install subassemblies and assemble power divider (continued)

ing care not to damage oil seal. Install flange nut. Tighten nut to correct torque and install cotter pin. Tighten rear bearing cover cap screws to correct torque.

13. *Lubricate pinion bearings.* Install partially-assembled drive pinion in divider case. On Model 50M Axles, position inner bearing sleeve in case bore and end of pinion through inner bearing cup. Align sleeve with set screw hole in case and install set screw and lockwasher. *On Model 36M Axles, position end of pinion through inner bearing cup. Install inner bearing sleeve (see Step 16) after pinion bearing cage cover is installed.*

14. Install pinion bearing spacer, outer pinion bearing cone, tongued washer and pinion nut. Tighten nut to correct torque, then install cotter pin.

15. Remove temporarily-installed bearing cage cap screws. Install new cork seal in cage groove. Install cover and fasten with nuts, cap screws and lockwashers. Tighten nuts and cap screws to correct torque.

16. *On Model 36M Axles,* place inner bearing sleeve on pinion inner bearing and in power divider case. Align sleeve with set screw hole in case and install set screw and lockwasher.

For Torque Requirements . . . refer to page 122.

►reassembly of differential carrier and installation of power divider

Model 50M Axles

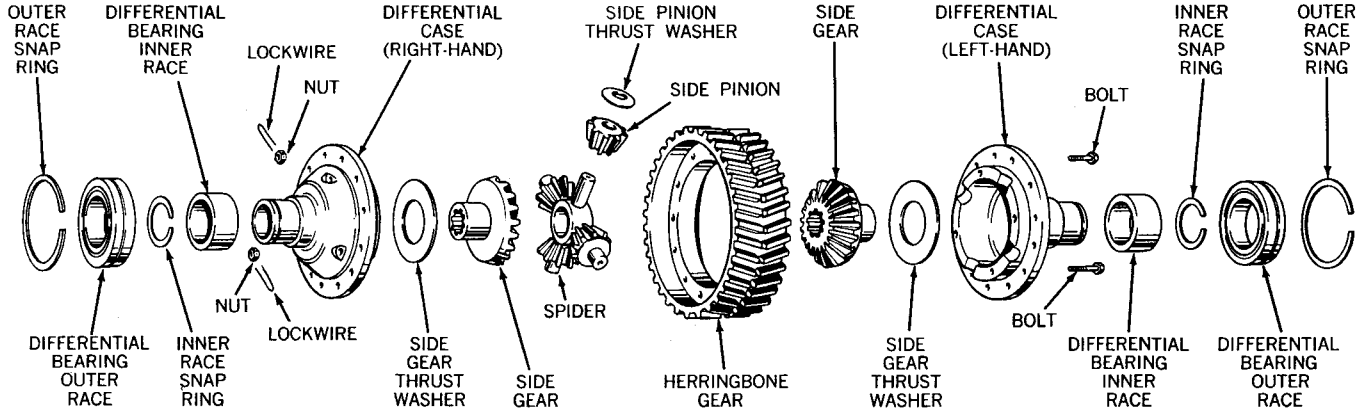


Fig. 151. Exploded View of Axle Differential

assemble differential

1. Press differential bearing inner races on differential case halves. Install snap rings.

Lubricate internal parts of differential during reassembly.

2. Place herringbone gear on left-hand differential case. Place thrust washer and side gear in left-hand case. Assemble side pinions and thrust washers to spider, then place this assembly in left-hand case. Place right-hand side gear on side pinions.

Model 50M Axles

assemble differential (continued)

3. Place side gear thrust washer on right-hand side gear. Position right-hand case over left-hand case, matching marks on each case and, using two bolts as guides, drive right-hand case into herringbone gear.

4. Install bolts with heads positioned on left-hand side, and tighten to correct torque. The four oversize bolts are mounted midway between spider arms. Lockwire nuts.

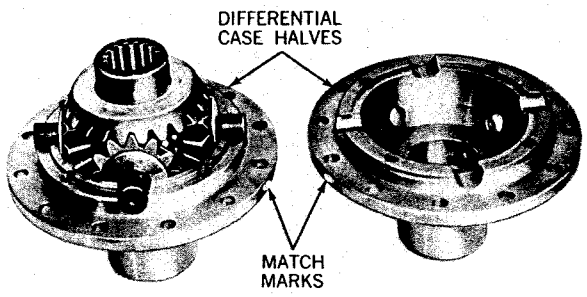


Fig. 152. Differential Case Match Marks

For Torque Requirements . . . refer to page 122.

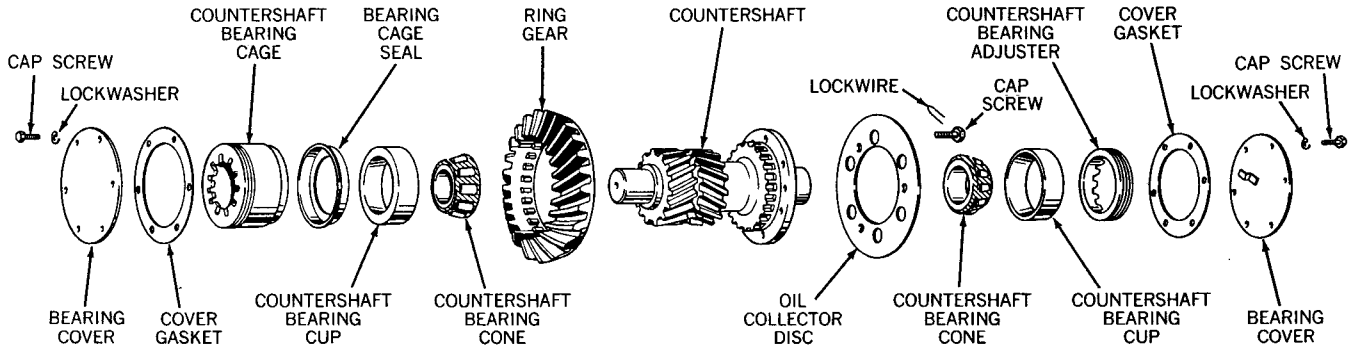


Fig. 153. Exploded View of Countershaft

assemble countershaft

1. Place ring gear on countershaft, aligning punch marks (see fig. 129). Place oil collector disc on opposite side of countershaft flange. Install cap screws to secure assembly. Tighten cap screws to correct torque, then lockwire.

2. Press bearing cones on ends of countershaft.

assemble differential carrier and install power divider

1. Place countershaft assembly in differential carrier (see fig. 121 and 122).

2. *Lubricate bearings.* Install bearing cups. Install left-hand bearing adjuster in differential carrier, engaging only 2 or 3 threads. Install right-hand bearing cage. Tighten bearing cage to preload countershaft bearings. (Refer to "Adjustment" Section of this manual.)

3. Place divider case gasket on differential carrier. Install power divider on differential carrier. Install lockwashers and nuts. Tighten nuts to correct torque.

4. Adjust ring gear and drive pinion for proper tooth contact. (Refer to "Adjustment" Section of this manual.)

5. After correct adjustment, install countershaft bearing cover gaskets, bearing covers, cap screws and lockwashers. Tighten cap screws to correct torque.

assemble differential carrier and install power divider (continued)

6. Place oil reservoir in carrier (see fig. 120) and secure with cap screws and lockwashers. Tighten cap screws to correct torque.

7. *Lubricate bearing outer races.* If removed, place snap rings on differential bearings. Place bearing outer races on inner races, then place assembly in carrier (see fig. 116). Install bearing caps making certain that snap rings rest in grooves of carrier and caps.

8. Install bearing cap screws and flat washers and tighten to correct torque. Lockwire cap screws.

9. Insert oil distributor in carrier (see fig. 117) and install cap screw and lockwasher. Install spring, gasket and plug.

► installation of differential carrier and power divider assembly

install differential carrier and power divider assembly in axle housing

1. Place carrier gasket on axle housing. Install differential carrier and power divider assembly in axle housing. Install lockwashers and nuts. Tighten nuts to correct torque.

2. Connect lockout shift lever connections.

3. Install axle shafts and connect propeller shafts. Fill axle with correct lubricant. (Refer to "Lubrication" Section of this manual.)

adjustment

Refer to "Adjustment" Section of this manual.

lubrication

Refer to "Lubrication" Section of this manual.

This section of the manual includes service information for the Eaton Air-Torsion Spring and Electric Shift Systems. Separate bulletins for other Eaton Axle Shift Systems are available upon request.

► 2-SPEED AIR-TORSION SPRING SHIFT SYSTEM

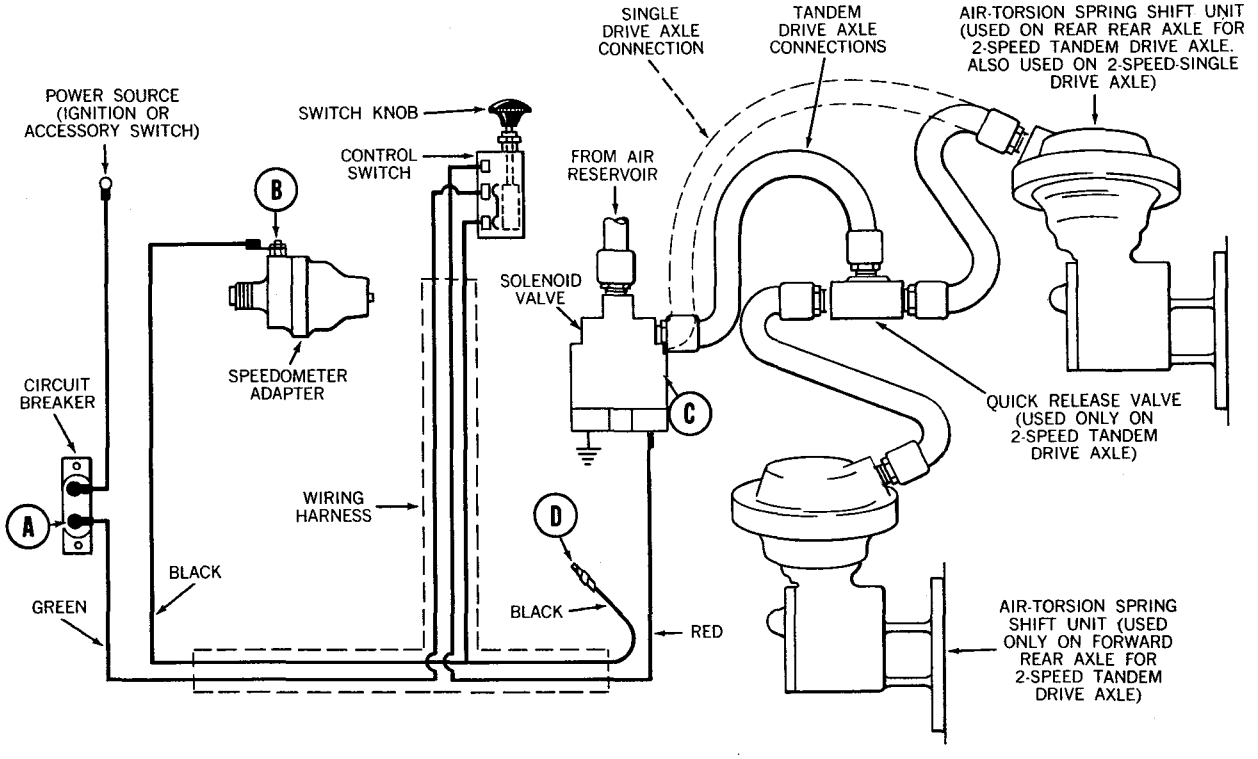


Fig. 154. Air-Torsion Spring Shift System

► Description and Operation of System Components

CONTROL SWITCH. The control switch is of the push-pull type and is manually-operated by the vehicle driver. This switch controls current flow through the electrical system to operate speedometer adapter and solenoid valve.

SPEEDOMETER ADAPTER. The speedometer adapter compensates for drive shaft speed variations between high and low axle ratios. A spring holds adapter in high range position and an electromagnet holds adapter in low range position.

2-Speed Air-Torsion Spring Shift System

WIRING HARNESS AND CIRCUIT BREAKER. Electric wiring in the system is a completely assembled unit including a circuit breaker. Individual wires in the harness are identified by various colors (see fig. 154).

The circuit breaker is connected in the wire leading from the power source. If a short circuit occurs, the circuit breaker will open and cut off electrical current to the system.

SOLENOID VALVE. The solenoid valve provides the link between the electrical control system and the air-torsion spring shift unit. When the control switch knob is up, air is allowed to travel to the air shift unit to shift axle into high range. When the control switch knob is down, the solenoid valve shuts off air pressure supply and allows the air-torsion spring shift unit to bleed air back through the solenoid valve exhaust port. This action allows axle to shift to low range.

AIR-TORSION SPRING SHIFT UNIT. The air-torsion spring shift unit is mechanically connected to the axle shift fork and shifts axle into low or high range. This unit includes an air chamber and a torsion spring drive assembly. A diaphragm, operated by air pressure, moves a push rod. The end of the push rod connects to a spring winding lever. This lever is part of the torsion spring drive assembly, which acts to move shift fork and change axle range as described under system operation.

QUICK RELEASE VALVE FOR TANDEM DRIVE AXLES. In this shift system, a quick release valve is incorporated with the solenoid valve to bleed air from the two air-torsion spring shift units, when axle shifts to low range (see fig. 154).

► System Operation

OPERATION IN HIGH RANGE. With control switch knob in the down position, the axle will be in low range. When the driver pulls up the control switch knob, current to the solenoid valve will open an air passage and permit air pressure to be applied to air shift unit diaphragm.

Diaphragm movement operates push rod which, in turn, moves the spring winding lever. The spring winding lever increases load placed on torsion spring. When this condition occurs, the axle is ready to shift into high range. When load (torque) on gears is relieved by opening or closing the throttle or declutching, the axle will shift. The torsion spring is assembled in the shift unit under a preload of 50 to 80 lbs. pressure. When the spring winding lever is moved to wind the spring, the pressure of the spring is increased to 90 to 135 lbs. This additional pressure is used to shift the axle, and when shift is completed, the initial 50 to 80 lbs. preload again becomes effective and holds the axle in high range.

OPERATION IN LOW RANGE. When the control switch knob is pushed down, the solenoid valve shuts off air supply. Air pressure in the air-torsion spring shift unit bleeds back through the solenoid valve and air lines. Pressure on diaphragm is released. Push rod moves toward diaphragm and moves spring winding lever. Additional load (in opposite direction of shifting to high range) is placed on torsion spring, providing a condition ready for axle to shift to low range, when load (torque) on gears is relieved by opening or closing the throttle or declutching.

TANDEM DRIVE AXLE SYSTEM OPERATION. Operation of air-torsion spring shift system on Tandem Drive Axles is similar to the single unit type axle, except that two air shift units are used (see fig. 154). Also a quick release valve is incorporated in the air system (between solenoid valve and air shift units) to bleed air pressure from both air shift units and lines.

2-Speed Air-Torsion Spring Shift System

► Trouble Shooting

If axle will not shift, test system and components as follows:

Test lamp voltage should be same as system rated voltage. Refer to figure 154 for terminal references.

check circuit breaker operation

Disconnect circuit breaker lead wire (Terminal "A"). Connect test lamp across Terminal "A" and ground on vehicle frame. Turn on ignition switch (or accessory switch for diesel engines) and observe test lamp operation:

1. *If lamp lights and stays on continuously,* circuit breaker and lead wire are satisfactory.

2. *If lamp does not light,* check for poor electrical connections or broken lead wire. If lead wire and electrical connections are satisfactory, circuit breaker is faulty.

3. *If lamp does not light immediately then starts to flash on and off* (also a faint clicking of the circuit breaker may be heard), the circuit breaker is faulty.

check control switch and wiring harness

If trouble in control switch or wiring harness is suspected, visually check as follows: Check harness for damaged or worn insulation that may cause a ground connection, especially where harness passes through cab floor. Check for accidental grounding of wire terminals to metal box at transmission lever. Check for short circuits between wire terminals. Check for poor insulation or accidental ground at end of lead wire (Terminal "D").

To determine condition of control switch, it is recommended that a new control switch be temporarily installed. However, if desirable, control switch operation may be checked with a test lamp as follows:

Disconnect lead wires at speedometer adapter Terminal "B" and at solenoid valve Terminal "C". Turn ignition switch on and alternately connect test lamp leads to disconnected lead wires. Operate control switch and observe test lamp for the following conditions:

When test lamp is connected to speedometer adapter lead wire (Terminal "B"), lamp should light in *low range* or *down* position of control switch. Lamp should go out with control switch in *up* position.

