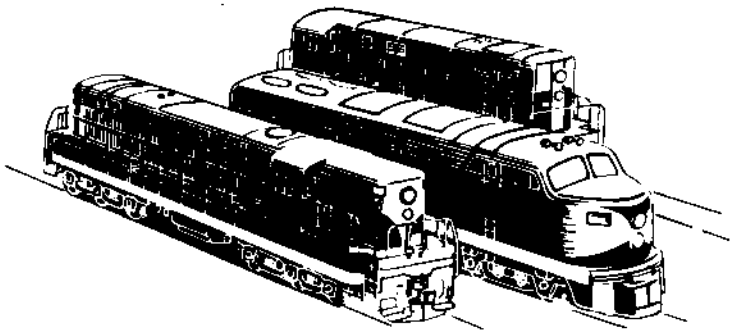

MAINTENANCE
BULLETIN
Sec. 411.5, June 1954
Supersedes Bulletin of April 1954

FAIRBANKS-MORSE

Traction Motor

F.M. TYPE DRZH FRAME RR1815

APPLICATION: H10-44 and H12-44 Locomotives with Fairbanks-Morse Rotating Equipment

FOREWORD

The purpose of this bulletin is to provide maintenance information for the particular piece of equipment named. These instructions do not, however, purport to provide for every possible contingency to be met in connection with the maintenance of this equipment. Neither is the amount of material supplied by Fairbanks, Morse & Co. increased by anything shown in these instructions or associated drawings. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to Fairbanks, Morse & Co., Diesel Locomotive Service Dept., Beloit, Wis.

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TRACTION MOTOR, TYPE DRZH
FRAME RR1815

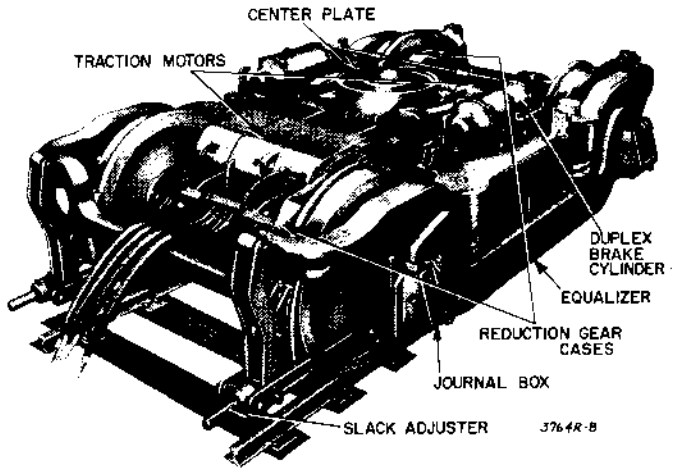
GENERAL DATA

OPERATING LIMITS	
Maximum Safe RPM	2400
Rated Volts	400
Continuous Amps	530
BRUSHES	
Number of Brush Arms	4
Brushes per Arm	3
Grade of Brush	NCC-AX5
Size of Brush	3/4"x1-3/4"x2"
Minimum Radial Length of Brush when Worn (Measured on Long Side)	1-1/4"
Brush Pressure (Pressure Finger 1-7/8" from Bottom of Brush Box)	8 to 9 lbs.
Brush Holder Clearance (To Commutator Face)	1/8"
LUBRICATION	
Armature Bearing Grease (Refer to Bul. Sec. 203)	Fill Bearings 2/3 Full
Commutator End Bearing	3/4 lb.
Pinion End Bearing	1 lb.
Axle Bearing Oil (Refer to Bul. Sec. 203)	1-1/2" to 3-1/2" Deep
Gear Compound (Refer to Bul. Sec. 203)	Keep bottom teeth covered
RESISTANCES (Values given in ohms at 75° C.)	
Armature	0.0222
Series Field	0.0158
Commutating Field	0.0133
COMMUTATOR WEAR LIMIT	
Radial	3/8"
Minimum Diameter	13-1/4"
WEIGHTS IN POUNDS	
Complete Traction Motor with Pinion	5,600
Armature	1,643
Pinion - 14 Tooth	36-1/2
Gear - 68 Tooth	570
Gear Case	185
VENTILATION	Forced

GENERAL DESCRIPTION

The traction motor converts the electrical power of the main generator into mechanical power to drive the locomotive wheels. It is a direct current, series motor. One side of the motor is supported by bearings on the locomotive axle, while the other side is supported by a nose on the motor frame, thru springs, to the truck frame. See Illus. 1.

The blower units are mounted in the locomotive above the trucks, and supply cool air to the traction motors in each truck. Each traction motor is connected to its corresponding axle thru single reduction gearing. The armature is supported by a roller bearing assembly at either end.



Illus. 1. Traction Motors Mounted on Truck

GENERAL INSPECTION AND MAINTENANCE

The entire unit should be inspected at intervals as outlined in Sec. 206, as a precaution against breakdown during operation. This inspection should include a thorough examination of the following:

1. Inspect the brushes and brush holders as explained under Service and Maintenance in the article entitled, "BRUSH HOLDER ASSEMBLY."

2. Inspect the commutator surface as explained under Service and Maintenance in the article entitled, "COMMUTATOR."

3. Inspect the axle bearing caps to see that they are properly packed and none of the waste is glazed. On some of the newer types of traction motors, inspect the felt lubricators to see that they are in good condition and are properly seated. Also check the oil well to see that it contains no water and that the oil is at the proper level. Failure of the apparatus to comply with the above mentioned conditions will require repacking and refilling of the axle caps, as described in one of the articles following.

4. Check the axle bearings for wear as explained in the article entitled "AXLE BEARINGS."

5. Inspect all connections to see that they are clean, secure, and making good contact.

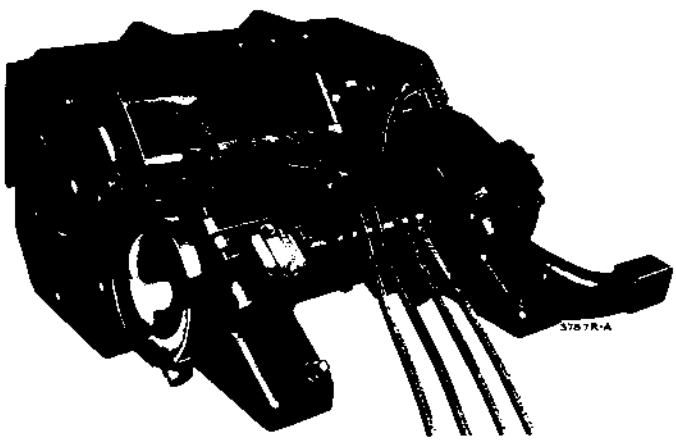
6. Inspect the lubricant in the gear case as explained in the article entitled, "GEARS AND GEAR CASES."

7. For information on the periodic lubrication of armature bearings, refer to Sec. 203.

The apparatus should be kept clean at all times. Blow out the unit with dry low pressure compressed air at least once a month. When using compressed air for cleaning in the vicinity of exposed mica insulation, care must be taken not to use too high pressure or get the nozzle too close to the mica. If this practice is not followed, small flakes of mica will be blown off, finally resulting in the complete destruction of the insulation.

Oil is very destructive to insulating materials as it collects dust and dirt, causing the insulation to break down electrically. If any oil should get on any insulated parts, it should be thoroughly wiped off with a clean cloth. Remove any accumulation of oil and dirt, using compressed air and a petroleum solvent of the safety type. If the deposit is easily accessible, the solvent may be applied with a cloth, assisted by a stiff brush or wooden scraper. Care should be taken so that the petroleum solvent does not get on the commutator or other copper parts.

When removing dirt and grease from trucks, traction motors, fuel tanks and underframe, using methods similar to those used on steam locomotives, it is necessary that the Diesel engine be run at 4 to 6 notch while washing with steam jet. This must be done so that the forced air from the traction motor blower will prevent any water or moisture from enter-



Illus. 2. Traction Motor Commutator End

Illus. 3. Traction Motor, Pinion End

ing the traction motors which might cause moisture grounds.

Maintenance instructions for the heavier repairs are covered in the articles following, under the titles of the various parts.

