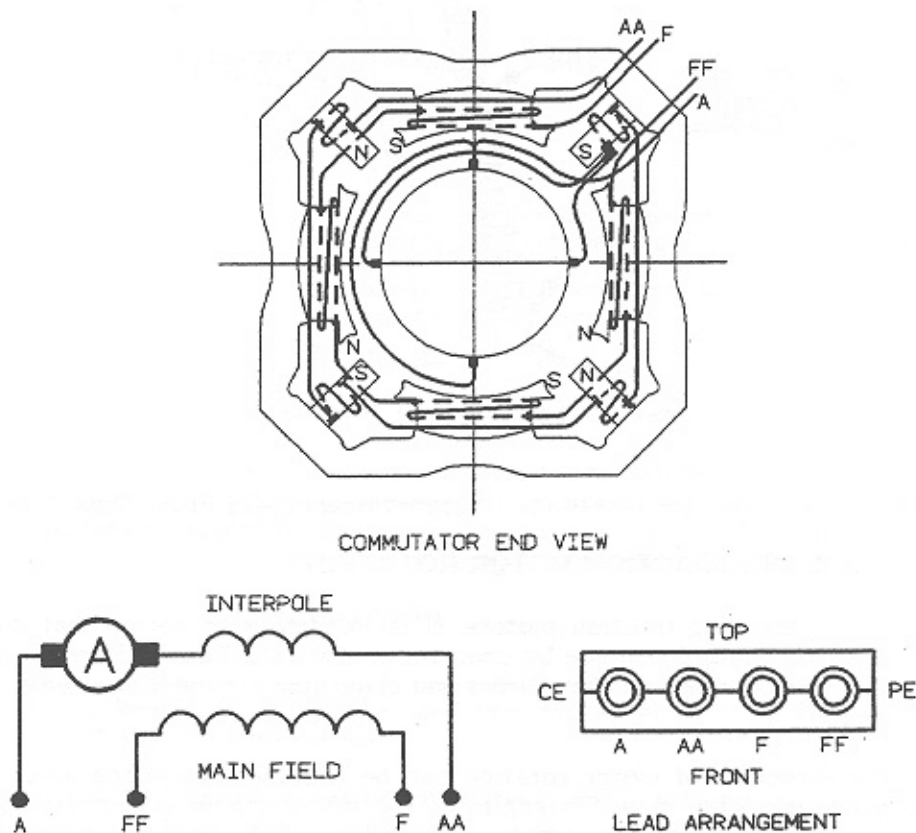


Fig. 47 - Wiring Diagrams

- c. Connect the Kelvin bridge to the "AA" cable and to the axle side brush holder and take resistance readings of the interpole circuit. Record readings.

NOTE

Ensure the bridge is connected between the end of the "AA" cable and the axle side of the brush holder. If connection is made to the suspension side of the brush holder, the resistance will be out of tolerance.

- d. Check and record temperature indicated on the potentiometer

The resistance values of the circuits when readings are converted to 75°C (167°F) should be as specified in the Service Data by model number.

NOTE

The following formula can be used to convert resistance under ambient (room temperature) conditions to a nominal resistance at 75°C (167°F).

"R" @ 75° (167°F) =

$$\text{"R" @ Ambient} \times \frac{75 + 234.5}{\text{"T" @ Ambient} + 234.5}$$

"R" = Resistance "T" = Temperature

If the readings are higher than those specified, inspect all connections. It is necessary in most cases to check each individual coil to determine which coil is defective. Split the circuit to determine the "low side" before opening all the connectors between the coils.

If the readings are lower than those specified, a short is indicated. Individual readings of each coil should be taken to determine that the coils balance.

If the resistance is satisfactory, polarity may be checked to determine that the coils are properly located in their magnetic position. Using a low voltage DC power supply and a compass, check the polarity as follows. Refer to Fig. 47.

1. Connect low voltage DC power supply to external cables "F" (negative) and "FF" (positive).
2. Hold the compass at the centre of the top main field coil. The compass should indicate a south pole reading. Move compass from pole to pole. Each pole should indicate a definite change in polarity on the compass. If the 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 connector bars.
3. Check the interpoles in the same manner, connecting the low voltage DC power supply to the "A" cable and to the axle side brush holder of the stator.
4. If there is evidence of a wrong polarity in either the main or interpole circuits, the defective coils or connections will have to be corrected to obtain proper motor performance.

ARMATURE RESISTANCE

Check armature resistance. Measure temperature with thermocouple probe and potentiometer on commutator.

The armature resistance at 75°C (167°F) should be as specified in the Service Data by Model number.