When test lamp is connected to solenoid valve lead wire (Terminal "C"), lamp should light in *high range* or *up* position of control switch. Lamp should go out when control switch is in *down* position.

If test lamp indications are correct in the above tests, current supply is correct to speedometer adapter and solenoid valve.

If lamp does not light correctly, trouble may be a short circuit in wiring harness or control switch, or a wire in harness may be broken. Plug assembly in wiring harness may also be faulty.

check solenoid valve operation

The solenoid valve is energized to supply air to shift unit in high axle range only. The valve must have a good ground connection to vehicle frame to operate satisfactorily. Before condemning solenoid valve operation, make certain that ground connection is satisfactory.

To check solenoid valve operation, disconnect lead wire at Terminal "C" and air line leading to shift units. Install an air pressure gage in air line opening in solenoid valve. Apply power supply (vehicle voltage) to solenoid valve terminal and observe pressure gage reading.

Operating pressure should be approximate reservoir pressure. *If gage indicates approximate reservoir pressure,* solenoid valve operation is satisfactory. *If gage indicates low or no pressure,* solenoid valve is faulty.

check air-torsion spring shift unit operation

If electrical system is functioning properly but axle does not shift satisfactorily, trouble may be caused by a faulty air-torsion spring shift unit. Disassemble and repair a faulty shift unit as indicated on pages 87 through 90.

check speedometer adapter operation

The speedometer adapter is energized in low axle range only. The adapter is grounded through speedometer mounting or speedometer cable and cable housing. Before condemning speedometer adapter operation, make certain that ground connection is satisfactory.

To test speedometer adapter circuit with a test lamp, disconnect lead wire at Terminal "B". Connect test lamp to Terminal "B" lead wire and ground on vehicle frame. Turn ignition switch on and observe test lamp operation.

The test lamp should light in *low range* or *down* position of control switch. Lamp should go out when control switch is placed in *up* position.

If lamp indications are correct, current supply to adapter is correct. *If lamp indications are correct and axle shifts normally,* but speedometer does not operate properly, replace adapter.

If test lamp indications are not correct, trouble is in wiring harness or control switch.

2-Speed Air-Torsion Spring Shift System

► Service and Maintenance

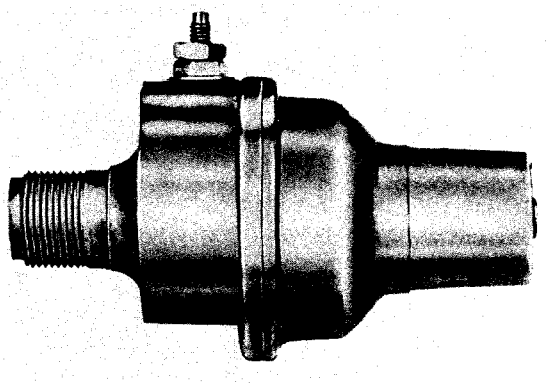


Fig. 155. Speedometer Adapter

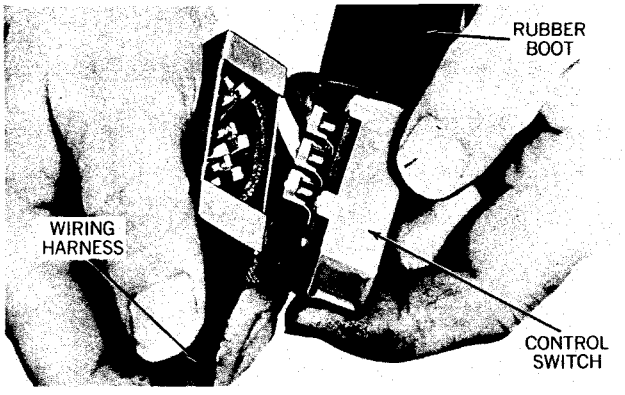


Fig. 156. Removing Control Switch

► speedometer adapter repair

The speedometer adapter is lubricated and sealed for life of the unit. No maintenance is required. Replace a faulty unit.

► quick release valve repair (for tandem drive axles)

If quick release valve fails to operate properly, it may be repaired as follows: Disassemble valve. Inspect valve body, valve seat and spring for evidence of faulty operation. Replace faulty parts, then reassemble.

► control switch repair

For inspection or replacement, the control switch can easily be removed by sliding the rubber boot up to the knob, then separate switch from harness (see fig. 156).

Inspect switch for loose connections and other visual defects that may cause short circuit or electrical failure. Replace a faulty switch as an assembly.

► solenoid valve repair

Replace solenoid valve as an assembly. The valve should not be serviced.

► air-torsion spring shift unit repair

Figures 157 and 158 illustrate shift units used on individual rear axles and on tandem drive axles. Figure 159 illustrates parts of an individual rear axle shift unit. Service instructions are the same for all shift units.

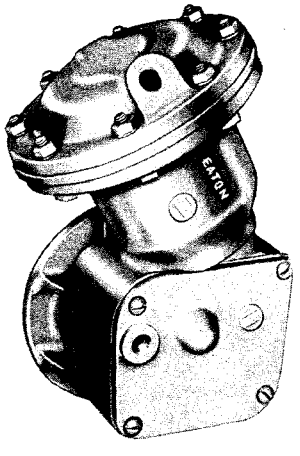


Fig. 157. Air-Torsion Spring Shift Unit for Individual Axles

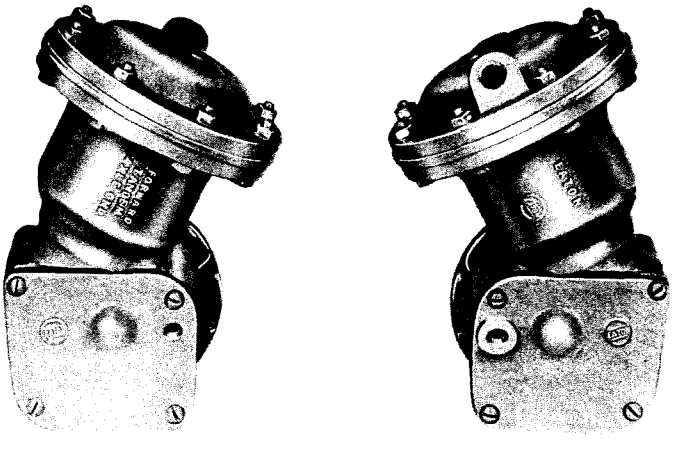


Fig. 158. Air-Torsion Spring Shift Units for Tandem Drive Axles

2-Speed Air-Torsion Spring Shift System

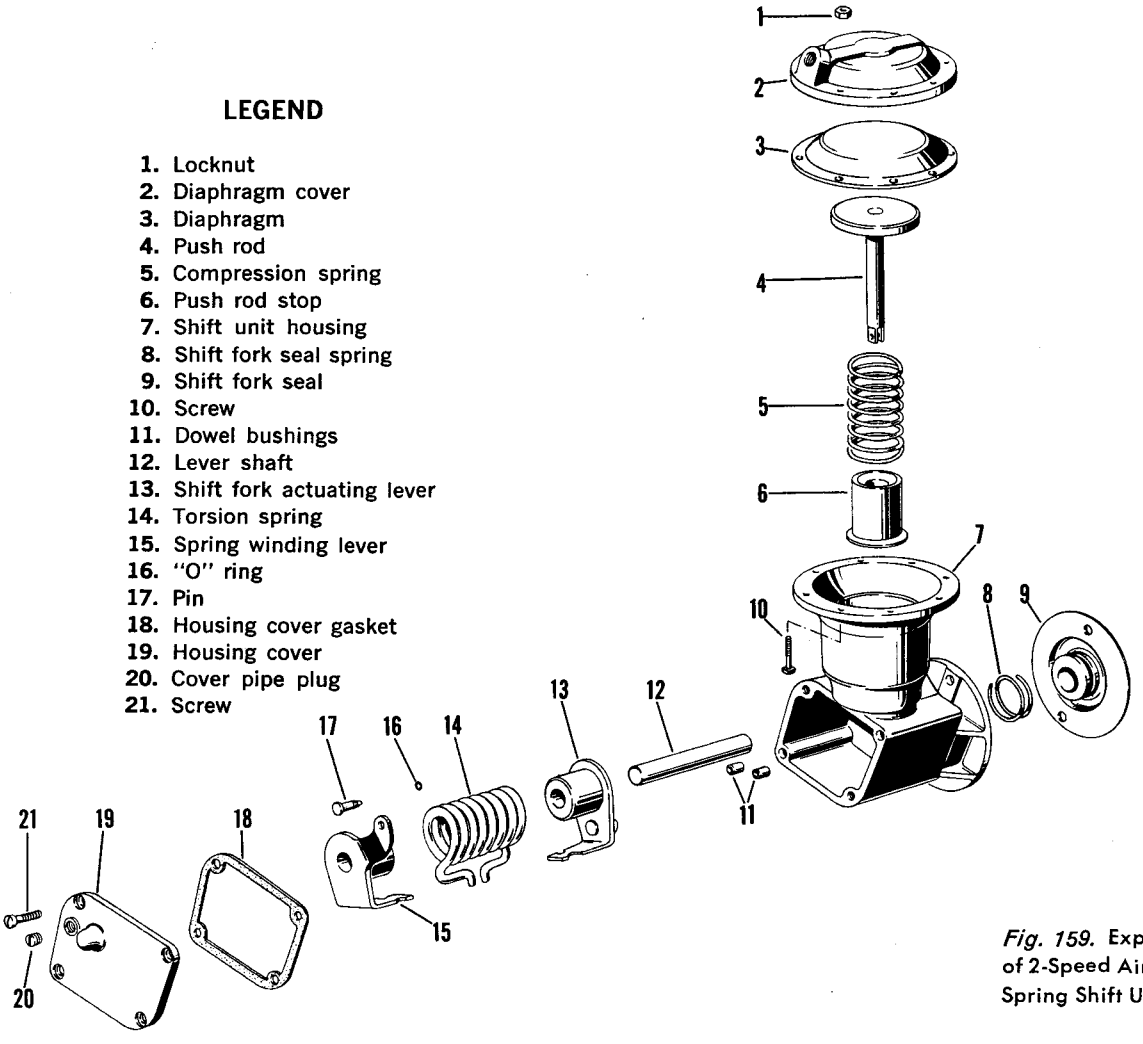


Fig. 159. Exploded View of 2-Speed Air-Torsion Spring Shift Unit

► disassembly of air-torsion spring shift unit

remove air-torsion spring shift unit from differential carrier

1. Disconnect air line connection from shift unit cover. Remove shift unit housing to differential carrier stud nuts. Lift shift unit off studs. Remove shift fork seal and spring.

NOTE: Instructions for disassembly, inspection and reassembly of the 2-Speed shift units are the same as those for the 3-Speed shift units. Refer to pages 87 through 90 for repair instructions.

install air-torsion spring shift unit on differential carrier

1. Place shift fork seal on studs and differential carrier. Install spring on seal.

2. Place shift unit on mounting studs and make certain shift fork actuating lever engages slot in shift fork. Install stud nuts and lockwashers.

3. Connect air line to shift unit cover.

lubrication

Refer to "Lubrication" Section of this manual.

3-SPEED AIR-TORSION SPRING SHIFT SYSTEM

The 3-Speed Axle Shift System instructions include two types of systems: (1). Electric Switch Type, and (2). Low Pressure Switch Type. Unless otherwise specified, the following instructions cover both type systems.

Description and Operation of System Components

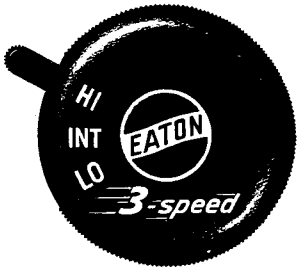


Fig. 160. 3-Speed Control Switch

CONTROL SWITCH

The control switch is a 3-position switch mounted on the gear shift lever and is manually operated by the vehicle driver. The switch controls current flow through the electrical system to operate the speedometer adapters and solenoid valves.

SPEEDOMETER ADAPTERS. Two speedometer adapters are mounted in the system and compensate for drive shaft speed variations between low, intermediate and high axle range. In low range the adapters are unexcited. In intermediate range one adapter is energized to 1:1 ratio while the other adapter is unexcited. In high range both adapters are energized to 1:1 ratio. The above arrangement is accomplished by connecting each adapter in parallel to one of each of the two solenoid valves in the system.

For systems that use the front wheel drive speedometer, the above mentioned speedometer adapters are not required in the electrical system.

WIRING HARNESS AND CIRCUIT BREAKER. Electric wiring in the system is a completely assembled unit including a circuit breaker. Individual wires in the harness are identified by various colors (see figure 161 or 162). The circuit breaker is connected to the wire leading from the power source. If a short circuit occurs, the circuit breaker will open and cut off electrical current to the system.

SOLENOID VALVES. Two solenoid valves provide the link between the electrical control system and the air-torsion spring shift units. When the solenoids are energized, air is allowed to travel to the air shift units and thus shift the axles. When the solenoid valves are de-energized, by movement of the control switch, air pressure supply is shut off allowing the air-torsion spring shift unit to bleed air through the solenoid valve exhaust port. In units with an electric lockout, an additional solenoid valve controls air pressure supply to operate the lockout unit mounted on the power divider.

AIR-TORSION SPRING SHIFT UNIT. The air-torsion spring shift unit is mechanically connected to the axle shift fork and shifts axle. This unit includes an air chamber and a torsion spring drive assembly. A diaphragm, operated by air pressure, moves a push rod. The end of the push rod connects to a spring winding lever. This lever is part of the torsion spring drive assembly, which acts to move shift fork and change axle range as described under System Operation.

3-Speed Air-Torsion Spring Shift System

LOCKOUT FOR ELECTRIC SWITCH TYPE SYSTEM. The electric type lockout consists of two electric switches and a solenoid valve (see fig. 161). One switch is located in vehicle cab and the other is mounted on the forward rear axle shift unit. This type system permits lockout to engage in low range only.

When cab switch is in "Lockout Engaged" position, electrical circuit to 3-speed control switch is opened, rendering control switch inoperative. Also, the electrical circuit to shift unit electric switch is energized but will not close to operate solenoid until axle is in low range. This prevents completion of the electrical circuit to the lockout solenoid valve until the axle is in low range.

LOCKOUT FOR LOW PRESSURE SWITCH TYPE SYSTEM. A low pressure switch is included in this type shift system (see fig. 162). This switch is mounted in lockout valve and prevents the use of the interaxle differential lockout except when the axles are in low ratio. When the lockout is engaged this switch immediately allows the axles to go to low ratio, no matter what range they were in previously. With lockout engaged, the axles cannot be shifted.

►System Operation

OPERATION IN HIGH RANGE. *When shifting from "LO" to "HI" range, both axles are shifted to high range.* Operation is as follows:

When the control switch is moved to "HI" position (high axle range), current to the two solenoid valves allows air to pass from its supply through the valves and be applied to the air shift diaphragm on both forward and rear rear driving axles.

Diaphragm movement operates the push rod on each unit, which, in turn, moves the spring winding levers. The spring winding levers increase the load placed on the torsion springs. When this occurs, the axles are ready to shift to high range. When torque on the gears is relieved by closing and opening the throttle, or declutching, the shift is completed.

When shifting from "INT" to "HI" range, the rear rear axle shifts as described above. Since the forward rear axle is already in high range at the "INT" position, it does not shift.

OPERATION IN INTERMEDIATE RANGE. *When shifting from "HI" to "INT" range, the forward rear axle remains in high range and the rear rear axle shifts to low range.* Operation is as follows:

When the control switch is moved to the "INT" position (intermediate range), the forward rear axle solenoid valve remains open, allowing the shift unit to retain its air. The forward rear axle remains in high range.

The rear rear axle solenoid valve is de-energized, closing off the air supply to the rear rear axle shift unit. Air pressure in the rear rear axle shift unit bleeds back through the solenoid valve and air lines, releasing diaphragm pressure. Push rod moves toward diaphragm, and moves spring winding lever. Additional load is thereby placed on torsion spring, readying the rear rear axle for shift to low range.

Thus, when torque on the gears is relieved, by closing and opening the throttle, or declutching, the rear rear axle is shifted to low range, the forward rear axle remains in high range and the shift to intermediate is complete.