TO REMOVE TRACTION MOTOR FROM TRUCK

1. Remove the three bolts securing the gear case to the motor frame. Pull the gear case clips; the lower half of the gear case will drop down, and the upper half may be lifted off the frame.
2. Remove the axle shield.
3. Remove the two motor axle caps, and the outer bearing halves.
4. Compress the springs by means of two clamping bolts. Lift the traction motor slightly, and slide out the nose suspension assembly.
5. Lift the motor out of the truck with a crane, hooking the lifting chains into the lugs on the motor frame. If three chains are employed, their lengths should be adjusted so that the motor will be lifted first on the side next to the truck center and rotated around the axle a sufficient amount so that the lower lip of the axle bearing housing will clear the axle before the slack in the chain attached to the axle side of the motor is taken up. The inner halves of the axle bearings may be blocked so that they remain with the motor when it is lifted off the axle.

TO DISASSEMBLE THE TRACTION MOTOR

1. Unscrew the pinion nut from the end of the shaft.
2. Remove the pinion.

When removing a pinion, use a suitable puller, either the screw type provided, Illus. 5, or if available, a hydraulic puller. Do not heat the pinion before pulling and do not use wedges between the pinion and the bearing cap. In order to prevent damage to the bearings, do not hammer on either the pinion or pinion puller.

3. Remove the carbon brushes.
4. Remove the bolts holding the inner and outer closures to the bearing arm on the commutator end.
5. Remove the outer closure.
6. Cover the bearing with paper to keep out dirt.
7. Wrap heavy paper around the commutator surface to protect it when the armature is removed from the frame.
8. By use of a crane, turn the motor on end with the commutator down. Level it so that the armature can be raised vertically without injuring the bearings, commutator, or brush holders.
9. Remove the capscrews holding the pinion end bearing arm to the frame.
10. Screw an eyenut over the threaded end of the armature shaft.
11. Place three of the capscrews into the threaded jack holes in the bearing arm. With armature shaft vertical, jack loose the pinion end bearing arm. During this operation, take care that the armature is properly leveled and that there is sufficient strain on the hoist cable to keep the armature weight from bearing on the bearing arm.
12. The armature may then be lifted out of the frame.
13. Remove the three capscrews, and place the armature on a rack in a horizontal position resting on the core portion.

NOTE: If the brush holders are removed, they should be marked so that they will be put back in the same place.

TO REASSEMBLE THE TRACTION MOTOR

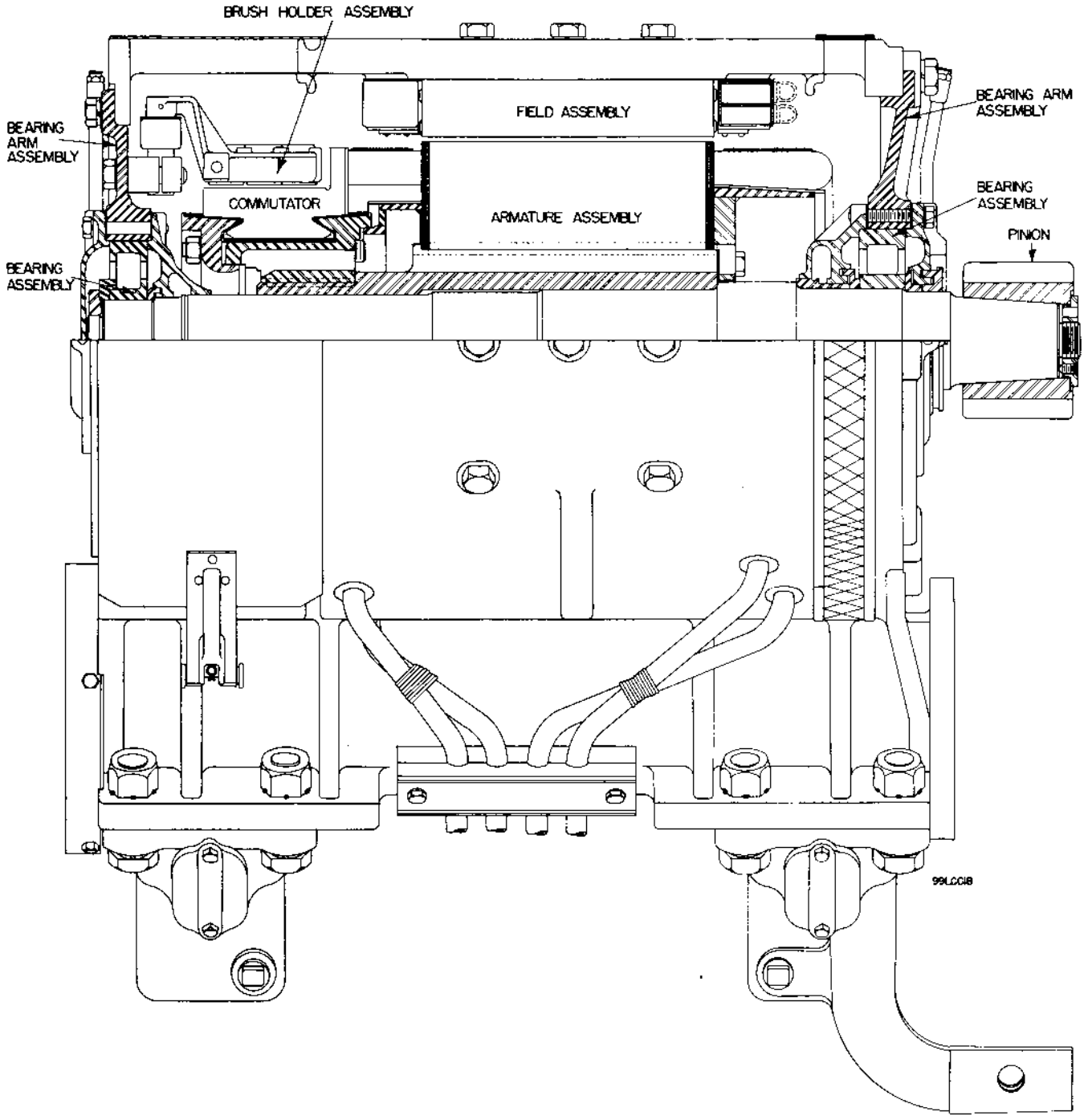
1. Bolt the brush holders in place well back from the commutator. Fasten and insulate the connections.
2. Place the frame in a vertical position with the bearing arm level, commutator end downward.
3. Screw the eyenut over the end of the armature shaft.
4. Wrap heavy paper around the commutator surface to protect it while lowering the armature into the frame, taking care not to strike the brush holders.
5. Assemble the studs into the commutator end inner bearing cap to guide the armature. Lower the armature into the frame.
6. Insert the pinion end bearing arm bolts and tighten the bolts to draw the armature into place. Be extremely careful to pull down evenly on all bolts to prevent tipping the bearing assemblies and damaging the raceways.

7. Put the motor in a horizontal position.
8. Remove studs used for guiding purposes.
9. Put gasket on commutator end outer closure. Use shellac to hold the gasket in place.
10. Fasten outer closure by tightening diametrically opposite capscrews.
11. Adjust brush holders for proper clearance of commutator.
12. Install carbon brushes, see data sheet for recommended grade.
13. Fasten dust covers over commutator with capscrews.
14. Motor is now ready for the pinion. See the following instructions on "APPLYING PINIONS."

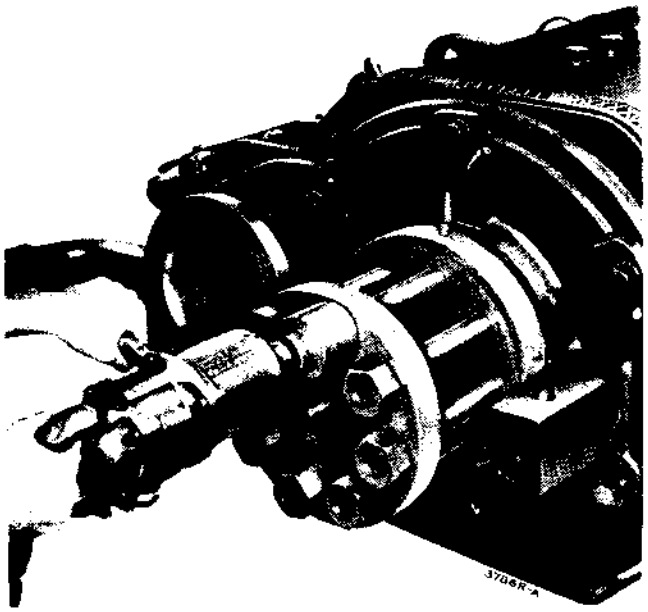
APPLYING PINIONS

Gears and pinions should be kept together in matched sets. That is, if a new motor is put on an axle, take the pinion from the old motor and apply it to the new one.