WEIGHTS (Approximate)

	<u>D43</u>
Complete Motor	2211 kg (4875 lbs)
Armature	670 kg (1475 lbs)
Gear Case	65 kg (144 lbs)

RESISTANCE AT 75°C

	<u>Ohms +/- 2%</u>
Armature 1-10	0.003808
Armature	0.010453
Series Field	0.009261
Interpole Field	0.006565

BRUSH HOLDERS

Number of Brush Holders	4
Clearance to Commutator	3-5 mm (1/8"-3/16")
Spring Pressure	
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

Three wafer rubber top	
62mm x 42mm x 16mm	
2-7/16" x 1-21/32" x 5/8"	
Grade DE-7000	40026427

PINION APPLICATION

	<u>Pinion Advance</u>	<u>Approximate Temperature Rise Above Shaft Temperature</u>
15 teeth	1.65 mm \pm 0.13 mm (.065" \pm .005")	144°C (260°F)
17 to 25 teeth	1.40 mm \pm 0.13 mm (.055" \pm .005")	121°C (218°F)

COMMUTATOR

Mica Groove Width	1.27 mm (.050")
Mica Groove Depth	
Minimum	1.2 mm (3/64")
Maximum	2.0 mm (5/64")

GEAR CASE

Lubricant	as specified in M.I. 1756
Initial charge of lubricant	5.4 kg (11.9 lbs)

SUPPORT BEARINGS

Lubricant	as specified in M.I. 1756
Lubricant Level	
Minimum	90 mm (3-1/2")
Maximum	Overflow

REPLACEMENT SUPPORT BEARING

D43 - 203 mm (8") Lined

PART NO.	BORE	FLANGE
9557784	Standard	Standard
9557785	0.8 mm (1/32") Undersize	Standard
9557786	1.6 mm (1/16") Undersize	Standard
9557787	Standard	0.8 mm (1/32") Oversize

BEARING LUBRICANT QUANTITY \pm 7g (1/4 oz.)

	PINION END		COMMUTATOR END	
	Kilograms	Ounces	Kilograms	Ounces
Cover	0.255	9	.099	3-1/2
Inner Cap	0.284	10		
Housing			.071	2-1/2
Roller Cage OD	0.057	2	.014	$\frac{1}{2}$
Roller Cage ID	0.057	2	.014	$\frac{1}{2}$
	<u>0.454</u>	<u>23</u>	<u>.198</u>	<u>7</u>

MATERIAL LIST

Armature Bearing Lubricant	
Shell Cyprina RA Grade 3	
16 kg (35 lb) Pail	8449819
54 kg (120 lb) Drum	8249820
Liquid Cleaner (pinion application)	
19 litre (5 gal) Can	8365668

NOTE

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.

Grounding Cable	8351902
Caulking Compound 0.7 kg (1-1/2 lb) Can	8198204
Enamel, Red Air Drying	
1 litre (1 qt)	8061130
19 litre (5 gal)	8048876
Mineral Spirits	8492097
RTV, Silicone Compound 340 g (12 oz) Cartridge	8366747
Flux, Solder, 0.5 kg (1 lb)	8122570
Solder, Tin Base, No. 8 Wire, Approx. 23 kg (50 lb) Spool	8225761
Solder, Pure Tin, 7.5 kg (16 lbs)	8069984
Threadtex, Texaco, 19 litre (5 gal)	8307731
Tubing, Heat Shrinkable, 38 mm dia. x 76 mm lg (1-1/2" x 3")	8352037
Primer, Buff, 4 litre (1 gal)	8228726

SPECIAL TOOLS

Pyrometer, Hand type	8364533
Heater, Induction type pinion	8041446
Die, Armature Shaft rethreading	8050721
Die Holder	8050722
Protector, Pinion	8054871
Spacer	8116073
Handle, Sliding "T"	8127528
Wrench, Pinion Nut	8127529
Depth Gauge, Pinion Advance	9539037
File, Commutator Slot	8238905
Thermo-Grip Pliers	8064918
Aligning Tool, Brush Holder Spring Cell	8305181
Scale, Brush Holder Spring Tension	8415805
Adapter, Commutator Grinder	8204168
Commutator Grinder	8204166
Grinder Alignment Bar	8211051
Vacuum Cleaner Blower	8210140
Dust Collector	8210142
Grinding Stones, Finish Grade - 2 Required	8204167
Brush Seating Stone (Chalk Stone)	8204957
Sandpaper, 220 Grit - 216 mm x 46 m (4-1/4" x 50 yd.) roll, 3 m (10 ft) per motor	19AB11

Hydraulic Pinion Puller Kit	9533321
Hydraulic Pump	8302969
Coupling	9533327
Nipple, Adapter ($\frac{1}{2}$ "-20)	9533328
Gland Nut (with sleeve)	9533322
Tube, Connection	9533323
Tube, Connection	9533324
Tube, Connection	9533325
Elbow, Connection	9533326
Hydraulic Oil, 3.8 litres (1 U.S. Gal.)	8246430
Retaining Nut (Models D47B2 and D47B3 only)	8303020
Nipple, Adapter (Models D47B2 and D47B3 only) 3/8"-24	9566297
Manual Pinion Puller Kit (Models D37 and D47 only)	8303330
Pulling Plate Assembly	8168577
Pulling Plate	8168604
Includes Studs.	
5/8"-11 NC (C.E. bearing cap)	8168606
3/8"-16 NC (P.E. outer oil ring)	8168611
5/8"-11 UNC-2A (P.E. bearing cap)	8204436
Wick Lubricator Cleaning Machine	9502464
Depth Gauge and Indicator, Pinion Advance	9539037
Axle Alignment Mandrel with Lifting Fixture	*File No. 904
Axle Alignment Mandrel with Lifting Fixture	*File No. 905

* File number represents facility drawing that the available (no charge) from EMD Service Publication Department. These drawings include construction details of tooling that can be manufactured by the customer.