When shifting from "LO" to "INT" range, the rear rear axle remains in low range and the forward rear axle shifts to high range. Operation is as follows:

When the control switch is moved to the "INT" position (intermediate range), the rear rear axle solenoid valve remains closed. The rear rear axle stays in low range.

The forward rear axle solenoid valve is energized and opens. Air passes through the valve and is applied to the air shift diaphragm. Diaphragm movement operates the push rod on the shift unit which, in turn, moves the spring winding lever. The spring winding lever increases the load placed on the torsion springs, readying the forward rear axle for shift to high range.

Thus, when torque on the gears is relieved, by closing and opening the throttle, or declutching, the forward rear axle is shifted to high range, the rear rear axle remains in low range and the shift to intermediate is complete.

OPERATION IN LOW RANGE. *When shifting from "HI" to "LO", both axles are shifted to low range.* Operation is as follows:

When the control switch is moved to "LO" position (low range), both solenoid valves shut off the air supply. Air pressure in the air-torsion spring shift units bleeds back through the solenoid valves and air lines. Pressure on diaphragm is released. Push rod moves toward diaphragm and moves spring winding lever, thereby placing additional load on torsion spring. This readies the axle for shift to low range. When torque on gears is relieved by closing and opening the throttle, or declutching, the shift to low range is complete.

When shifting from "INT" to "LO", the forward rear axle shifts as described above. Since the rear rear axle is already in low range at the "INT" position, it does not shift.

3-Speed Air-Torsion Spring Shift System

Electric Switch Type

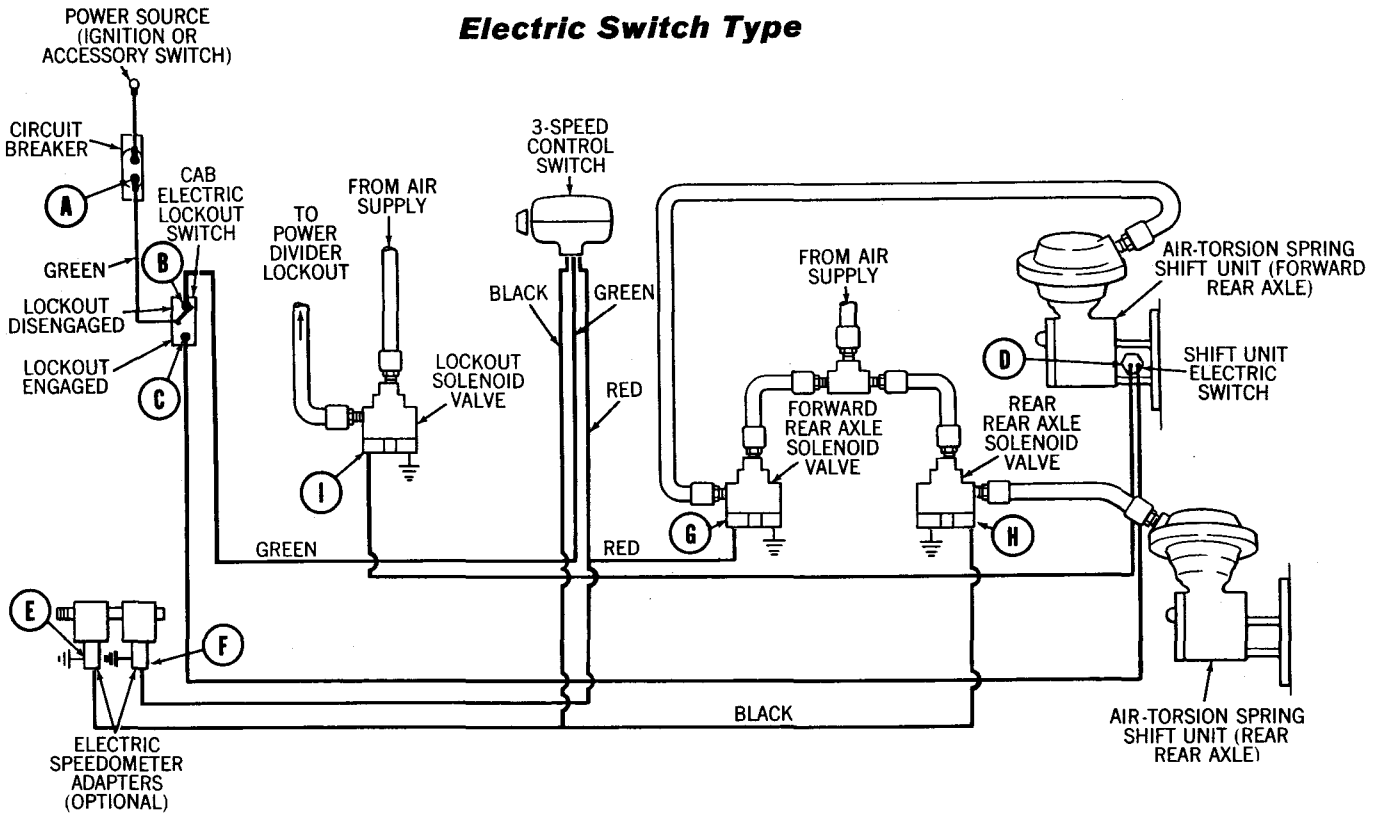


Fig. 161. 3-Speed Air-Torsion Spring Shift System (Electric Switch Type)

► Trouble Shooting

If the axle will not shift, test system and components as follows:

Test lamp (12 volt) should be used at terminal references indicated in Figure 161.

check circuit breaker operation

Disconnect circuit breaker lead wire (Terminal "A"). Connect test lamp across Terminal "A" and ground on vehicle frame. Turn on ignition switch (or accessory switch for diesel engines) and observe test lamp operation:

1. *If lamp lights and stays on continuously,* circuit breaker and lead wire are satisfactory.

2. *If lamp does not light,* check for poor electrical connections or broken lead wire. If lead wire and electrical connections are satisfactory, circuit breaker is faulty.

3. *If lamp does not light immediately then starts to flash on and off* (also a faint clicking of the circuit breaker may be heard), the circuit breaker is faulty.

check cab electric lockout switch

Connect test lamp to cab electric lockout switch terminals "B" and "C" and check as follows: With test lamp connected to Terminal "B", lamp should light when cab switch is in the "Lockout Disengaged" position. If lamp lights, current supply to control switch is satisfactory. Test lamp should go out when cab switch is in "Lockout Engaged" position.

With test lamp connected to Terminal "C", lamp should light when cab switch is in "Lockout Engaged" position. If lamp lights, current supply to the shift unit electric switch is satisfactory. Test lamp should go out with cab switch in "Lockout Disengaged" position. If test indications are as indicated above, cab electric lockout switch operation is satisfactory.

check shift unit electric switch

The shift unit electric switch is open in "HI" or "INT" ranges. The switch closes in "LO" range (with axle and shift unit in low range).

To check shift unit electric switch, disconnect lead wire at Terminal "D". Connect test lamp to Terminal "D" and ground. Place cab electric lockout switch in "Lockout Engaged" position. With axle in "LO" range, lamp should light. Test lamp should not light with axle in "HI" or "INT" ranges. With cab electric switch in "Lockout Disengaged" position, the test lamp should not light regardless of axle range.

3-Speed Air-Torsion Spring Shift System
Electric Switch Type

check control switch and wiring harness

If trouble in control switch or wiring harness is suspected, first check operation of the cab electric lockout switch to make certain current supply to wiring harness is satisfactory. Next, visually check wiring as follows: Check harness for damaged or worn insulation that may cause a ground connection, especially where harness passes through cab floor. Check for short circuits between wire terminals.

If wiring checks out satisfactorily, check control switch. To determine condition of control switch, it is recommended that a new control switch be temporarily installed. However, if desirable, control switch operation may be checked with a test lamp as follows:

NOTE: Under actual installation conditions, lead wires to speedometer adapters could be transposed without affecting operation. However, in the following tests, it is assumed that Terminal "E" lead wire is connected to the black wire leading to the rear rear axle solenoid valve, and Terminal "F" lead wire is connected to the red wire leading to the forward rear axle solenoid valve.

Disconnect lead wires at speedometer adapters Terminals "E" and "F" and at solenoid valves Terminals "G" and "H". Turn ignition switch on and alternately connect test lamp leads to disconnected lead wires. Operate control switch and observe test lamp for the following conditions:

When test lamp is connected to speedometer adapter lead wire (Terminal "E"), lamp should light in *high range* or "HI" position of control switch. Lamp should go out with control switch in "INT" *(intermediate range)* or "LO" *(low range)* position.

When test lamp is connected to speedometer adapter lead wire (Terminal "F"), lamp should light in *high range* or "HI" position and *intermediate range* or "INT" position. Lamp should go out with control switch in "LO" *(low range)* position.

When test lamp is connected to solenoid valve lead wire (Terminal "G"), lamp should light in *intermediate range* or "INT" position and *high range* or "HI" position of control switch. Lamp should go out when control switch is in "LO" position.

When test lamp is connected to solenoid valve lead wire (Terminal "H") lamp should light in *high range* or "HI" position of control switch. Lamp should go out when control switch is in "INT" position or "LO" position of control switch.

If test indications are correct in the above tests, current supply is correct to speedometer adapters and solenoid valves.

If lamp does not light correctly, trouble may be a short circuit in wiring harness or control switch, or a wire in a harness may be broken.

check solenoid valve operation

One solenoid valve is energized to supply air to shift unit in intermediate ("INT") and high ("HI") range. A second solenoid valve is energized to supply air to shift unit in high ("HI") range only. A third solenoid valve operates lockout on power divider. Each valve must have a good ground connection to vehicle frame to operate satisfactorily. Before condemning solenoid valve operation, make certain that ground connection is satisfactory.

To check solenoid valve operation, disconnect lead wires at Terminals "G", "H" and "I", and air lines leading to respective shift unit. Install an air pressure gage in air line opening in solenoid valve. Apply power supply (vehicle voltage) to solenoid valve terminal and observe pressure gage reading. Operating pressure should be approximate reservoir pressure. *If gage indicates approximate reservoir pressure,* solenoid valve operation is satisfactory. *If gage indicates low or no pressure,* solenoid valve is faulty.

check air-torsion spring shift unit operation

If electrical system is functioning properly but axle does not shift satisfactorily, trouble may be caused by a faulty air-torsion spring shift unit. Disassemble and repair a faulty shift unit as indicated on pages 87 through 90.

check speedometer adapter operation

Two speedometer adapters are mounted together with one adapter being energized in high axle range only while the other is energized in intermediate axle range and high axle range. The adapters are grounded through speedometer mounting or speedometer cable and cable housing. Before condemning speedometer adapter operation, make certain that ground connection is satisfactory.

To test speedometer adapter circuit with a test lamp, first disconnect lead wire at Terminal "E". *It is assumed that Terminal "E" lead wire connects to the black wire leading to the rear rear axle solenoid valve.* Connect test lamp to Terminal "E" lead wire and ground on vehicle frame. Turn ignition switch on and observe test lamp operation. The test lamp should light in high range or "HI" position of control switch. Lamp should go out when control switch is placed in "INT" or "LO" position.

To test other speedometer adapter circuit with a test lamp, disconnect lead wire at Terminal "F". *It is assumed that Terminal "F" lead wire connects to the red wire leading to the forward rear axle solenoid valve.* Connect test lamp to Terminal "F" lead wire and ground on vehicle frame. Turn ignition switch on and observe test lamp operation. The test lamp should light in intermediate range or "INT" position and high range or "HI" position of control switch. Lamp should go out when control switch is placed in "LO" position.

If lamp indications are correct, current supply to adapters is correct. If lamp indications are correct and axle shifts normally, but speedometer does not operate properly, replace faulty adapter.

If test lamp indications are not correct, trouble is in wiring harness or control switch.

3-Speed Air-Torsion Spring Shift System

Low Pressure Switch Type

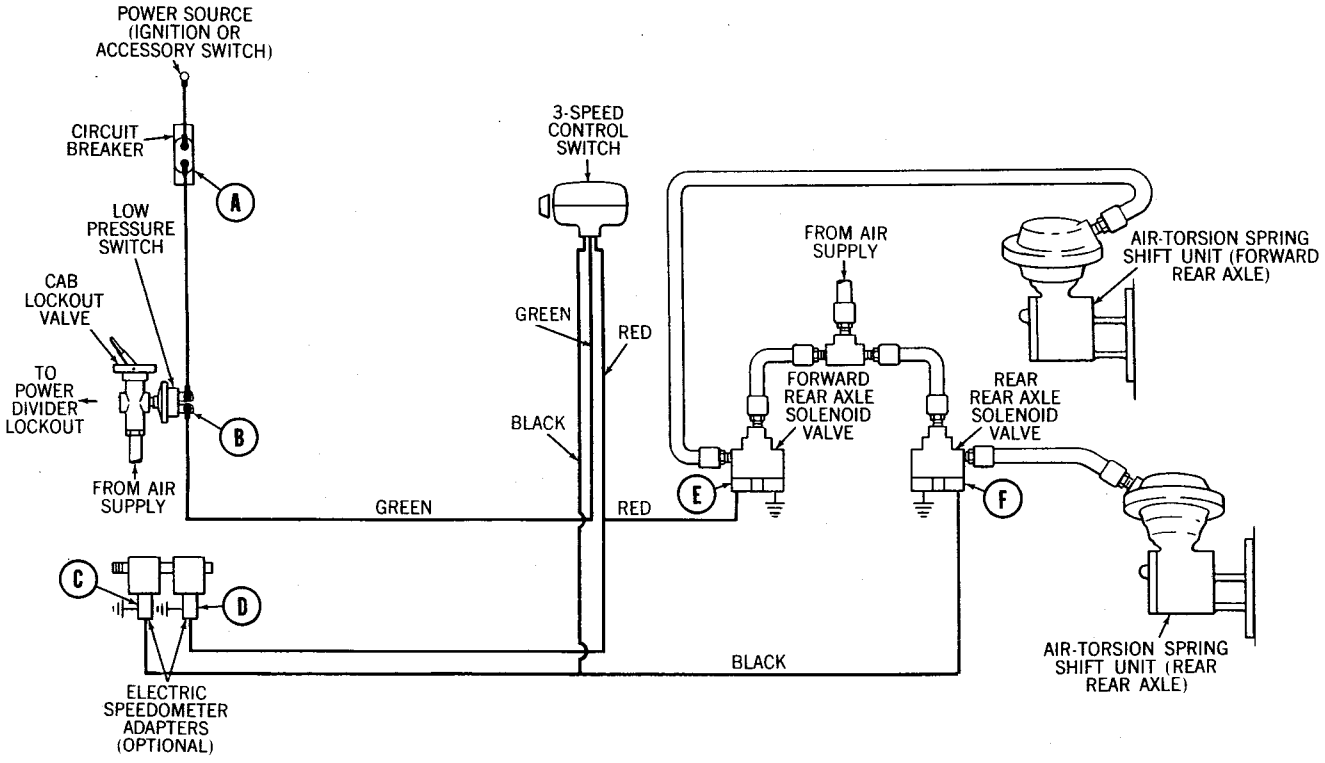


Fig. 162. 3-Speed Air-Torsion Spring Shift System (Low Pressure Switch Type)

►Trouble Shooting

If the axle will not shift, test system and components as follows:

Test lamp (12 volt) should be used at terminal references indicated in Figure 162.

check circuit breaker operation

Disconnect circuit breaker lead wire (Terminal "A"). Connect test lamp across Terminal "A" and ground on vehicle frame. Turn on ignition switch (or accessory switch for diesel engines) and observe test lamp operation:

1. *If lamp lights and stays on continuously,* circuit breaker and lead wire are satisfactory.

2. *If lamp does not light,* check for poor electrical connections or broken lead wire. If lead wire and electrical connections are satisfactory, circuit breaker is faulty.

3. *If lamp does not light immediately then starts to flash on and off* (also a faint clicking of the circuit breaker may be heard), the circuit breaker is faulty.

check low pressure switch

The low pressure switch opens the shift system electrical circuit when the interaxle differential lockout is engaged. Before condemning low pressure switch operation, make certain connections are satisfactory.

To test low pressure switch, place control switch in "HI" position or high axle range. Turn on ignition switch, then engage interaxle differential lockout. Air should bleed from shift system and the axles should shift to low range. If this does not occur, check low pressure switch circuit with a test lamp as follows:

Disconnect lead wire at Terminal "B". Connect test lamp to terminal "B" and ground on vehicle frame. Turn on ignition switch. Place lockout valve in engaged and disengaged positions, and observe test lamp operation.