The pinions are not provided with keys and experience has shown that in order to obtain satisfactory operation, the pinions must be shrunk on the shaft.



Illus. 4. Cross-Section of Traction Motor



Illus. 5. Pinion Puller

The following points should be observed when the pinions are applied:

1. The shaft and the pinion bore should be clean and free from burrs and swellings Clean with a suitable solvent.

2. The fit of the pinion bore should be in contact with at least three quarters (75%) of the surface of the taper fit on the shaft. The contact area can be determined by rubbing Prussian blue, thin red lead and oil, or thin lamp black and oil on the pinion bore and fitting it on the shaft.

3. After checking the pinion fit, the shaft and bore should be wiped perfectly clean.

4. To insure correct shrink fit, the pinions should be applied with an advance on shaft of 0.130 inch $\pm$ 0.005 inch. The proper procedure to obtain this advance is as follows:

a. Place the cold pinion on shaft with 1 inch overhang and then push pinion on by hand as far as possible.

b. Measure the overhang after operation number one.

c. Remove pinion.

d. After checking the above, the pinion should be heated in an electric oven or induction heater to 142° C. above room temperature for two hours, then remove and quickly wipe the bore dry without allowing the pinion to cool. It should be pushed on the shaft by hand.

e. Measure the overhang after operation number four.

f. The difference in measurements obtained between operations two and five indicate the advance.

g. If the pinion advance is less than 0.125 inch, the pinion should be removed and reapplied. Pinions are removed by use of a suitable pinion puller.

h. As soon as pinion is in proper place, put on pinion nut. Screw the pinion nut home tightly. Screw up the set screws, then strike with a hammer, and again tighten screws. Lock the setscrews by peening the threads.

ARMATURE

Service and Maintenance

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

The armature bands and slot wedges should be tight and secure. The solder in the bands should be intact. If the solder has been thrown off, the cause should be determined and corrected and the bands replaced by tight banding. See article under "BANDING" for details.

The coil insulation should be clean and free from blisters, flakes, or cracked insulating varnish surfaces.

When the condition of the insulating varnish is such that treatment is necessary, the following should be observed.

1. Clean all surfaces with cloth dipped in a suitable solvent, and blow out with dry compressed air. Care should be taken so as not to damage the insulation by air blast.

2. Preheat the armature to a minimum temperature of 160° F.; this should take approximately three hours.

3. While the armature is warm, give one dip in clear synthetic varnish, either Schenectady #160 or Sterling #M472. The armature should be allowed to remain in the varnish until bubbling has practically ceased since it must be thoroughly saturated with varnish. The armature should be held on a swivel hook with the commutator end up and submerged in varnish up to the commutator risers.

4. Thoroughly drain the excess accumulation of varnish by spinning and wipe varnish from the shaft, using a cloth soaked in Toluol.

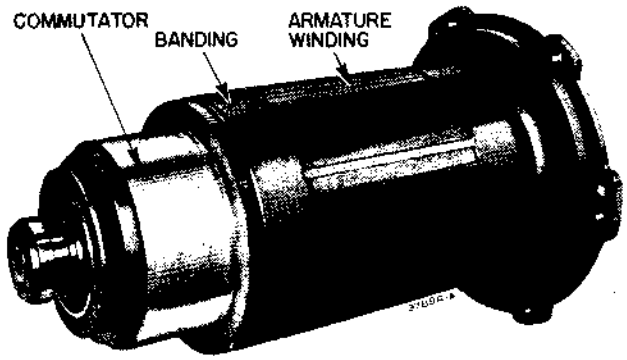
5. Bake until dry at 250° F. with a maximum baking time of eight hours. The armature is to be rotated while baking.

6. Allow the armature to cool down to room temperature.

7. Repeat steps 3, 4, and 5 once with the armature at room temperature.

8. Give completed armature one spray coat of an approved black air drying varnish.

9. Give armature a dielectric test at 1500 volts AC for one minute.



Illus. 6. Armature Assembly

COMMUTATOR

Service and Maintenance

The commutator should present a smooth surface free from pitting. If it has been excessively pitted or damaged from any cause, it should be stoned or turned.

When commutators have been subjected to exceedingly heavy surge currents resulting from flashovers, burned spots may appear on the bars. Since such spots cause a brush to momentarily leave the commutator, the spot may spread and grow progressively worse. Likewise, any other eccentricity of a portion of a commutator surface may cause burned spots. When such spots appear, it may be necessary to smooth the surface and restore the commutator to concentricity by means of a grinding fixture. By touching a brush with the machine running, it is possible to judge from the severity of vibration whether there is eccentricity. This should be done with an insulating stick. A better way, however, is to clamp a dial gage on the machine to measure thousandths of an inch commutator radius and rotate the machine by hand one commutator bar distance at a time. An eccentricity of 0.001 inch in less than brush spacing around the commutator may indicate the necessity of grinding. For bad burns and extreme eccentricity, it may be necessary to turn the commutator on a lathe.

Grinding

Obtain a grinding rig with adapter and a grinding stone. This rig should preferably be mounted with aid of adapter above the left brush holder support. The grinding stone has two directions of feed. Care should be taken to make sure that the radial pressure of the stone on the turning commutator cannot readily deflect the rig. The commutator should be wiped clean of all oil or dirt before grinding.

Operate the motor at slow speed. The approximate speed may be obtained by jacking the wheels off of the rails and connecting the motor to a welding generator.

Extremely light cuts should be taken at first until the commutator approaches a true condition. Heavy cuts tend to cause some deflection of the rig and therefore, the commutator may not reach true concentricity. The final cut should be made with a fine stone.

Check the trued commutator with a dial indicator. After grinding, check the depth of undercut of the mica; if this is less than 3/64 inch, undercutting is necessary. See paragraph on "Undercutting of Mica."

Turning

In turning a commutator on a lathe, remove only enough copper to give a uniform surface.

Whenever possible, turn the commutator by supporting the armature in its own bearings If the armature is held on lathe centers, be sure that these centers are true with respect to the bearing seats.

Before turning a commutator, make a suitable covering to keep the chips and dust from working into the armature. This covering can best be made as follows: Use a strip of cloth wide enough to cover commutator riser and end extensions, and long enough to encircle the commutator, binding the inside edge with a cord as close to the end connections of the coils as possible. Then turn the cloth up over the cord and bind with another cord to the outside of the armature core, covering the band.

Make sure that the turning post is so set that the ways are parallel to the commutator and that they are fastened and braced securely. Use a sidecutting tool with the point ground to about 1/16 inch radius. The cutting side of the point should be given more rake than is customary for working iron and steel. The tool should be sharp enough to make a clean, smooth cut without dragging over the mica.

While turning the commutator, it should be run at a surface speed of approximately 300 ft. per minute using a carboloy tool. With a file, round off the ends of the commutator segments to at least 1/16 inch radius, while the commutator is still in the lathe. After the commutator has been turned in the lathe, it should be brought to its final concentricity and finish by means of a fine grinding stone as explained in the previous article.

After grinding, check the commutator surface for concentricity by using a dial indicator. Use #00 sandpaper for final polishing.

After turning, the mica should be undercut. See paragraph on undercutting the mica for details.

Undercutting the Mica

After a commutator has been turned, undercut the side mica to a minimum of 3/64 inch in depth and a maximum of 5/64 inch. Special saws are available for this purpose and care must be taken not to cut the slot too wide. Remove the sharp edges of the commutator segments with a hand scraper or a knife. Do not bevel the edges of the segments. Clean out the slots to remove all mica chips and fins and be sure that no copper chips remain in the slot. A satisfactory tool for this operation can be made from a piece of worn-out hacksaw blade.

FIBERGLAS CORD BAND

Wipe dirt or grease off the cord band. Be certain the cord band is tight and has a smooth surface. If the finish has started to flake or chip, sand it lightly and blow out with dry compressed air. A coat of Benolite No. 672 red insulating paint or equivalent should then be applied and permitted to dry.

Should the cord break it may be replaced with 1/16 inch fiberglas cord. One layer of this cord is wound over the mica V-ring by hand. After winding, the cord should be given several coats of red insulating paint, Benolite No. 672 or equivalent, to provide a smooth surface across the top of the cord.

Do not use any lubricant on the commutator since there is a sufficient quantity of graphite in the brushes to supply all the lubrication required. Oil is very destructive to insulating materials as it collects dust and dirt, causing the insulation to break down electrically. If any oil should get on any insulated parts, it should be immediately and thoroughly wiped off with clean rags.

The leads from the armature winding are soldered into the ends of the commutator segments which should be carefully inspected when examining the armature. If the armature has been overheated and the solder thrown out, the leads should be resoldered with 100% pure tin solder.

When using air for cleaning in the vicinity of exposed mica insulation, care should be taken not to use too high pressure, or get the nozzle too close to the mica. If this practice is not followed, small flakes of mica will be thrown off, finally resulting in the complete destruction of the insulation.

WINDING

The armature winding is composed of all the armature coils which are placed in the slots of the armature core. The armature conductors are wound into coils, the ends of which are connected to segments on the commutator.

The coils are pulled so that one side lies on the bottom of one slot and the other side at the top of another slot thus forming a double layer winding. After the coils have been placed in the core slots, canvas base bakelite wedges or equivalent are driven into the core slots over the coil sides to hold them in place. The coil leads are then soldered to the commutator risers. A layer of insulation is placed over the coil extensions and a non-magnetic wire band wrapped tightly around both ends adjacent to the core to hold the coil extensions in place.

Service and Maintenance

The armature coils, due to their nature and position, will not generally be serviced in the field. Should a short occur between conductors in a coil, it would be necessary to replace the coil. This would involve removing the banding, the canvas base bakelite wedges, unsoldering the leads from the commutator risers, replacement, and rebalancing, which should preferably be done in the manufacturer's shop. If the solder holding the leads in the commutators should ever be thrown out, the leads may be resoldered with 100% pure tin solder.

BANDING

The function of the banding is to prevent the armature coil extensions from being thrown out by centrifugal force. This band consists of two layers of tightly wound non-magnetic wire placed over the armature coil extensions.

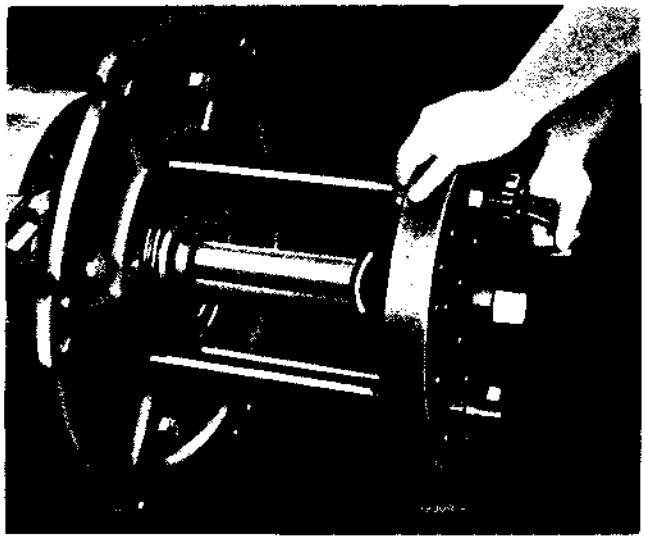
Service and Maintenance

During the periodic inspection, when the armature is removed for cleaning and dipping, the condition of the banding should be noted. Should there appear to be any shifting, or separation of the wires due to loss of solder, the band should be replaced either by a reliable electric repair shop or by the manufacturer.

REMOVAL OF COMMUTATOR END BEARING ASSEMBLY

Assuming the traction motor is dismounted and the armature is removed, proceed as follows:

1. Remove bearing nut.
2. Place the studs in the holes of the inner closure and use the bearing puller as shown in Illus. 7 to remove the bearing assembly.



Illus. 7. Use of Bearing Puller

REMOVAL OF PINION END BEARING ASSEMBLY

Assuming the traction motor is dismounted and the pinion removed, proceed as follows:

1. The water flinger is removed by heating it until it expands enough to slip off.
2. Remove outer closure by removing capscrews connecting it to the inner closure and bearing arm assembly.
3. Place the studs in the holes of the inner closure and use the bearing puller as shown in Illus. 7 to remove the bearing assembly.

BEARING ASSEMBLY

The traction motor armature bearings are of the roller bearing type. Roller bearings, by the nature of their design, MUST BE KEPT ABSOLUTELY FREE OF DIRT AND GRIT. Because of this, these bearings are equipped with an elaborate arrangement of labyrinths to exclude dirt while in service.

The commutator end bearing assembly consists of an outer and inner closure, a bearing nut, a shaft collar and grease seal, and a roller bearing. See Illus. 8.

The pinion end bearing assembly consists of a water flinger, an outer and inner closure, an outer and inner grease seal, a shaft collar, and a roller bearing. See Illus. 9.

Service and Maintenance

Refer to "ROLLER BEARINGS" for details of servicing and maintaining the roller bearings.

The main servicing required for the other parts of the bearing assembly will be cleaning with a suitable solvent to remove the accumulation of old and hardened grease. If oil leakage is occuring, the closure gaskets may require replacing. See instructions under "ROLLER BEARINGS."

ROLLER BEARINGS

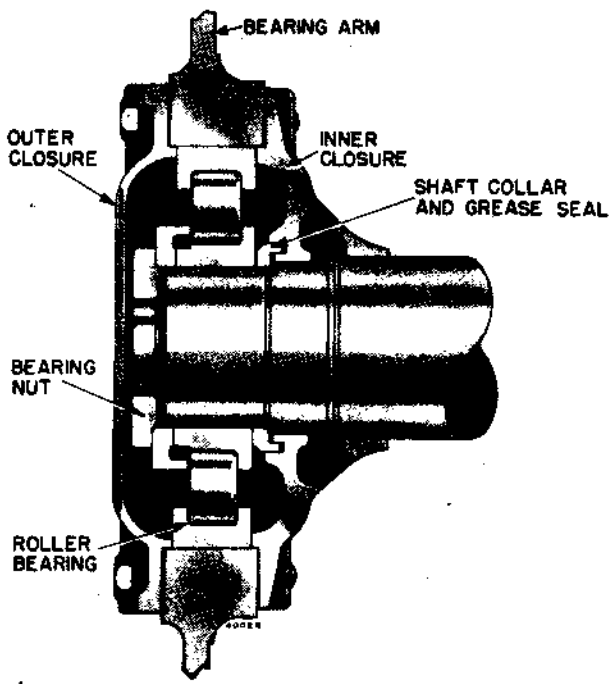
The roller bearing is the element which must bear the weight and thrust of the armature, and at the same time allow armature rotation with a minimum of friction.

Service and Maintenance

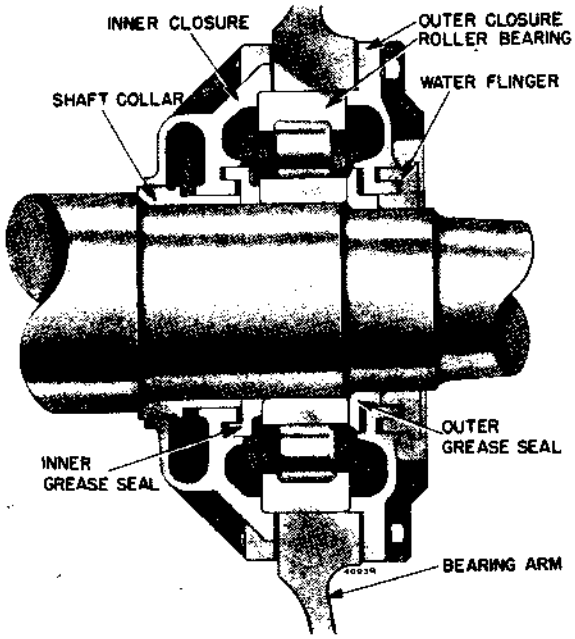
To insure continued operation, it is necessary to keep the bearing properly lubricated and all dirt, or other foreign matter must be excluded from contact with the bearing. The bearing is retained in the assembly by means of an inner and outer closure and the grease lubricant is held in the bearing chamber around the bearing by the closures and grease seal rings.