In the disengaged position, test lamp should light. If lamp does not light, check for poor electrical connection or broken lead wire. If wire and connection are satisfactory, low pressure switch is faulty.

In the engaged position, test lamp should not light. If lamp lights, low pressure switch is faulty.

3-Speed Air-Torsion Spring Shift System

Low Pressure Switch Type

check control switch and wiring harness

If trouble in control switch or wiring harness is suspected, first check operation of the low pressure lockout switch to make certain current supply to wiring harness is satisfactory. Next, visually check wiring as follows: Check harness for damaged or worn insulation that may cause a ground connection, especially where harness passes through cab floor. Check for short circuits between wire terminals.

If wiring checks out satisfactorily, check control switch. To determine condition of control switch, it is recommended that a new control switch be temporarily installed. However, if desirable, control switch operation may be checked with a test lamp as follows:

NOTE: Under actual installation conditions, lead wires to speedometer adapters could be transposed without affecting operation. However, in the following tests, it is assumed that Terminal "C" lead wire is connected to the black wire leading to the rear rear axle solenoid valve, and Terminal "D" lead wire is connected to the red wire leading to the forward rear axle solenoid valve.

Disconnect lead wires at speedometer adapters Terminals "C" and "D" and at solenoid valves Terminals "E" and "F". Turn ignition switch on and alternately connect test lamp leads to disconnected lead wires. Operate control switch and observe test lamp for the following conditions:

When test lamp is connected to speedometer adapter lead wire (Terminal "C"), lamp should light in *high range* or "HI" position of control switch. Lamp should go out with control switch in "INT" *(intermediate range)* or "LO" *(low range)* position.

When test lamp is connected to speedometer adapter lead wire (Terminal "D"), lamp should light in *high range* or "HI" position and *intermediate range* or "INT" position. Lamp should go out with control switch in "LO" *(low range)* position.

When test lamp is connected to solenoid valve lead wire (Terminal "E"), lamp should light in *intermediate range* or "INT" position and *high range* or "HI" position of control switch. Lamp should go out when control switch is in "LO" position.

When test lamp is connected to solenoid valve lead wire (Terminal "F") lamp should light in *high range* or "HI" position of control switch. Lamp should go out when control switch is in "INT" position or "LO" position of control switch.

If test indications are correct in the above tests, current supply is correct to speedometer adapters and solenoid valves.

If lamp does not light correctly, trouble may be a short circuit in wiring harness or control switch, or a wire in a harness may be broken.

check solenoid valve operation

One solenoid valve is energized to supply air to shift unit in intermediate ("INT") and high ("HI") range while the other solenoid valve is energized to supply air to shift unit in high ("HI") range only. Each valve must have a good ground connection to vehicle frame to operate satisfactorily. Before condemning solenoid valve operation, make certain that ground connection is satisfactory.

To check solenoid valve operation, disconnect lead wires at Terminals "E" and "F", and air lines leading to respective shift unit. Install an air pressure gage in air line opening in solenoid valve. Apply power supply (vehicle voltage) to solenoid valve terminal and observe pressure gage reading. Operating pressure should be approximate reservoir pressure. *If gage indicates approximate reservoir pressure,* solenoid valve operation is satisfactory. *If gage indicates low or no pressure,* solenoid valve is faulty.

check air-torsion spring shift unit operation

If electrical system is functioning properly but axle does not shift satisfactorily, trouble may be caused by a faulty air-torsion spring shift unit. Disassemble and repair a faulty shift unit as indicated on pages 87 through 90.

check speedometer adapter operation

Two speedometer adapters are mounted together with one adapter being energized in high axle range only while the other is energized in intermediate axle range and high axle range. The adapters are grounded through speedometer mounting or speedometer cable and cable housing. Before condemning speedometer adapter operation, make certain that ground connection is satisfactory.

To test speedometer adapter circuit with a test lamp, first disconnect lead wire at Terminal "C". *It is assumed that Terminal "C" lead wire connects to the black wire leading to the rear rear axle solenoid valve.* Connect test lamp to Terminal "C" lead wire and ground on vehicle frame. Turn ignition switch on and observe test lamp operation. The test lamp should light in high range or "HI" position of control switch. Lamp should go out when control switch is placed in "INT" or "LO" position.

To test other speedometer adapter circuit with a test lamp, disconnect lead wire at Terminal "D". *It is assumed that Terminal "D" lead wire connects to the red wire leading to the forward rear axle solenoid valve.* Connect test lamp to Terminal "D" lead wire and ground on vehicle frame. Turn ignition switch on and observe test lamp operation. The test lamp should light in intermediate range or "INT" position and high range or "HI" position of control switch. Lamp should go out when control switch is placed in "LO" position.

If lamp indications are correct, current supply to adapters is correct. If lamp indications are correct and axle shifts normally, but speedometer does not operate properly, replace faulty adapter.

If test lamp indications are not correct, trouble is in wiring harness or control switch.

3-Speed Air-Torsion Spring Shift System

►Service and Maintenance

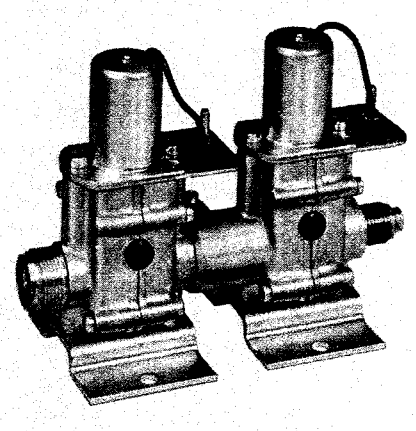


Fig. 163. Speedometer Adapter

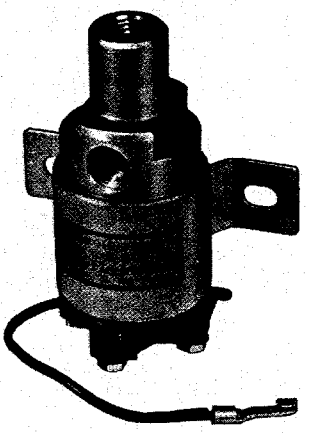


Fig. 164. Solenoid Valve

►speedometer adapter repair

The speedometer adapters are lubricated and sealed for life of the unit. No maintenance is required. Replace a faulty unit. It is not necessary to replace both units if only one has failed.

►solenoid valve repair

Replace solenoid valve as an assembly. The valve should not be serviced.

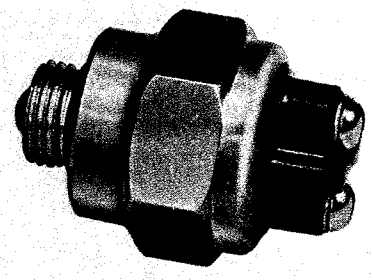


Fig. 165. Electric Lockout Switch

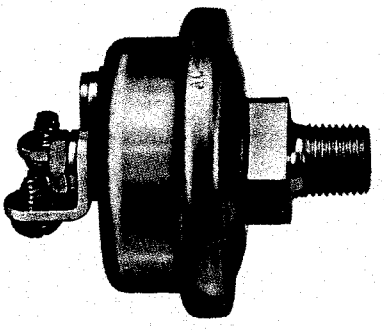


Fig. 166. Low Pressure Switch

electric switch type system

►electric lockout switch repair (at shift unit)

Replace lockout switch as an assembly.

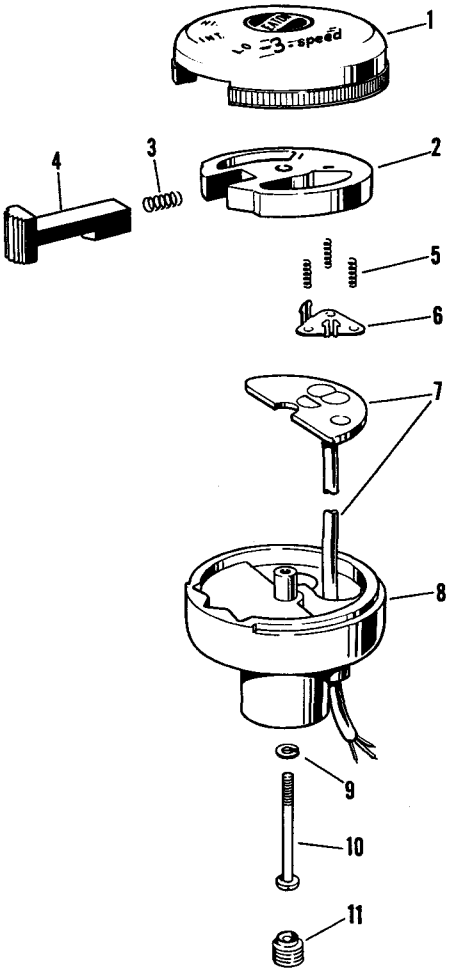
low pressure switch type system

►low pressure switch repair

Replace low pressure switch as an assembly. The switch is a sealed unit and cannot be serviced.

3-Speed Air-Torsion Spring Shift System

► control switch repair



LEGEND

1. Cover
2. Actuating plate
3. Shifter knob spring
4. Shifter knob
5. Contact springs
6. Sliding contact
7. Insulator, contacts and wiring harness assembly
8. Base plate
9. Lockwasher
10. Screw
11. Jam nut

Fig. 167. Exploded view of 3-Speed Control Switch

► disassembly of control switch

remove control switch

1. Disconnect wires at end of control switch wiring harness. Unscrew switch from gear shift lever.

disassemble control switch

1. Remove jam nut and screw from mounting side of switch then lift off cover, actuating plate, shifter knob, knob spring, contact springs and contact.

2. Remove insulator, contacts and wiring harness assembly from base plate.

3-Speed Air-Torsion Spring Shift System

► inspection

Inspect all parts for cracks or damage. Inspect contacts for burned or corroded condition. Check for faulty wiring connections. Replace individual parts if they are faulty. Replace insulator, contacts and wiring harness as an assembly.

► reassembly of control switch

assemble control switch

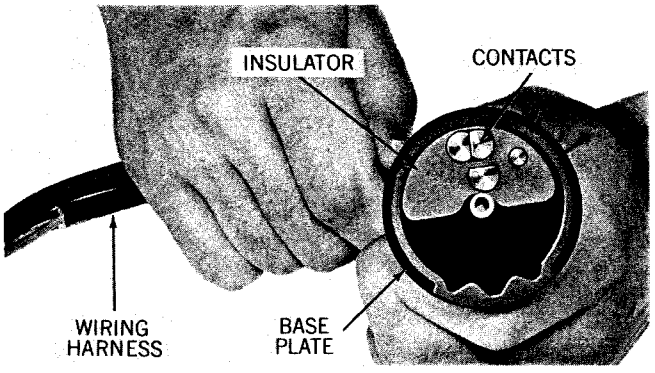


Fig. 168

1. Pass wiring harness through base plate, positioning insulator in recessed area of base plate.

At this point in reassembly, lubricate switch as follows: Lightly coat contacts and pivot hub (at center of base plate) with non-melting silicone grease.

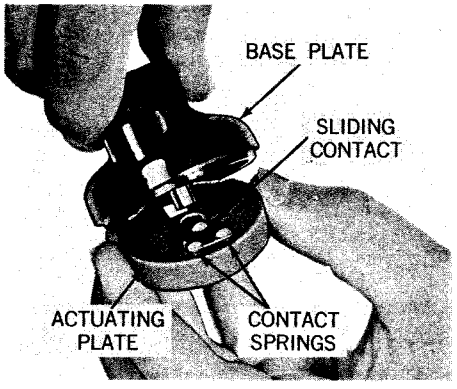


Fig. 169

2. Hold actuating plate (top side down) in one hand and install three springs and sliding contact in correct mounting position. Place base plate over actuating plate with the other hand.

3. Hold actuating plate and base plate together with one hand then install spring and shifter knob.

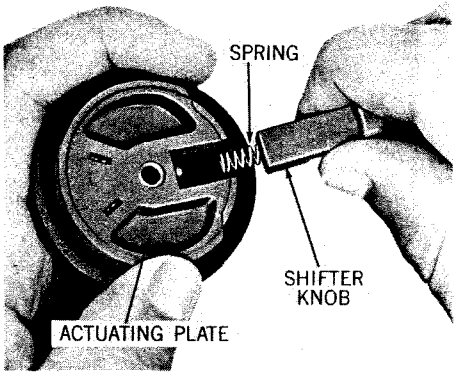


Fig. 170

4. Continue to hold actuating plate in mounting position and install cover. Fasten cover to base plate with lockwasher and screw. Install jam nut.

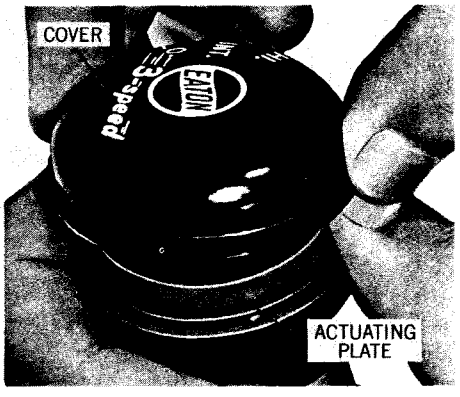


Fig. 171

install control switch

1. Thread control switch assembly on gear shift lever. Connect wiring harness (see Fig. 161 or 162).

3-Speed Air-Torsion Spring Shift System

► air-torsion spring shift unit repair

Fig. 172 illustrates shift units for the 3-Speed Tandem Drive Axle. The unit on the left is for the forward rear axle and the unit on the right is for the rear rear axle. *If system is equipped with electric lockout, the shift unit for forward rear axle incorporates an electric switch.* The following service procedures are the same for all shift units unless specified otherwise.

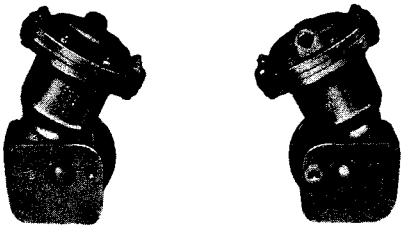


Fig. 172. 3-Speed Air-Torsion Spring Shift Units

LEGEND

1. Locknut
2. Diaphragm cover
3. Diaphragm
4. Push rod
5. Compression spring
6. Push rod stop
7. Shift unit housing
8. Shift fork seal spring
9. Shift fork seal
10. Screw
11. Switch (electric switch type system)
12. "O" ring (electric switch type system)
13. Dowel bushings
14. Lever shaft
15. Shift fork actuating lever (electric switch type system)

15A. Shift fork actuating lever (low pressure switch type system)

16. Torsion spring
17. Spring winding lever
18. "O" ring
19. Pin
20. Housing cover gasket
21. Housing cover
22. Oil level plug
23. Screw

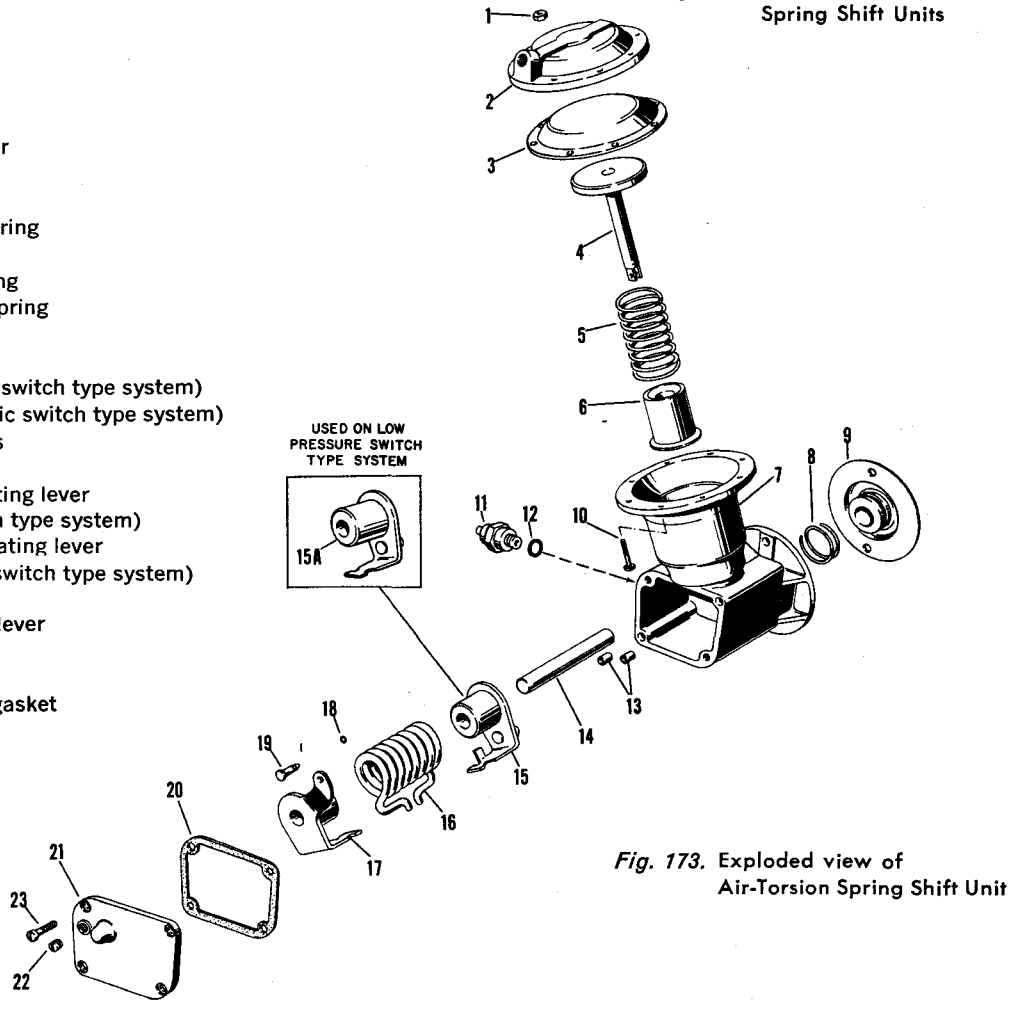


Fig. 173. Exploded view of Air-Torsion Spring Shift Unit

► disassembly of air-torsion spring shift unit

remove air-torsion spring shift unit from differential carrier

1. Disconnect air line connection from shift unit cover *(when equipped with electric lockout disconnect wires at switch).* Remove shift unit housing to differential carrier stud nuts. Lift shift unit off studs. Remove shift fork seal and spring.

EATON TRUCK AXLES

3-Speed Air-Torsion Spring Shift System

disassemble air-torsion spring shift unit

Shift unit need not be completely disassembled to replace torsion spring drive assembly. Air pressure applied to opening in diaphragm cover will move push rod sufficiently to remove or install the pin which connects push rod to spring winding lever.

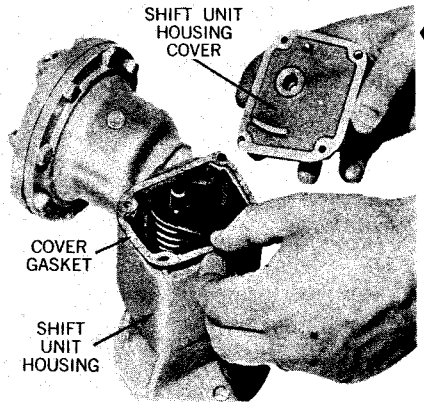


Fig. 174.

1. Remove screws, housing cover and cover gasket from shift unit housing. Drain lubricant.

2. Remove screws, diaphragm cover and diaphragm from shift unit housing.

When equipped with electric lockout, unscrew switch and "O" ring from housing.

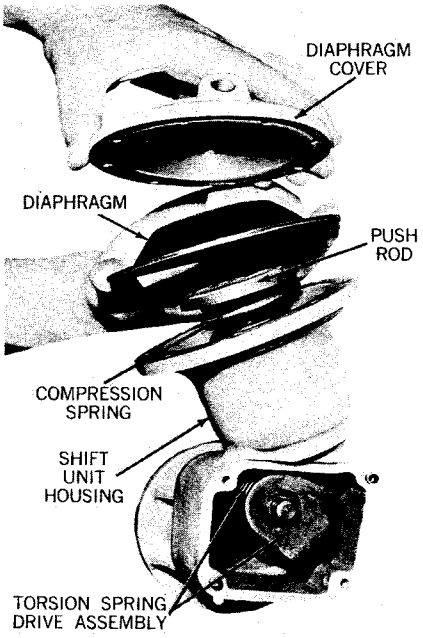
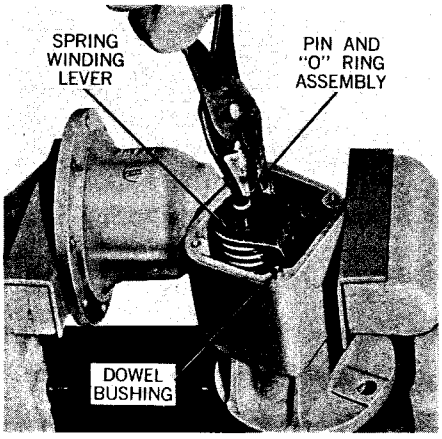


Fig. 175



3. Place housing assembly in vise, positioned as shown in figure 176. Compress spring until pin, which connects push rod and spring winding lever together, can be removed. Remove pin and "O" ring assembly.

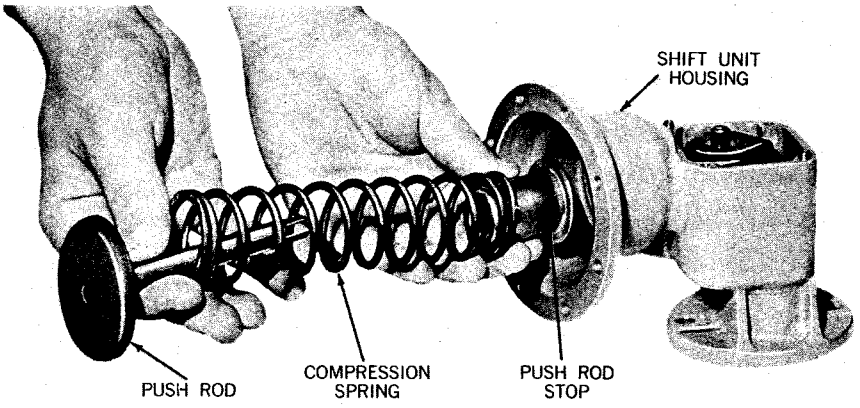
CAUTION: *Carefully open vise until tension on compression spring is completely relieved.*

Remove housing assembly from vise.

Fig. 176.

4. Remove push rod, compression spring and push rod stop from shift unit housing.

Fig. 177.



3-Speed Air-Torsion Spring Shift System

disassemble air-torsion spring shift unit (continued)

5. Remove lever shaft, then lift torsion spring drive assembly from shift unit housing. *Do not disassemble these parts unless replacement is necessary.*

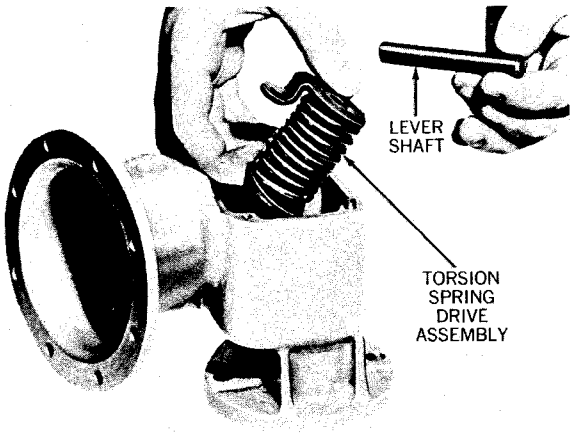
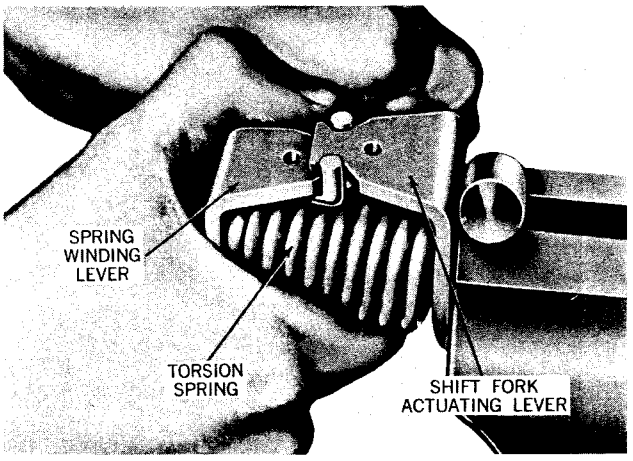


Fig. 178.

disassemble torsion spring drive

1. If disassembly is necessary, insert lever shaft in torsion spring drive assembly. Clamp lever shaft in vise jaws. Turn spring winding lever and pull to disengage end of torsion spring from shift fork actuating lever. Components can now be disassembled.

Fig. 179.



► inspection

SHIFT FORK SEAL. Inspect shift fork seal for good condition and tight fit on shift fork. A spring is used to assure a closer fit of seal around shift fork. *If this spring is not present on axle being serviced, install one when reassembling unit.*

DIAPHRAGM. Inspect shift unit diaphragm for good condition. Make certain that it is not cracked, torn or deteriorated.

PUSH ROD, SPRING WINDING LEVER AND PIN. Inspect push rod and spring winding lever for worn or elongated holes at the point where they are connected together. Also inspect pin for worn or grooved condition. Check spring winding lever for broken welds. Replace faulty parts.

TORSION SPRING. Inspect spring for distortion or other visual defects. Replace a faulty spring.

SHIFT FORK ACTUATING LEVER. Inspect lever for broken welds or other defects. Replace a faulty lever.

3-Speed Air-Torsion Spring Shift System

► reassembly of air-torsion spring shift unit

assemble torsion spring drive.

1. Clamp end of lever shaft in vise jaws. Position shift fork actuating lever, torsion spring and spring winding lever on shaft as shown in figure 180. Grasp spring winding lever by hand, turn lever and push until end of torsion spring engages shift fork actuating lever.

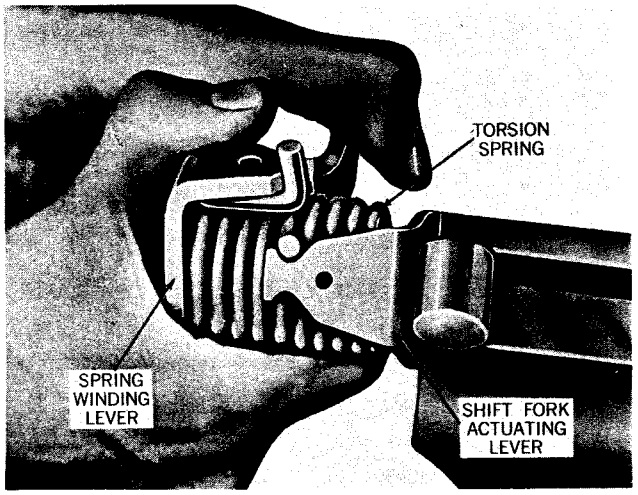


Fig. 180. Assembling Levers and Torsion Spring

assemble air-torsion spring shift unit.

1. Place torsion spring drive assembly in shift unit housing. Insert lever shaft through torsion spring drive assembly and into hole provided in housing.

2. Place push rod stop, compression spring and push rod in shift unit housing. Place housing assembly in vise, positioned as shown in figure 176. Close vise to compress spring until pin can be installed to connect push rod to spring winding lever. Install "O" ring on pin, then insert pin assembly in openings provided in spring winding lever and push rod end. Remove housing assembly from vise.

3. Place diaphragm and cover on shift unit housing and secure with screws and locknuts. Tighten locknuts to torque of 50 to 60 in.-lbs. After initial torquing, recheck torque and, if necessary, retighten until torque of 50 to 60 in.-lbs. is permanently maintained.

4. Install dowel bushings (if removed), gasket and housing cover on shift unit housing. Secure cover with screws. Tighten screws to torque of 35 to 40 in.-lbs.

When equipped with electric lockout, install switch and "O" ring in housing.

install air-torsion spring shift unit on differential carrier.

1. Place shift fork seal on studs and differential carrier. Install spring on seal.

2. Place shift unit on mounting studs and make certain shift fork actuating lever engages slot in shift fork. Install stud nuts and lockwashers.

3. Connect air line to shift unit cover. *(When equipped with electric lockout, connect wiring to switch).*

lubrication

Refer to "Lubrication" Section of this manual.

► ELECTRIC SHIFT SYSTEM

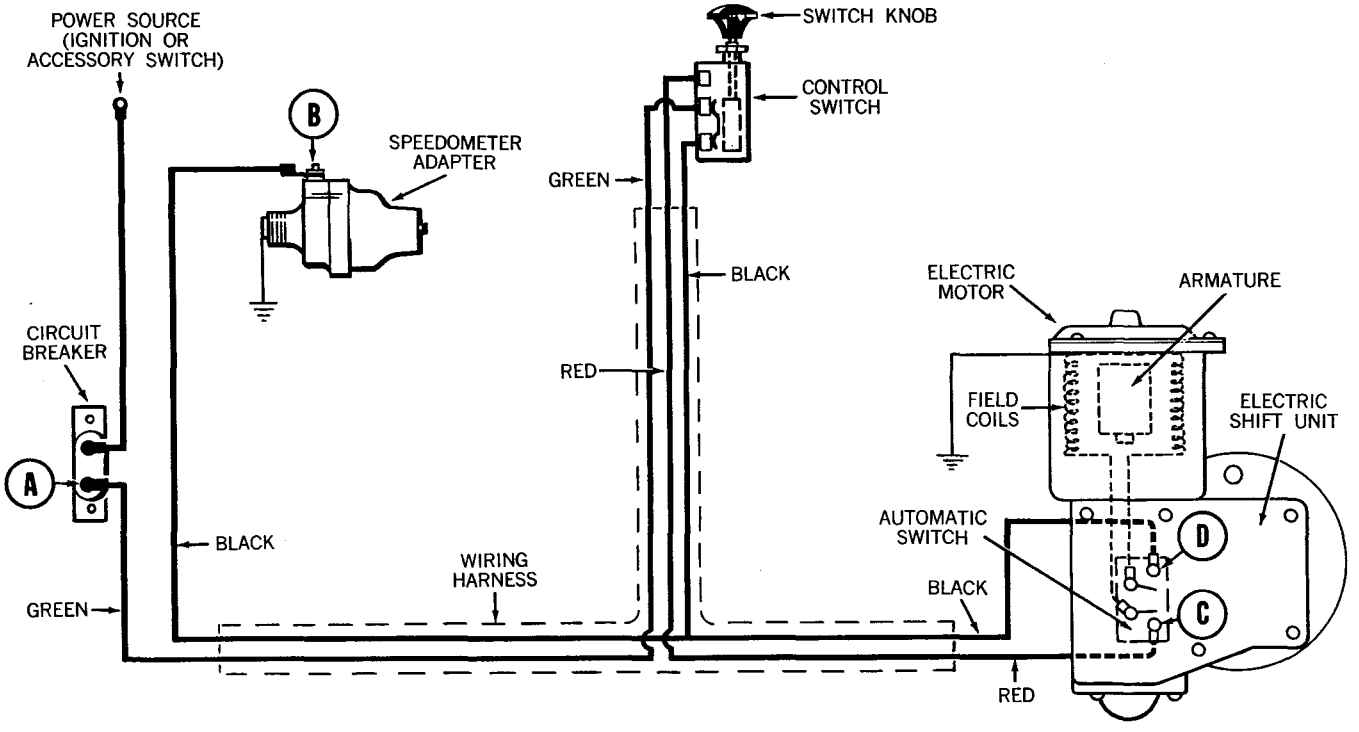


Fig. 181. Electric Shift System

►Description and Operation of System Components

CONTROL SWITCH. The control switch is of the push-pull type and is manually-operated by the vehicle driver. This switch controls current flow through the electrical system to operate speedometer adapter and electric motor.

SPEEDOMETER ADAPTER. The speedometer adapter compensates for drive shaft speed variations between high and low axle ratios. A spring holds adapter in high range position and an electromagnet holds adapter in low range position.

WIRING HARNESS AND CIRCUIT BREAKER. Electric wiring in the system is a completely assembled unit including a circuit breaker. Individual wires in the harness are identified by various colors (see figure 181).

The circuit breaker is connected in the wire leading from the power source. If a short circuit occurs, the circuit breaker will open and cut off electrical current to the system.

ELECTRIC SHIFT UNIT. The electric shift unit is mechanically connected to the axle shift fork and shifts axle into low or high range. The shift unit consists of a reversible electric motor, automatic switch, drive screw assembly and a torsion spring drive.