Inspection

When a traction motor has been dismantled for repair, the roller bearings should be thoroughly inspected for possible evidence of impending failure. If there is any evidence that the bearing shows signs of distress, it should be replaced with a new bearing. The following procedure may be helpful in inspecting bearings.



Illus. 8. Commutator End Bearing Assembly



Illus. 9. Pinion End Bearing Assembly

Cleaning

If a regular tank or booth is not available, the bearing parts may be cleaned in an open container filled with kerosene or some other suitable petroleum solvent such as petroleum spirits or Stoddard solvent. The container should preferably have a screen false bottom to minimize the circulation of dirt and old grease. The cleaning solution should be changed frequently and the container thoroughly cleaned. Care must be taken to utilize solvents in accordance with the solvent manufacturer's instructions. Protection in accordance with local laws regarding fire hazards must be provided. Gasolines containing lead compounds should not be used because of their toxic nature. Light petroleum solvents are effective but must be free of corrosive action and must be followed up with flushing oil. Be sure that the flushing oil removes all old grease and solvent before adding fresh grease.

After the inspection of the bearings is completed as explained below, they should be completely dried with clean, dry compressed air. If the bearings are to be put into immediate service, they should be dipped in a warm mineral lubricating oil of SAE 10 grade to prevent corrosion of the highly polished surfaces. If the bearings are to be stored, they should be dipped in a slushing compound of warm petroleum jelly. In either case, a suitable protective wrapping should be immediately applied.

Wear

A properly lubricated bearing not subjected to misalignment, dirt or distortion will show no evidence of wear. If wear has occurred, it is good evidence that one or more of the above factors has been present and will usually be evidenced by highly polished or lapped surfaces.

As a means of checking wear, the internal radial clearance of the bearing may be checked by passing a "feeler gage" between the rollers and race on the unloaded side. (Do not roll a feeler thru a bearing.) Where a dial indicator is available, internal clearance may be checked by clamping the inner race on a flat plate and measuring the total radial play of the outer race by the indicator. The following condemning limits for clearance should be used as a guide for replacement.

Bearings not mounted on armature shaft	Condemning Limit
Pinion End Bearing	0.011" Max.
Commutator End Bearing	0.009" Max.

(Final check must be made with bearings installed in motor.)

Bearings mounted in motor	
Pinion End Bearing	0.008" Max.
Commutator End Bearing	0.007" Max.

No bearing should be used which has minimum radial clearance (after being installed) less than:

Pinion End Bearing	0.004" Min.
Commutator End Bearing	0.003" Min.

End play should not be less than 0.006" or more than 0.021".

NOTE: The condemning limits on radial clearance should be used merely as a guide for judging the amount of wear which has taken place. This wear, if excessive or near the limits shown, should be interpreted in terms of the cause of the wear in making the inspection.

Fatigue Failure

Fatigue failures on the bearing surfaces are evident usually after failure of the material has started, as the actual failure almost always starts beneath the surface and is visually evident only after it progresses to the surface. Final failures of the material are usually evident as ragged craters and may be of any size.

Any bearing showing signs of cracks of any size or craters of any size, regardless of how

small they might be, should be replaced.

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

Dents

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

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

Scratches

Scratches due to mishandling, etc., in general are not serious providing they are small. Scratches may be recognized because they will be bright in the bottom after being cleaned. Scratches on the bearing surface parallel to the length of the bearing being more serious than those at an angle. Sometimes scratches are difficult to differentiate from cracks and for this character, they should be treated as cracks due to fatigue failure.

Heat

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

After removing the roller bearing from the cleaning fluid, it should be immersed in clean, light oil and spun until the solvent has been removed. This is to prevent corrosion of the highly polished surfaces.

Repacking

When the bearing assembly is clean and dry, repack with fresh grease. Refer to Sec. 203 for the recommended lubricant. Too much grease will cause the bearing to overheat. This is a common cause of bearing failure.

The bearings should be 2/3 full which requires using about 3/4 lb. of grease for the commutator end bearing and about 1 lb. of grease for the pinion end bearing.

REPLACING COMMUTATOR END BEARING ASSEMBLY

1. After the bearing assembly has been serviced as explained in the preceding articles, the shaft collar and grease seal, and the inner race of the roller bearing should be heated in an oil bath to a temperature of 270° F. for shrinking onto the shaft. SAE-40 oil may be used for heating. The parts should be left in the oil for at least 1-1/2 hours to insure complete expansion.

2. Wipe the armature shaft clean of all dirt and grease and slide the inner closure into place. Place a closure gasket over the inner closure; it may be held in place with shellac.

3. Slide the shaft collar and grease seal, and inner race into position making certain that the collar fits snug against the shaft shoulder and the inner race against the collar. When removing the parts from the hot oil it is best, first, to pick them out with a wire and wipe off the excess oil. Then, using heavy clean gloves, the parts may be slipped over the shaft. Should any of the parts stick, they may be tapped on lightly by using a copper or brass tube over the shaft against the inner race.

4. Place on rest of roller bearing.

5. Lock bearing nut in place.

6. Refer to article covering reassembly of traction motor for details on putting armature shaft into frame and putting outer closure in place.

REPLACING PINION END BEARING ASSEMBLY

1. After the bearing assembly has been serviced as explained in the preceding articles, the shaft collar inner grease seal, roller bearing, outer grease seal, and water flinger should be heated in an oil bath to a temperature of 270° F. for shrinking onto the shaft. SAE-40 oil may be used for heating. The parts should be left in the oil for at least 1-1/2 hours to insure complete expansion.

2. Wipe the armature shaft clean of all dirt and grease and slide the shaft collar into position. When removing the collar from the hot oil, it is best, first, to pick it out with a wire and wipe off the excess oil. Then, using heavy clean gloves, the collar may be slipped over the shaft making sure all parts fit snugly in position.

3. Slide the inner closure into place over the shaft collar. Place a closure gasket over the closure; it can be held in place with shellac.

4. Slide the inner grease seal, the roller bearing, and the outer grease seal into position. Use the same precautions as given in step 2 when removing parts from hot oil.

5. Place a closure gasket over the outer closure and bolt the outer closure to the bearing arm assembly and the inner closure.

Illus. 10. Field Assembly

6. Slide the water flinger into position.

7. See article covering application of pinion for details on mounting pinion.

FIELD ASSEMBLY

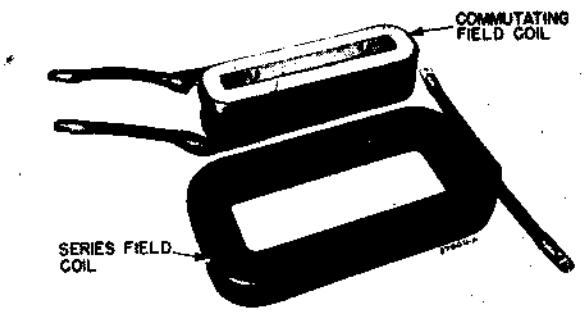
The field assembly consists of the frame, poles, field coils, and cable connections.

Service and Maintenance

The field assembly should be closely inspected for the condition of the poles, coils, cable connections, and insulation. The coil insulation should be clean and free from blisters, flakes or cracked insulating varnish surfaces. Cable connections should be tight and insulation in good condition.

FIELD COILS

The traction motor has a series field winding and a commutating field winding.



Illus. 11. Field Coils

Service and Maintenance

When a field coil burns out, it is necessary to replace it with a new coil. When the condition of the insulation warrants it, the coils should be redipped and baked as described in article covering "Dipping and Baking."

REMOVAL OF FIELD COILS

In case one of the field coils has to be removed from a traction motor it will be necessary first to remove the motor from the locomotive.

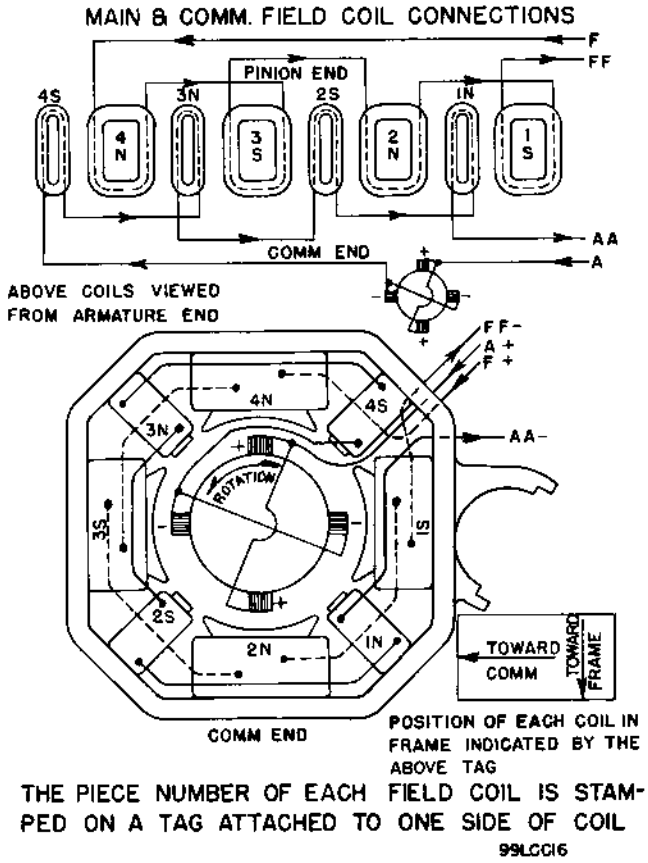
Assuming the motor to be dismounted with the armature removed, proceed as follows:

1. Mark all coils and pole pieces so they can be replaced in their original positions when reassembling.

2. To remove series coils, set the frame on end, commutator end down. To remove commutating coils, set the frame on end, pinion end down.

3. Strip the insulation off the leads from the coil to be removed to the adjacent coils, and disconnect the connections.

4. Remove the two capscrews which hold



Illus. 12. Traction Motor Wiring Diagram

the commutating poles in place. By the use of a hoist, the commutating coil assemblies can be slid out the commutator end of the frame.

5. To remove a series coil it is necessary to first loosen the commutating coils on either side of it and tilt them out of the way. Using a hoist, place a chain around the main pole. Remove the three capscrews which hold the main pole in place. The series coil assemblies can now be hoisted out the pinion end of the frame.

6. Remove the coils from their poles, being careful not to get the shims mixed if they have been used.

Dipping and Baking

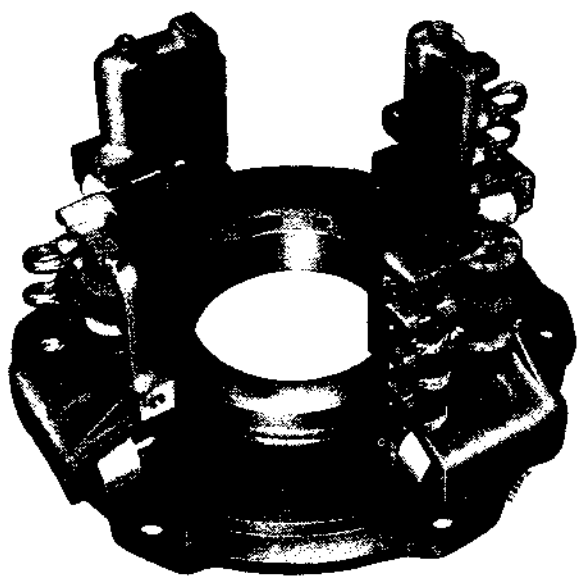
Coils removed from the traction motor should be given the following treatment.

1. Thoroughly clean the coil to remove any dirt, oil or grease.
2. Preheat the coil for two hours at 250° F.
3. While coil is warm give one vacuum impregnation of an approved grade of varnish, either Schenectady #160 or Sterling #M472.
4. Bake coil for eight hours at 250° F.
5. Dip coil in clear synthetic varnish, either Schenectady #160 or Sterling #M472.
6. Bake coil for four hours at 250° F.
7. Repeat steps 5 and 6, reversing coil after first bake.

REPLACING FIELD COILS

When replacing coils, the procedure should be the reverse of the removal described above and the following points should be carefully noted:

1. Align the holes in the frame with those in the pole by inserting a round bar. Any shims that were taken out originally should be replaced and held in position by the round bar. Make sure that the shims have been wiped clean of all grease and dirt.
2. See that the pole seats and backs are clean and free from chips before putting the poles in place. Make sure that the poles are pulled to their seat by the capscrews.
3. If more than one coil is removed, be sure they are reassembled in correct positions by checking the style number on each coil.
4. Always use new lockwashers under the pole piece capscrews when reassembling.
5. Connect all cables. Refer to the connection diagram, Illus. 12, for the particular coil winding.
6. After connecting the coils according to the connection diagram, the relative polarity can be checked by exciting the field circuit. Adjacent poles of the same field circuit should be of opposite polarity. This can be observed by means of a compass.
7. Apply high potential test between the coils and frame using 1500 volts.



Illus. 13. Bearing Arm Assembly

BEARING ARM ASSEMBLY

The bearing arm assembly consists of a bearing arm which is bolted to the main frame, four brush rocker support blocks which are welded to the bearing arm and four brush holder assemblies. See Illus. 13.

Service and Maintenance

For details on servicing and maintenance refer to the article covering the specific part desired.

BRUSH HOLDER ASSEMBLY

See the data sheet for the type, size, and recommended pressures for the brushes and also the clearance between the brush holder and commutator.

Service and Maintenance

It is necessary to remove the dust covers from the commutator to inspect the brushes and brush holders.

Periodically examine the brush holders for damage caused by flashover, broken springs, or binding of the brushes. The brushes must slide freely in the holders. Work the brush up and down several times to release any carbon

dust or other foreign material which tends to cause binding. Do not snap the springs as they may chip the brush.

Replace brushes which have been chipped or worn excessively with the same grade of brush. This is especially true when only a partial replacement is made as two widely different kinds of brushes on the same machine may be detrimental to its successful operation.

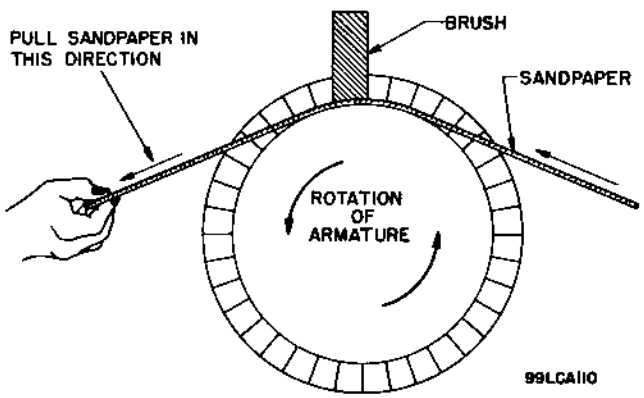
In replacing brushes, first reach thru the frame and unscrew the terminal screw holding the pigtail. Lift the spring from the brush and remove the brush. Clean the brush slot of any grit or carbon dust and add a new brush. Release the spring carefully, not allowing it to strike the brush and chip it. Attach the free end of the pigtail to the brush holder casting with the terminal screw.

When new brushes are put in they should be fitted to the commutator by sandpapering, Illus. 14. In fitting brushes a piece of sandpaper is inserted under the brush, with rough side toward brush, and drawn in the direction of rotation; lift the brush when moving the paper back and keep the paper close to the commutator to avoid rounding the edges of the brushes.

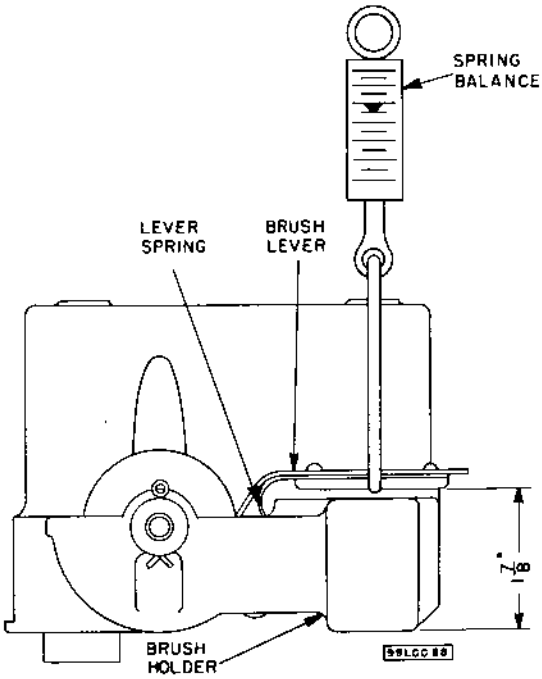
Proper brush pressure should be maintained, as unequal brush pressure will cause unequal current distribution in the brushes. The brush pressure can be determined as follows: Remove the brush, attach a spring balance to the brush finger and lift the finger until its under surface (that which rides on the brush) is 1-7/8 inches from the bottom of the brush box. The scale reading at this point should be between 8 and 9 pounds. Refer to Illus. 15.