In operation, the automatic switch starts and stops motor as required. The motor rotates a drive screw which, in turn, causes a drive nut to travel the length of the drive screw. This drive nut operates the torsion spring drive which, in turn, provides tension required to move shift fork and change axle range.

Electric Shift System

► System Operation

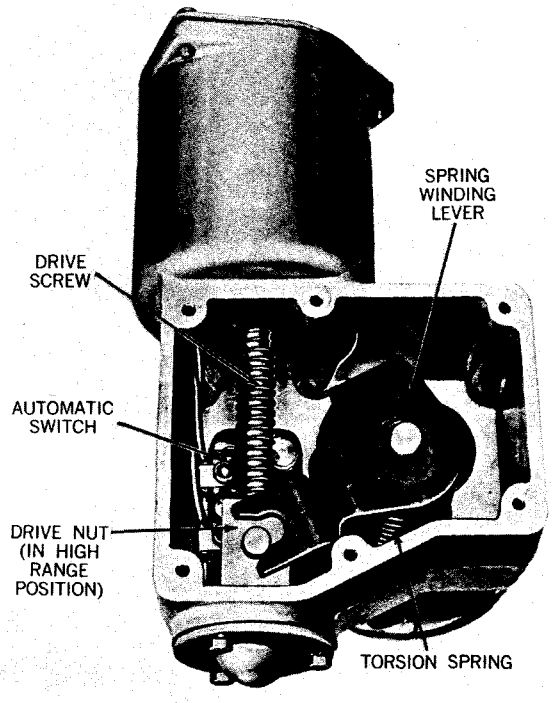


Fig. 182. Electric Shift Unit in High Range Position

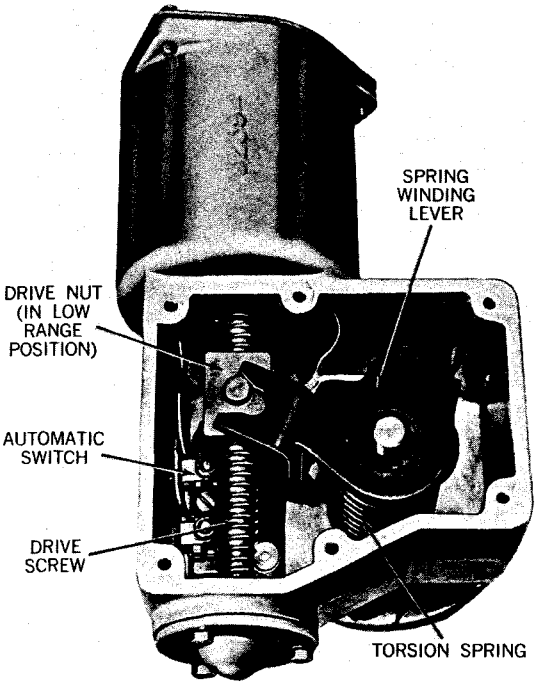


Fig. 183. Electric Shift Unit in Low Range Position

OPERATION IN HIGH RANGE. Figure 182 illustrates electric shift unit in high range operating position.

With control switch knob pulled up, the motor operates to rotate armature and drive screw in a clockwise direction and moves the drive nut down.

When the drive nut has traveled a sufficient distance to wind the torsion spring, a contact bumper *(on the drive nut)* breaks electrical connection on the automatic switch which, in turn, stops the motor. *To make certain that vibration does not move nut, a ball screw detent spring holds nut at the end of its travel on the screw.*

The drive nut moves the spring winding lever down which, in turn, winds the torsion spring. Thus, an increased load is placed on the spring and, in this position, the axle is ready to shift into high range as soon as the load (torque) on the axle is relieved by opening and closing the throttle or declutching.

The torsion spring is assembled under a preload of 50 to 80 pounds pressure. When the spring winding lever is moved so that spring is wound, the pressure is increased to 90 to 135 pounds.

This additional spring load is used to shift the axle and when shift is completed, the initial 50 to 80 lbs. preload again becomes effective and holds the axle in high range.

OPERATION IN LOW RANGE. When control switch knob is pushed down, the motor rotates to operate armature and drive screw in a counter-clockwise direction. The drive nut travels to the top of the drive screw (see fig. 183) thus winding the torsion spring for a shift to low range in the same manner as described for high range.

Electric Shift System

►Trouble Shooting

If axle will not shift, test system and components as follows:

Test lamp voltage should be same as system rated voltage. Refer to figure 181 for terminal references.

check circuit breaker operation

Disconnect circuit breaker lead wire (Terminal "A"). Connect test lamp across Terminal "A" and ground on vehicle frame. Turn on ignition switch (or accessory switch for diesel engines) and observe test lamp operation:

1. *If lamp lights and stays on continuously,* circuit breaker and lead wire are satisfactory.

2. *If lamp does not light,* check for poor electrical connections or broken lead wire. If lead wire and electrical connections are satisfactory, circuit breaker is faulty.

3. *If lamp does not light immediately then starts to flash on and off* (also a faint clicking of the circuit breaker may be heard), the circuit breaker is faulty.

check control switch and wiring harness

If trouble in control switch or wiring harness is suspected, visually check as follows: Check harness for damaged or worn insulation that may cause a ground connection, especially where harness passes through cab floor. Check for accidental grounding of wire terminals to metal box at transmission lever. Check for short circuits between wire terminals.

To determine condition of control switch, it is recommended that a new control switch be temporarily installed. However, if desirable, control switch operation may be checked with test lamp as follows:

Disconnect lead wires at speedometer adapter Terminal "B" and at shift unit Terminals "C" and "D". Turn ignition switch on and alternately connect test lamp leads to disconnected lead wires. Operate control switch and observe test lamp for the following conditions:

When test lamp is connected to the shift unit *red* wire, lamp should light in *high range* or *up* position of control switch. Lamp should go out when control switch is in *down* position.

When test lamp is connected to shift unit *black* wire, lamp should light in *low range* or *down* position of control switch. Lamp should go out when control switch is in *up* position.

If test lamp indications are correct in the above tests, current supply is correct to shift unit.

If lamp does not light correctly, trouble may be a short circuit in wiring harness or control switch, or a wire may be broken. Plug assembly in wiring harness may also be faulty.

When test lamp is connected to speedometer adapter lead wire (Terminal "B"), lamp should light in *low range* or *down* position of control switch. Lamp should go out with control switch in *up* position.

If test lamp indications are correct in above tests, current supply is correct to speedometer adapter.

If lamp does not light correctly, trouble may be a short circuit in wiring harness or control switch, or a wire in harness may be broken.

check electric shift unit

If electrical system is satisfactory, trouble may be in shift unit or electric motor. Disassemble shift unit, test motor and repair as indicated on page 95.

check speedometer adapter operation

The speedometer adapter is energized in low axle range only. The adapter is grounded through speedometer mounting or speedometer cable and cable housing. Before condemning speedometer adapter operation, make certain that ground connection is satisfactory.

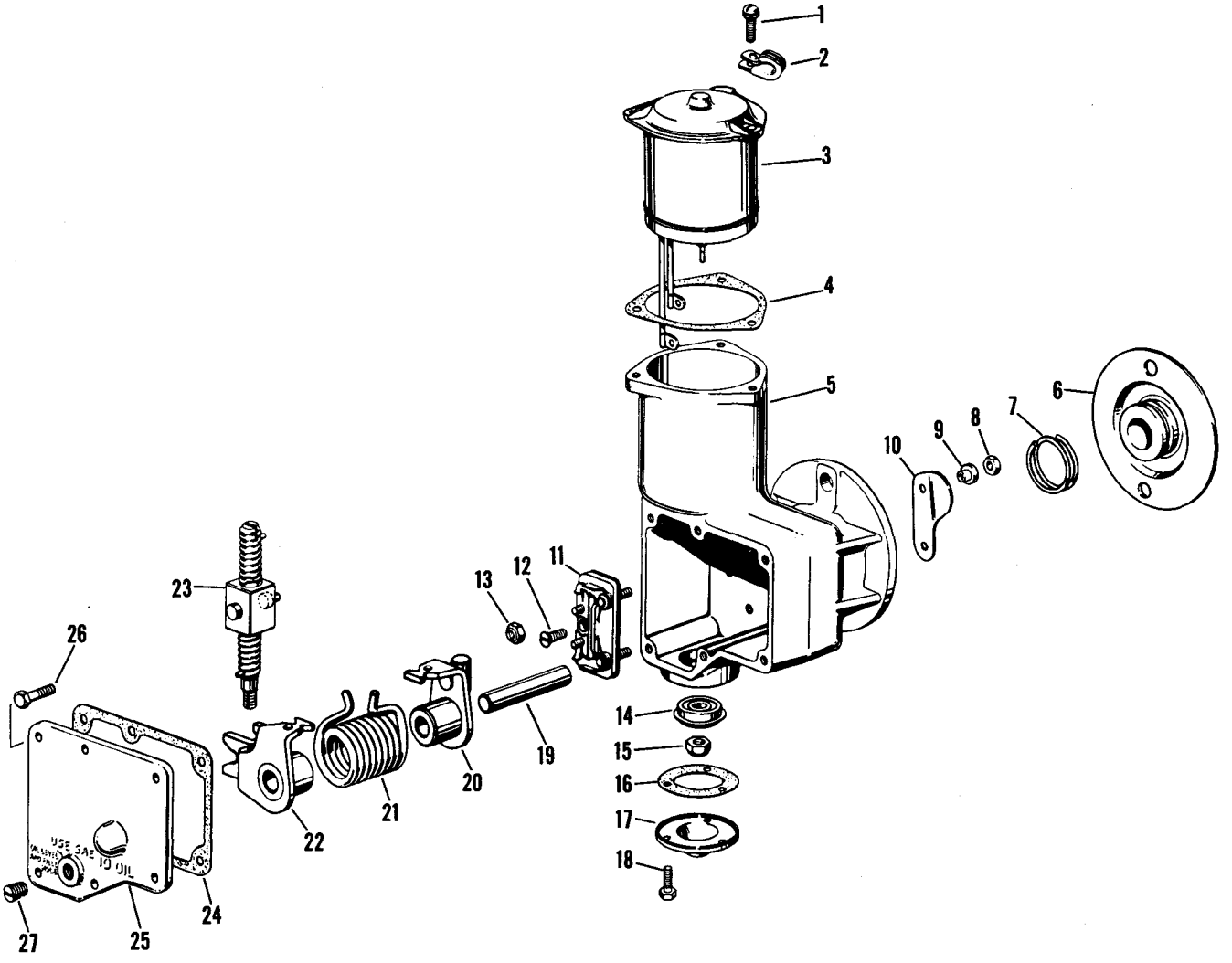
To test speedometer adapter circuit with a test lamp, disconnect lead wire at Terminal "B". Connect test lamp to Terminal "B" lead wire and ground on vehicle frame. Turn ignition switch on and observe test lamp operation.

The test lamp should light in *low range* or *down* position of control switch. Lamp should go out when control switch is placed in *up* position.

If lamp indications are correct, current supply to adapter is correct. *If lamp indications are correct and axle shifts normally,* but speedometer does not operate properly, replace adapter.

If test lamp indications are not correct, the trouble is in the wiring harness or control switch.

Electric Shift System



LEGEND

1. Screw
2. Motor cable clip
3. Motor assembly
4. Motor gasket
5. Shift unit housing
6. Shift fork seal
7. Shift fork seal spring
8. Locknut
9. Insulator bushing
10. Insulator
11. Automatic switch
12. Screw
13. Terminal locknut
14. Drive screw bearing
15. Locknut
16. Bearing cover gasket
17. Bearing cover
18. Cap Screw
19. Lever shaft
20. Shift fork actuating lever
21. Torsion spring
22. Spring winding lever
23. Drive screw assembly
24. Housing cover gasket
25. Shift unit housing cover
26. Cap Screw
27. Cover pipe plug

Fig. 184. Exploded View of Electric Shift Unit

Electric Shift System

► Service and Maintenance

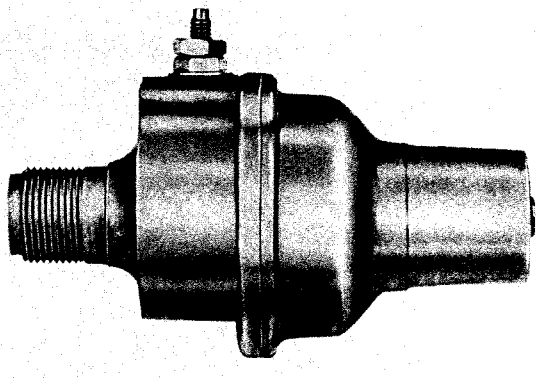


Fig. 185. Speedometer Adapter

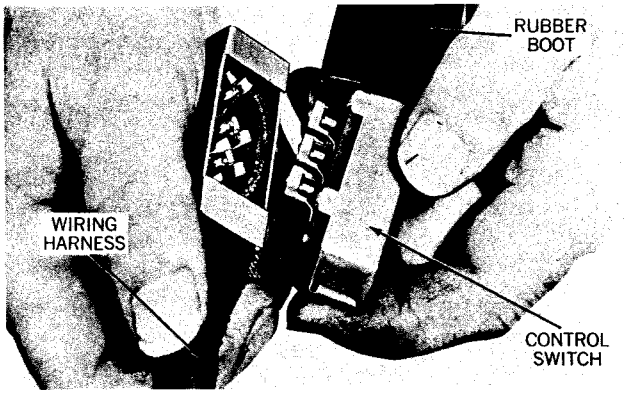


Fig. 186. Removing Control Switch

► speedometer adapter repair

The speedometer adapter is lubricated and sealed for life of the unit. No maintenance is required. Replace a faulty unit.

► control switch repair

For inspection or replacement, the control switch can easily be removed by sliding the rubber boot up to the knob, then separate switch from harness (see fig. 186).

Inspect switch for loose connections and other visual defects that may cause short circuit or electrical failure. Replace a faulty switch as an assembly.

► electric shift unit repair

► disassembly of electric shift unit

remove electric shift unit from differential carrier.

1. Remove shift unit housing to differential carrier stud nuts and lockwashers. Lift shift unit off studs and disconnect electric wires. Remove shift fork seal and spring.

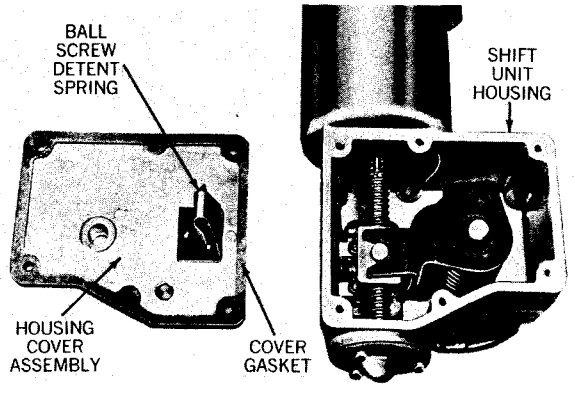


Fig. 187.

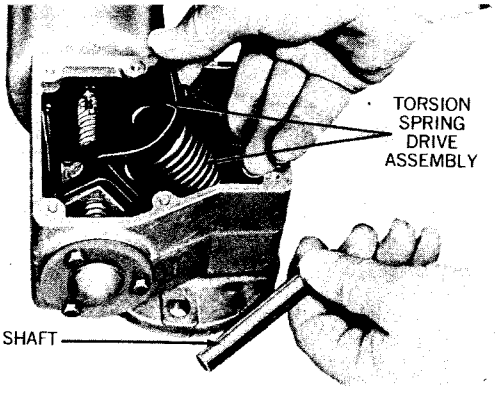


Fig. 188.

disassemble electric shift unit

1. Remove screws, then remove housing cover assembly and drain lubricant. Discard cover gasket.

2. Turn drive screw to position drive nut at center of screw. *This procedure is necessary to prevent damage to drive nut contact bumper during disassembly.* Pull out lever shaft and remove torsion spring drive assembly. *Do not disassemble these parts unless replacement is necessary.*

Electric Shift System

disassemble electric shift unit (continued)

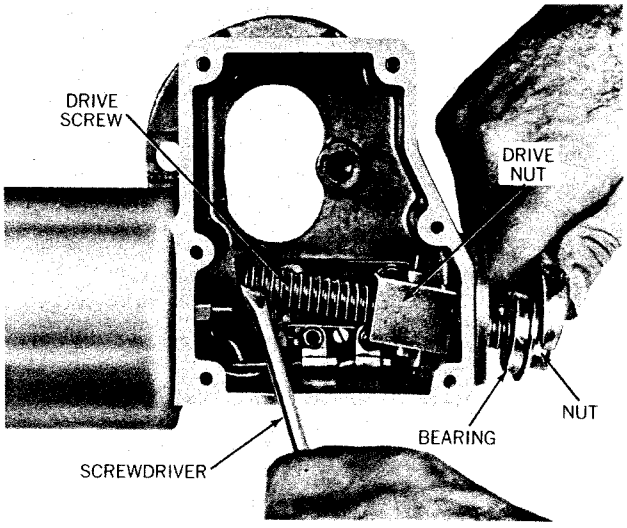


Fig. 189.