Should it be necessary to readjust the brush tension on the traction motor proceed as follows:

1. Insert an 1/8" pin in one of the holes in the spring mounting bushing to hold the existing tension on the brush.



Illus. 14. Method of Sanding Brushes



Illus. 15. Measuring Brush Pressure

2. Withdraw the cotter pin which holds the spring mounting bushing. The spring mounting bushing holds the spring.

3. Turn the spring mounting bushing using the 1/8" pin, until the spring pressure is correct. The proper spring pressure is designated on the data sheet.

4. Line up one of the holes in the sleeve with the hole in the pin and insert cotter pins.

Maintain proper clearance between bottom of brush holder and the commutator. When adjusting the brush holders, a piece of flexible material such as cardboard, as thick as the specified clearance, is placed over the commutator to provide the proper spacing between the brush holder and the commutator. The capscrew which closes the brush rocker support block should be loosened. This permits the brush holder to be moved up or down into proper position. When the brush holder is firm against the spacer, the capscrew may be tightened. The flexible spacer may then be removed.

Keep porcelains clean and replace when cracked or broken or when the glazed surface has been removed by flashover.

Brushes must fit in the carbonway so that they will not chatter. The carbonways must be smooth. Replace brush holder body which is worn sufficiently to allow a new brush to chatter.

BRUSH RIGGING CROSS CONNECTIONS

The brush rigging cross connections connect

brushes of like polarity, in other words, alternate brushes. These are then connected by means of other cables to field leads and terminal block leads. The cross connections should be tied together for support to prevent vibration.

Service and Maintenance

Check cross connections to make sure that they are tight and that they do not interfere with the brushes.

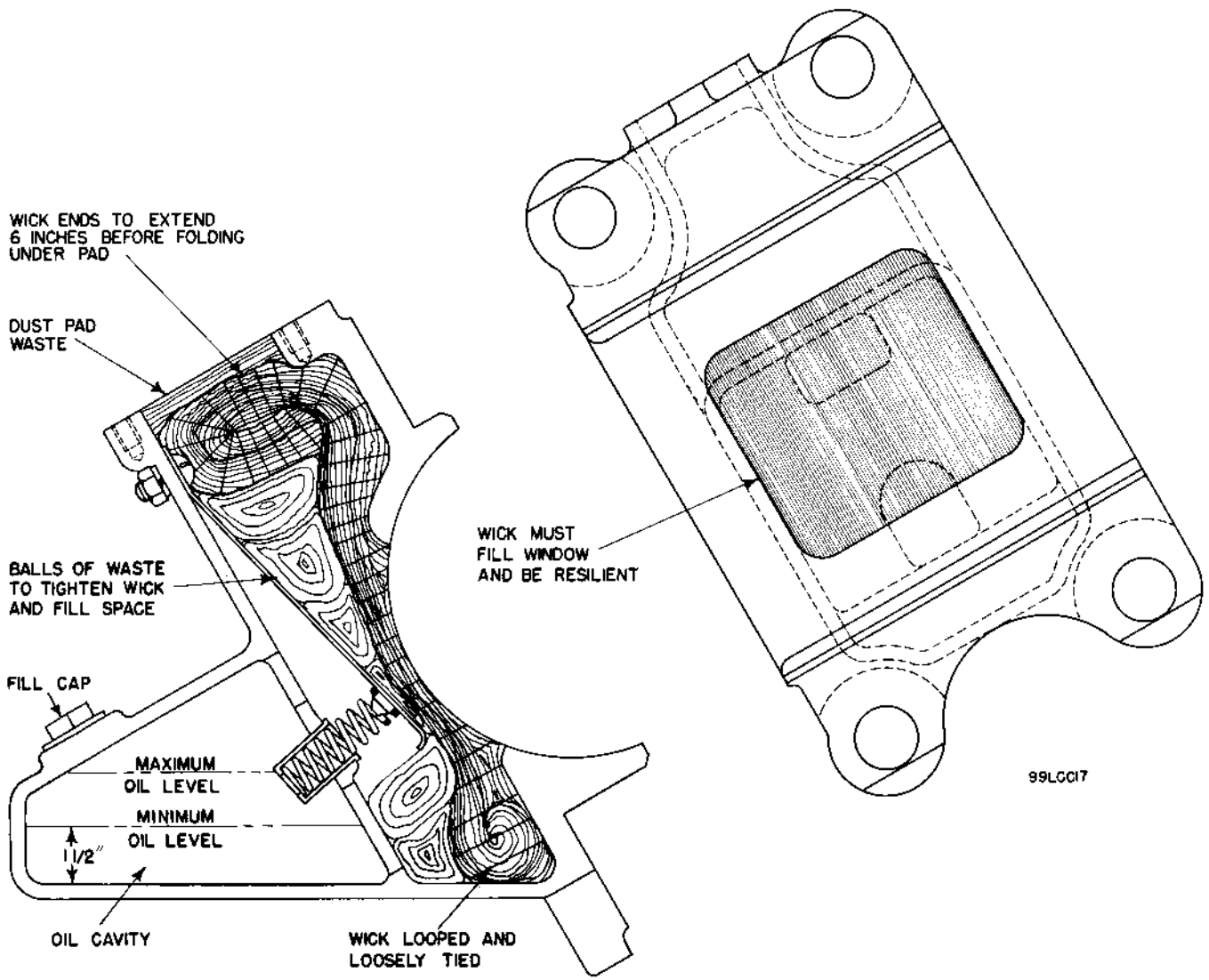
AXLE BEARINGS

The axle bearings consist of four bronze bearing halves which are held in the traction motor frame by two bearing caps. See Illus. 2. The bearings are oil lubricated. The axle bearings are waste packed, however some of the later traction motors are provided with felt lubricators.

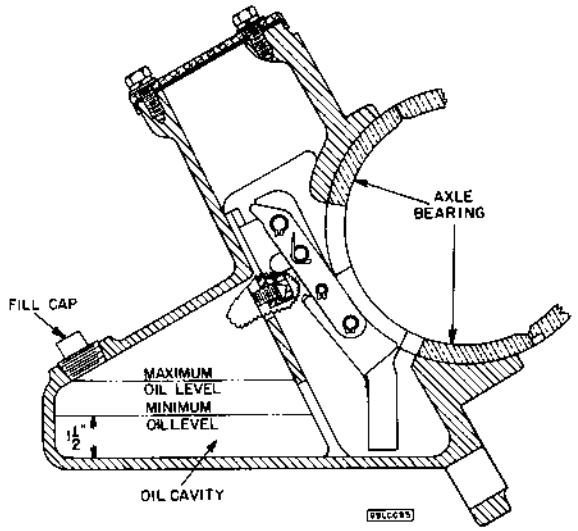
REMOVAL OF AXLE BEARINGS

In case it becomes necessary to remove the axle bearings while the motor is on the truck, proceed as follows:

1. Run the locomotive over a pit, if one is available, or locate it to the best advantage for working on the under side of the axle.
2. Remove axle dust shield between the axle bearings by taking out the four tap bolts which hold it in place.
3. If the bearing to be removed is on the gear side, it will be necessary to take out the gear case bolts and clips, and drop the lower half of the gear case.
4. Take out the four axle bearing cap bolts and remove the cap; if the cap sticks, it can be loosened by tapping a flat cold chisel in the crack between the cap and the motor frame, first on one side and then on the other side. Care should be taken to see that the cap is



Illus. 16. Sectional View of Waste Packed Traction Motor Axle Bearing Cap



Illus. 17. Sectional View of Traction Motor Axle Bearing Cap with Felpax Lubricator

properly supported by a helper, or backed up by blocking when it is being loosened, to prevent it from dropping suddenly and causing personal injury. The lower half of the axle bearing will drop down with the cap and can be readily knocked out with a wooden block and hammer. To remove the upper half of the bearing, jack up under the motor frame a sufficient amount to relieve the weight on the bearing and then revolve the upper half around the axle until it can be slipped off below. If the bearing sticks in the frame, it can be knocked loose by driving down on the flange with a hammer and wooden block.

HOT AXLE BEARINGS

Hot bearings will occur occasionally and are usually the result of one of the following causes:

1. Insufficient amount of oil.
2. Dirt working into the bearing.
3. Improperly packed waste or defective lubricator.
4. Excessive end play in truck axles.
5. New bearings with insufficient clearance.
6. Traction motor nose clamped in truck frame.

In case of trouble, investigate at once the level of oil in the cavity and make sure it is up to the amount specified on the data sheet. Examine the waste packing of felt and make sure that it has not fallen away from the shaft. If it is not in proper shape, repack in accordance with instructions under "TO REPACK THE AXLE BEARINGS."

In the case of new axle bearings, it is well to examine the radial clearance as bearings too tightly set up are frequently the cause of trouble. If the trouble persists with the bearing freshly packed, oil at the right level, and ample clearances, the bearing should be removed and examined. If the bearing shows signs of cutting, it should be carefully scraped down to a new surface, or if too badly scored, should be replaced with a new bearing.

Before replacing a bearing which has been cutting, examine the journal carefully. Remove any roughness with fine emery paper, taking care after the operation to remove all traces of grit with a clean cloth, and rub over the journal with oil. Grease should not be used on a bearing which is lubricated by oil and waste, as the grease will glaze over the waste surface and prevent the oil from reaching the bearing.

See that a new bearing is perfectly clean and rub a little oil over the surface before putting it in place.

Axle bearings should be assembled with shims between the cap and frame if necessary to give the proper clearance. Repack as instructed below and fill the oil cavity to the proper level. The straps holding the motor nose should not be applied in such a manner that they produce a clamping action, as severe stresses in the nose and axle bearings may result. At least an inch clearance on each side of the nose is necessary to allow for the wear of truck parts.

TO REPACK THE AXLE BEARINGS

The axle bearing lubricators supplied on some of the later traction motors are equipped with wicks made from a special grade of non-glazing felt. Normally the lubricators require very little attention aside from keeping the oil wells properly filled with oil. Periodic inspections should be made, however, to make sure that the felt pads are not worn out and that they are making good contact with the axle, without tilting and with no indication of glaze. Replacement of the lubricator should be made when the felts are worn to within 1/16 inch of the brass holder. The axle cap must be removed to install the lubricator.

The axle caps on all other traction motors are waste packed and must be packed before they are filled. The oil is drawn up from the oil well to the bearing by the capillary action in the strands of waste. Thus it is essential, for proper lubrication, to provide a continuous path for the oil flow. This means that long strand wool waste must be used, and the waste must be in actual contact with the journal. The axle cap should be flushed clean with kerosene before repacking.

Before using the waste, it should be satur-

ated in oil for at least 24 hours and left on a grating to dry for several hours. Wicks are prepared by forming the oiled waste into skeins of sufficient length to reach from the bottom of of the waste chamber up to about six inches above the waste chamber cover seat. When the skeins are packed they should be twisted about one complete turn to hold all of the strands of yarn in place and produce a springy wick.

The axle caps are fitted with a spring waste pusher. Insert a narrow wooden wedge between the pusher and the axle to compress the spring while packing the bearing. Three skeins should be packed into the waste chamber and held against the axle by means of a wide packing iron. The upper ends of the skeins should be allowed to hang out of the axle cap about six inches. The remainder of the chamber should then be filled with several balls of oiled waste and the wide packing iron and wooden wedge removed. The loose upper ends of the skeins should be folded over the other waste and tamped down tight. A pad of saturated waste large enough to fill the remainder of the waste chamber should be placed on top of the wick to catch and hold dirt which might fall in whenever the waste chamber cover is removed.

After the bearing has been packed, the oil well should be filled to the proper level. See Sec. 203 for the type of oil, and the data sheet, or Illus. 16 and 17 for the proper height of the oil measured from the bottom of the chamber. The oil should be poured into the oil well, and not on top of the waste.

CLEARANCE AND WEAR

Axle bearings should normally be replaced as indicated in Illus. 18. The inspection and cover plate can be removed in order to check the clearance between the underside of the axle and the bearing.

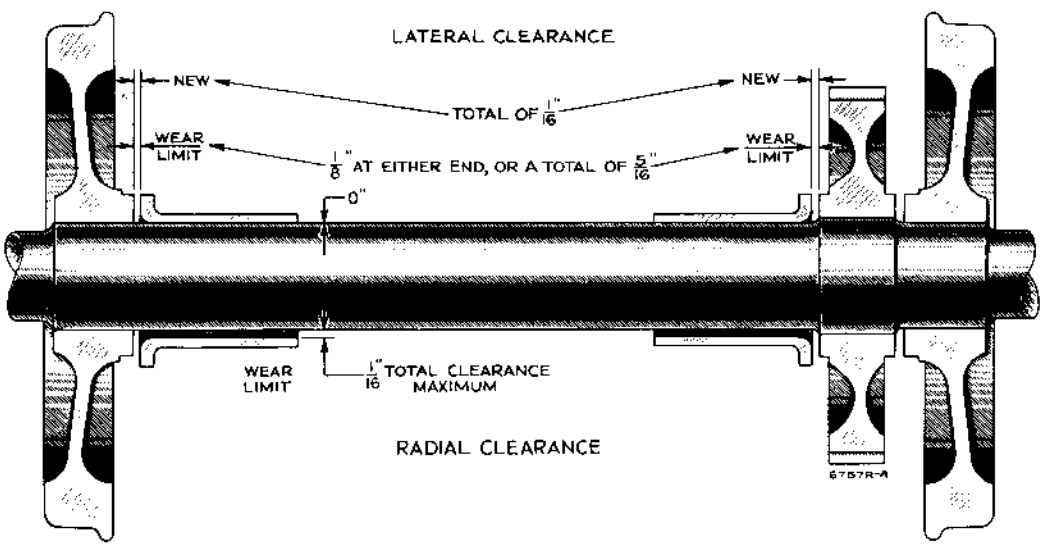
Care should be exercised to see that the axle shields are in place and the dust guards on at all times when the locomotive is in operation, as dust and grit working into the bearings will greatly increase the wear.

GEARS AND GEAR CASES

Never permit the gearing to run dry or the result will be excessive wear of the gear and pinion teeth. At each inspection (Refer to Sec. 206), open the inspection cover and examine the condition of the gear teeth. If there is appearance of insufficient lubrication, add lubricant more frequently until adequate lubrication is obtained. The gearing must be lubricated at all times. Refer to Sec. 203 for the recommended lubricants.

The gear lubricant used must be heavy enough to maintain a protective film on the gear teeth at heavy loads and yet tend to level back in the gear case at operating temperature. Since these characteristics are affected by temperature, it is advisable to use a summer and winter grade of a good grade of gear compound. Refer to Sec. 203.

If necessary to clean out the gear case, scrape out the grease or immerse the case in a solution of caustic potash in which steam is injected and continue until the case is boiled clean. NEVER ATTEMPT TO BURN OUT THE OLD GREASE AS IT WILL RESULT IN WARPING THE GEAR CASE. After it has been thoroughly cleaned and dried, repaint the inside of the case



Illus. 18. Lateral and Radial Clearances of Motor Axle Linings on Locomotive Axle

with red enamel or other oil resistant finish.

Should any unusual noises occur in the traction motor gearing the cause should be investigated and corrected immediately. Operating the locomotive with defective gearing will only serve to cause additional troubles.

TESTING DIRECTION OF ROTATION

Whenever the traction motor leads have been disturbed, the motors should always be tested for direction of rotation. This test is important, since it is quite possible to have the locomotive apparently operate correctly, and still have an improper connection which would later lead to serious motor trouble.

RECOMMENDED PROCEDURE TO PREPARE TRACTION MOTOR FOR SERVICE AFTER FLASHOVER

Refer to Sec. 411.5C

NOTES

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