3. Remove screws and bearing cover from shift unit housing. Push drive screw toward bearing until bearing is free of housing. Hold drive screw by inserting screwdriver in drive slot then remove nut and bearing. Remove drive screw assembly from housing.

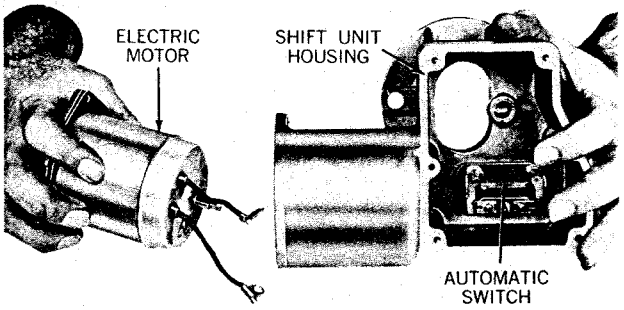


Fig. 190.

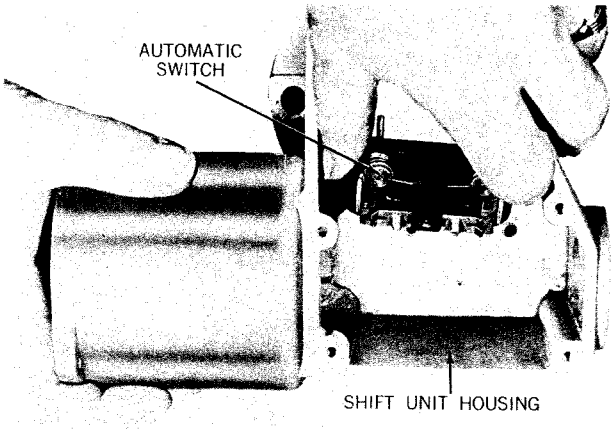


Fig. 191.

4. Remove locknuts to disconnect motor leads from automatic switch. Remove screws, cable clip and motor assembly from shift unit housing. *Do not under any conditions immerse motor assembly in cleaning solutions.*

5. Remove locknuts, insulator and insulator bushings (some shift units use fibre washers and insulator bushings) from automatic switch mounting studs. Remove screw from center of automatic switch then remove switch assembly from housing.

disassemble torsion spring drive.

1. If disassembly is necessary, insert lever shaft in torsion spring drive assembly. Clamp lever shaft in vise jaws. Turn spring winding lever and pull to disengage end of torsion spring from shift fork actuating lever. Components can now be disassembled.

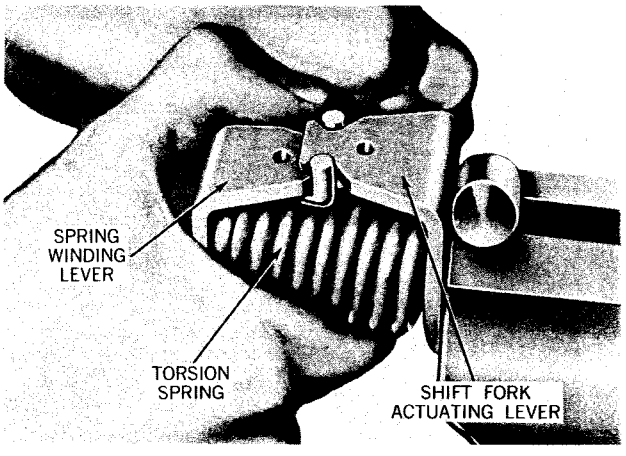


Fig. 192.

Electric Shift System

► inspection

AUTOMATIC SWITCH. Inspect switch for free movement of contacts. Contacts should close firmly and under spring tension. Replace a faulty switch as an assembly.

DRIVE SCREW ASSEMBLY. Check drive screw for turning freely in nut by hand. When nut has reached end of screw, screw should continue to turn and nut should not jam or run off end of screw. Rotate screw in opposite direction to see that nut moves to other end of screw and stops, without binding. The contact bumper mounted in the nut should be a press fit. If any part of drive screw assembly, except contact bumper, is faulty, replace drive screw assembly. The contact bumper can be replaced as an individual part.

TORSION SPRING DRIVE ASSEMBLY. Inspect levers for broken welds and torsion spring for distortion (see Torsion Spring Color Code Chart, page 98). Also visually inspect complete drive for defects that may cause faulty operation. Replace faulty parts.

SHIFT FORK SEAL. Inspect shift fork seal for good condition and tight fit on shift fork. A spring is used to assure a closer fit of seal around shift fork. *If this spring is not present on axle being serviced, install one when reassembling unit.*

ELECTRIC MOTOR. The motor is lubricated and sealed for life. No maintenance or lubrication is required. Replace faulty motor as a complete assembly. If faulty motor is suspected, check free running operation and torque as follows:

Operate motor at rated voltage and speeds indicated in Test Table and note current draw. If motor will not rotate at speeds indicated or current draw is excessive, replace motor.

Do not overheat motor during the following torque test. If free-running test is satisfactory check as follows:

For checking dead spots, clamp motor in a vise and place a small crescent wrench on rectangular end of armature shaft. Apply rated voltage to operate motor while holding crescent wrench by hand. Allow wrench to turn slowly, making sure that torque is present the full 360 degree turn of the wrench. If part of the armature winding is faulty, the torque will not be present for part of the 360 degree turn. This condition indicates a dead spot in the motor. Replace a faulty motor as an assembly.

► electric shift motor test specifications

The following are the electric shift motor test specifications for free running and loading conditions:

MOTOR FREE RUNNING TEST

SET		READ	
Motor Rated Voltage (volts)	Test Voltage (volts)	Speed (Min. rpm)	Current (Max. amps.)
6	6	10,000	11.5
12	12	10,000	8.0
24	24	10,000	6.0

MOTOR TORQUE TEST

SET		READ	
Motor Rated Voltage (volts)	Test Voltage (volts)	Torque (Min. in.-lbs.)	Current (Min. amps.)
6	6	6	85
12	12	6	42
24	24	6	32

Electric Shift System

► reassembly of electric shift unit

assemble torsion spring drive

1. Clamp end of lever shaft in vise jaws. Position shift fork actuating lever, torsion spring and spring winding lever on shaft as shown in figure 193. Grasp spring winding lever by hand, turn lever and push until end of torsion spring engages shift fork actuating lever.

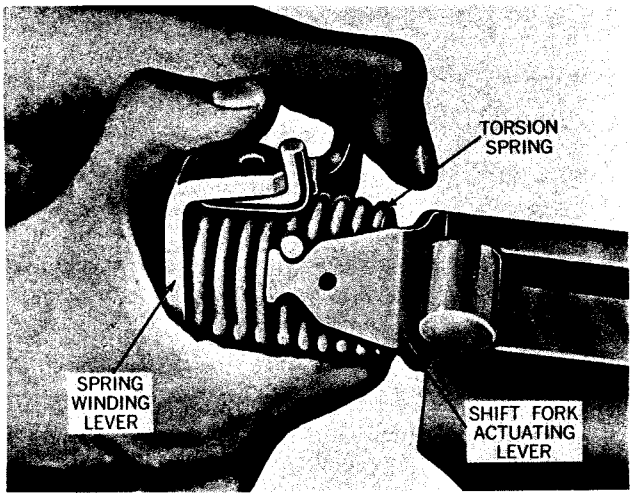


Fig. 193. Assembling Torsion Spring Drive

TORSION SPRING COLOR CODE CHART

13-16 Series — Black Stripe
17, 18, 19, 20 Series — Red Stripe
22 Series — Green Stripe

assemble electric shift unit.

1. Position automatic switch in shift unit housing and install screw at center of switch. Install insulator bushings *(some shift units use fibre washer and insulator bushings)*, insulator and locknuts on switch mounting studs.

2. Place gasket and electric motor in shift unit housing. Install screws, placing motor cable clip under one of the mounting screws.

3. Connect motor leads to automatic switch terminals and install locknuts.

4. Position drive screw assembly in shift unit housing to permit installation of bearing. Install bearing and locknut on end of drive screw. When tightening locknut, hold drive screw by placing screwdriver blade in drive slot. Position drive screw to engage drive slot with motor armature shaft and place bearing in housing. *Make certain bearing is properly seated in bearing bore.* Install gasket and bearing cover then install screws.

Be sure that contact bumper on nut is toward switch and position drive nut at center of drive screw, then install torsion spring drive assembly as follows:

5. Place torsion spring drive assembly in housing. Engage spring winding lever with pin at center of drive nut and install lever shaft.

6. Install gasket, housing cover and screws.

install electric shift unit on differential carrier.

1. Place shift fork seal on studs and differential carrier. Install spring on seal.

2. Connect electric wires to shift unit terminals *(long or red wire connects to bottom terminal).*

3. Place shift unit on mounting studs and make certain shift fork actuating lever engages slot in shift fork. Install stud nuts and lockwashers.

electric shift unit lubrication

Refer to "Lubrication" Section of this manual.

► INSPECTION AND FAILURE ANALYSIS OF EATON REAR AXLE PARTS

This section, basically compiled from actual case histories, describes some of the common types of rear axle failures and their causes. The unretouched photos illustrate conditions that occurred under actual vehicle operation or situations simulated by testing dynamometers in the Axle Division of Eaton Manufacturing Company.

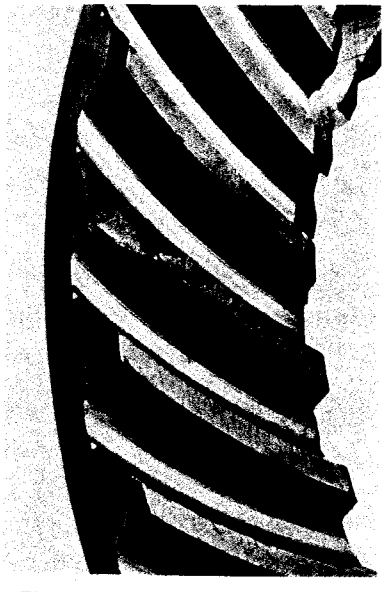
There are four items to consider when repairing an axle. (1) What parts failed, (2) How to repair the axle, (3) What caused failure and (4) How to prevent a repeated failure. The text outlines these procedures under each failure condition listed.

To complete the investigation of failure and to definitely prevent repeat failures, information must be available to provide answers to the following list of questions:

1. *Is vehicle of sufficient capacity to do satisfactorily all that the owner expects?*
2. *Does general mechanical condition of vehicle indicate proper maintenance or are signs of abuse in evidence?*
3. *Is unrecommended equipment used?*
4. *Does operator understand correct operation of vehicle and handle it in prescribed manner?*
5. *Is lubricant used of recommended quality, quantity and viscosity?*

► ring gear and drive pinion

FRACTURED RING GEAR TEETH



Fig, 194.

Repair: Replace ring gear and pinion as a matched set.

Cause of Failure: Incorrect gear adjustment. Figure 194 shows failure resulting from concentrated contact area on tooth heel, caused by excessive backlash. Figure 195 shows failure resulting from excessive loading on tooth toe, caused by insufficient backlash. Shock loading also may cause the above conditions; even to the extent of breaking an entire ring gear tooth or teeth.

Prevent Recurrence: Correct adjustment of ring gear to pinion backlash. (Refer to "Adjustment" Section of this manual.) Use ring gear and pinion matched set for replacement.

Fig. 195.

ring gear and drive pinion *(continued)*

SCORED AND SCUFFED TEETH —RING GEAR AND PINION

Repair: Replace ring gear and pinion as a matched set. Replace pinion bearings if they are worn.

Cause of Failure: Insufficient lubrication. Abnormal friction between gears create high temperatures resulting in softened metal and subsequent damage to teeth. Excessive torque input can also result in damage of this nature. Worn pinion bearings can also cause this condition. Worn pinion bearings permit end play of the pinion, resulting in incorrect tooth contact between pinion and ring gear.

Prevent Recurrence: Use only quality lubricant maintained at required level and changed at recommended intervals. (Refer to "Lubrication" Section of this manual.) Replace worn pinion bearings and make certain that the new bearings are adjusted properly. (Refer to "Ajustment" Section of this manual.)

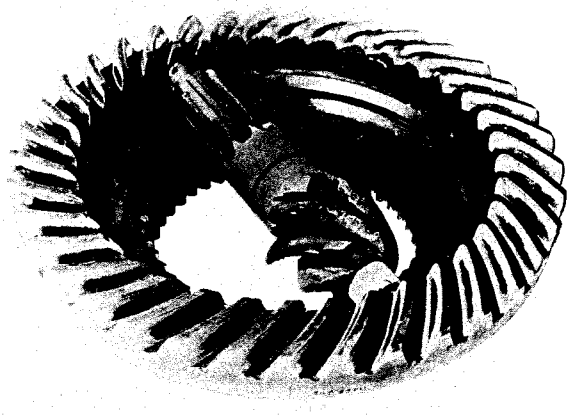


Fig. 196.

OVERHEATED RING GEAR AND PINION

Check for discoloration and distortion of teeth.

Repair: Replace ring gear and pinion as a matched set.

Cause of Failure: Operation at prolonged excessive temperatures. Incorrect lubricant, low level or infrequent oil changes will cause this condition. When correct lubricant film is not present between contacting metal surfaces, the surfaces will overheat because of excessive friction.

Prevent Recurrence: Check lubricant level and change lubricant at correct regular intervals. Use correct lubricant for axle type, operating temperatures and conditions. (Refer to "Lubrication" Section of this manual.)

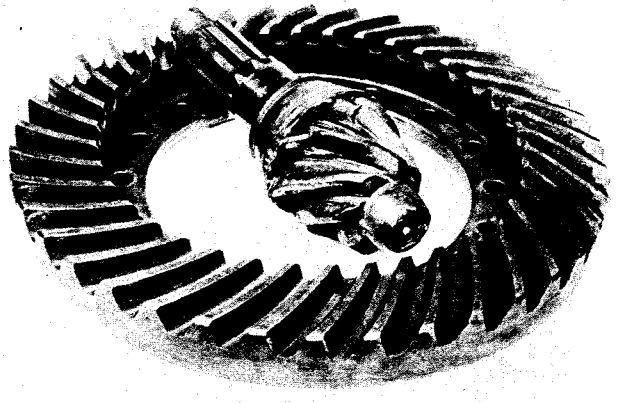


Fig. 197.

PITTED DRIVE PINION TEETH

Repair: Replace ring gear and pinion as a matched set.

Cause of Failure: Extremely severe service. Deflection in the assembly resulting in abnormal pressures caused this concentration of pitted areas at tooth heel. Normally pressures are evenly distributed over the entire gear and pinion tooth faces. Under excessive loading, deflection throws pinion out of correct position in relation to ring gear thus concentrating contact areas on tooth heels. Pressures build up in these concentrated areas and the high pressures exceed strength of oil film. Without correct oil film, tooth surfaces break down and pitting condition occurs.

Prevent Recurrence: The more severe the service, the greater the need for quality and correct lubricant. (Refer to "Lubrication" Section of this manual.)

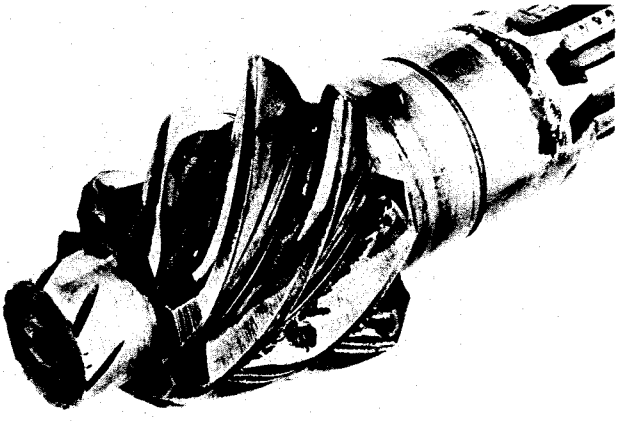


Fig. 198.

ring gear and drive pinion *(continued)*

FATIGUE FRACTURE—DRIVE PINION TEETH

Check for broken teeth and note type of break. A clear cut wavy fracture identifies fatigue as the cause.

Repair: Replace ring gear and pinion as a matched set.

Cause of Failure: Concentration of stresses frequently caused by abnormal and abusive operations.

During vehicle operation, momentary excessive stresses applied through the gears will frequently crack tooth surfaces. These cracks become focal points of stresses and fatigue fracture is the final result.

Continued operation of faulty gears will also result in fatigue fracture. When part of the tooth is worn or pitted, the remaining bearing area must carry an increased load. Thus, concentration of stresses starts fatigue which results in fracture.

Prevent Recurrence: Minimize abusive and abnormal vehicle operation.

Fig. 199.

► differential

SHOCK FRACTURE —SIDE GEARS AND PINIONS

Repair: Replace damaged side gears and pinions.

Cause of Failure: Abusive operation of vehicle will frequently cause the shock fractures shown in figure 200. Note that broken teeth areas of side gear are spaced approximately 90° (where side pinions meshed). Sufficient shock load was exerted on one side pinion to cause it to split. When stresses exceed strength of gears, fractures of this type will occur.

Prevent Recurrence: Correct operation of vehicle. Do not overload vehicle.

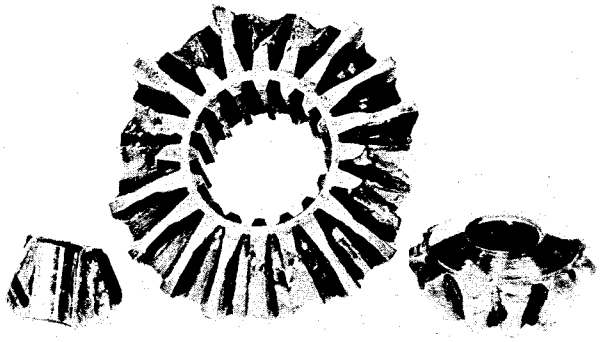


Fig. 200.

SCORING AND SEIZURE—SPIDER ARMS AND SIDE PINIONS

Repair: Replace side pinions and spider. Also examine side gears for damage and replace if necessary.

Causes of Failure: Wheel spinning, inadequate lubrication and overstress. All three of these conditions may result in loss of lubricating film between contact areas. Without oil protection, friction causes overheating, scoring occurs and finally seizure results as shown in figure 201.

Prevent Recurrence: Minimize wheel spinning and overstress. Use only quality lubricant, maintained at required level and changed at recommended intervals. (Refer to "Lubrication" Section of this manual.)

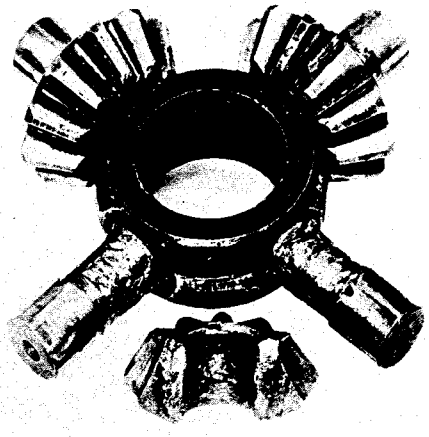


Fig. 201.

differential *(continued)*

FATIGUE FRACTURES—SIDE GEARS

Repair: Replace side gears and pinions. Replace worn or faulty wheel bearings. Examine axle shafts and housing for misalignment and replace faulty parts.

Cause of Failure: Abusive operation of vehicle to keep moving over rough terrain will produce fatigue fracture. Repeated stresses of this nature will cause original fatigue fractures shown in figure 202. Continued overstressing of gears will finally result in complete fracture of gears.

Misalignment in axle shafts and housing can also cause this condition. Misalignment causes concentration of stresses in localized areas — progressive fatigue occurs — final results are broken side gears as shown in figure 203. Also the sprung, bent or twisted axle shaft may break. Misalignment is usually caused by abusive vehicle operation. Loose wheel bearings will cause axle shaft misalignment.

Prevent Recurrence: Minimize abusive operation and overloading vehicle. Also, replace faulty parts when it is known that axle shafts or housing are misaligned. Replace worn or faulty wheel bearings. Make certain new bearings are adjusted properly. (Refer to "Adjustment" Section of this manual.)

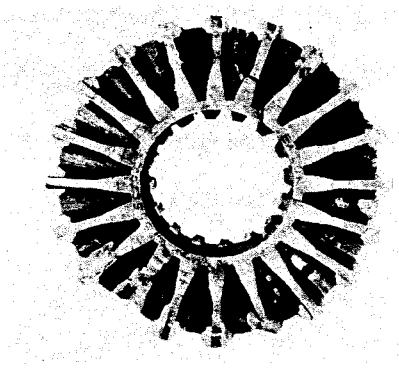


Fig. 202.

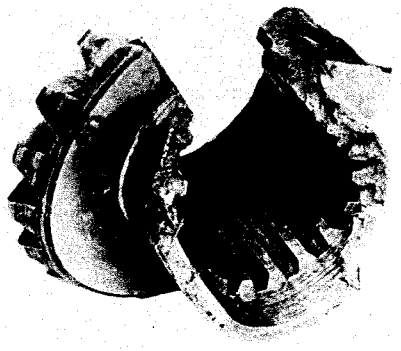


Fig. 203.

WORN SPLINES—SIDE GEARS

Repair: Replace side gears with worn splines.

Cause of Failure: Abusive vehicle operation causing repeated shock load on splines will cause wear. Excessive backlash between axle shaft and side gear will result. This condition will cause shock throughout the entire axle assembly.

Prevent Recurrence: Proper vehicle operation.

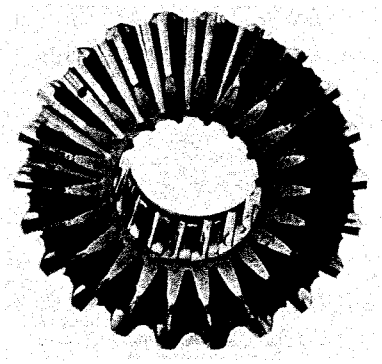


Fig. 204.

SCORED OR WORN SURFACES —THRUST WASHERS

Compare thrust washer thickness with a comparable new washer. If thrust washer is worn more than 0.005 in., replace it.

Repair: Replace thrust washers scored or worn more than 0.005 in.

Cause of Failure: of lubrication. When lubricant film is not present, friction between metal to metal surfaces will cause wear or scoring.

Prevent Recurrence: Maintain correct lubricant level. Use proper lubricant and change at regular intervals. (Refer to "Lubrication" Section of this manual.)

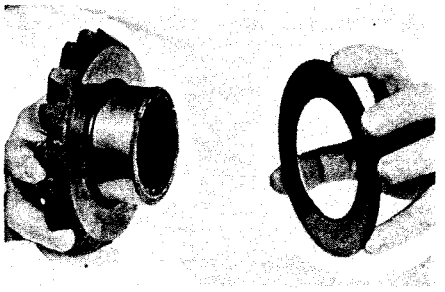


Fig. 205.

► **planetary unit**

WORN TEETH—HIGH-SPEED CLUTCH PLATE AND DIFFERENTIAL BEARING ADJUSTER

Repair: Replace high-speed clutch plate and differential bearing adjuster. Also examine sliding clutch gear for worn teeth and replace gear if faulty.

Cause of Failure: Improper shifting of gears.

Figure 206 illustrates worn teeth on high speed clutch. This is caused by shifting too rapidly from low to high range without sufficient pre-select time or with improper throttle action. Wear is due to sliding clutch gear teeth clashing against high speed clutch plate teeth.

Figure 207 illustrates worn teeth in differential bearing adjuster. This is caused by shifting too slowly from high to low range. Wear is due to sliding clutch gear teeth clashing against differential bearing adjuster internal teeth.

Prevent Recurrence: Observe correct procedures when shifting 2-speed or 3-speed axle.

Fig. 206.

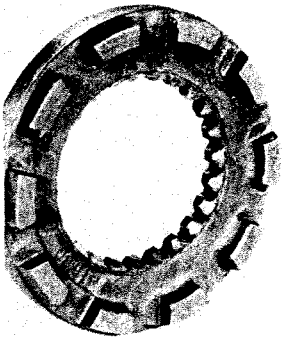


Fig. 207.

WORN OR SCORED IDLER PINION PINS

Repair: Replace faulty pins. Slight surface scratches on pins will not affect operation. Maximum tolerance for pin fit in high-speed clutch plate, differential case and idler pinions is 1/64 in., providing all pins are worn approximately the same amount.

Cause of Failure: Normal wear or foreign material in lubricant.

Prevent Recurrence: Use proper lubricant and change at prescribed time. (Refer to "Lubrication" Section of this manual.)

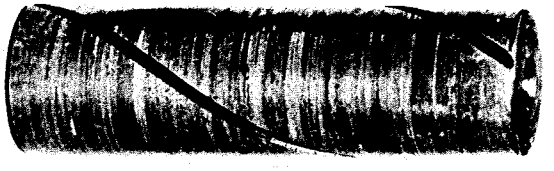


Fig. 208.

PITTED TEETH—SLIDING CLUTCH GEAR AND IDLER PINIONS

Repair: Replace all damaged sliding clutch gear, idler pinions and idler pinion pins.

Cause of Failure: Abusive operation of vehicle. Excessive loading caused deflection in the assembly and the stress areas were concentrated at one end of the teeth. Pressures were sufficiently high to break down lubricant film and cause metal to metal contact. Final result was breakdown of tooth surfaces. Note that galled section of sliding clutch gear correspond with pitted areas on idler pinion teeth.

Prevent Recurrence: Avoid overloading vehicle and minimize abusive operations.

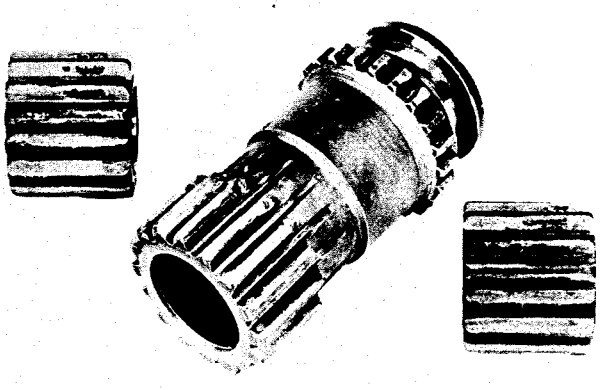


Fig. 209.

planetary unit *(continued)*

►gear support case

WORN BEARING HUB—GEAR SUPPORT CASE

Repair: Replace support case. Also examine related bearing for damaged condition.

Cause of Failure: Severe service. High torque application due to heavy overloading causes high pressures between differential bearing inner race and case hub. This causes compression of hub and bearing inner race starts to rotate on hub. Wear of hub occurs until bearing cannot function properly, then additional axle damage occurs.

Foreign material in lubricant could also cause this condition. Material enters bearing, locks bearing and causes inner race to rotate on case hub.

Prevent Recurrence: Operate vehicle correctly. Make certain all foreign material is removed from axle housing when overhauling an axle.

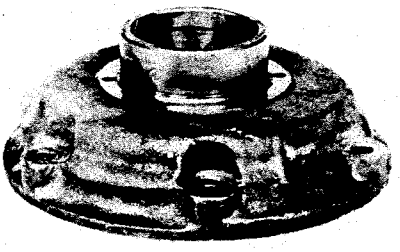


Fig. 210.

►bearings

WORN BEARING ROLLERS

Also examine for pitted rollers, cups and cones.

Repair: Replace bearing. Always replace both cups and cones.

Cause of Failure: Foreign substance in lubricant. Comparing roll ends with new bearing (A) and worn bearing (B), it is readily apparent that wear has occurred. New bearing (A) rollers have a raised ground and polished shoulder that contacts a matching shoulder on the inner race. Worn bearing (B) rollers have no shoulder. This lapping and wearing of the roll ends was caused by foreign substance in the lubricant.

Prevent Recurrence: Use of recommended lubricant changed at regular intervals. (Refer to "Lubrication" Section of this manual.) *Readjustment of bearings in this worn condition will not provide a satisfactory repair job.*

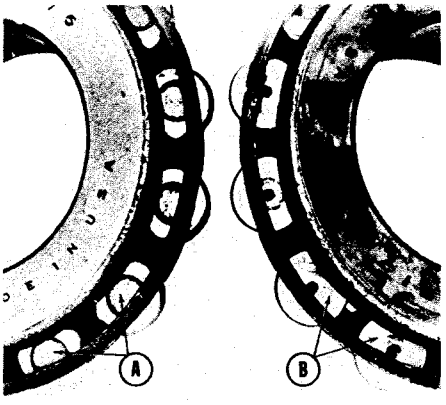


Fig. 211.

►axle shaft

TWISTED AXLE SHAFT

Repair: Replace shaft.

Cause of Failure: Abusive or very severe operation of vehicle. Usually, investigation will disclose overloading of vehicle or that drivers are improperly using equipment. Figure 212 illustrates an axle shaft in preliminary (twisted) failure stage. Twisting will continue until complete fracture occurs. Technically, the failure is the result of a series of torque or stress applications greater than the strength of the material.

Prevent Recurrence: Operate vehicle properly.

Fig. 212.

axle shaft *(continued)*

FRACTURED AXLE SHAFT AT FLANGE

Repair: Replace axle shaft. Also examine axle housing for bent condition.

Cause of Failure: Misalignment due to loose wheel bearing adjustment or bent axle housing. Figure 213 illustrates a progressive fracture of shaft extending from outside diameter to approximately one-third the distance to the center of the shaft. This progressive fracture occurred slowly until shaft was too weak at this point. The remaining portion (dark area at center of shaft) was then broken through in a single action. This final fracture could occur when vehicle is operating under desirable conditions.

Prevent Recurrence: Replace bent axle housing. Make certain wheel bearings are correctly adjusted. (Refer to "Adjustment" Section of this manual.)

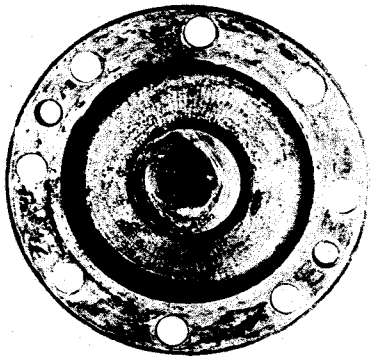


Fig. 213.

►differential carrier

LOOSE BEARING ADJUSTER LOCK

Repair: Rebuild adjuster lock with weld, if clearance between lock and bearing cap exceeds 0.004 in. Rebuilt lock should have no clearance to 0.001 in. press fit with differential bearing cap.

Cause of Failure: Improper shifting of axle. With improper shifting into low range, excessive stress is placed on adjuster lock, causing differential bearing cap and adjuster lock to wear. If condition continues without proper attention, bearing cap failure will probably result causing extensive axle damage. When loose adjuster locks are detected, shift parts should be carefully inspected for severe wear.

Prevent Recurrence: Observe correct procedures when shifting 2-speed or 3-speed axle.

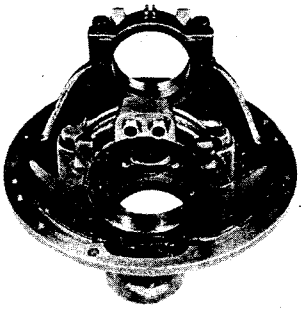


Fig. 214.

WORN PINION PILOT BEARING BORE

Repair: Replace differential carrier if pinion pilot bearing to differential carrier bore clearance exceeds 0.005 in.

Cause of Failure: Overloading vehicle. This is often made more serious by end play in the drive pinion bearings. The direct cause of worn bearing bores is seizure or locking of the bearing. This results in outer race movement in bearing bore and wear. Bearing seizure is caused by presence of foreign material or bearing failure.

Prevent Recurrence: Prevent vehicle overloading. A complete overhaul and thorough inspection of related parts is necessary if repeated failures of this nature are to be eliminated.

►companion flange

SPLINE WEAR OR SEAL BEARING SURFACE WEAR

Repair: Replace companion flange if splines or seal bearing surface are worn.

Cause of Failure: Spline wear may be caused by abusive and abnormal operation of vehicle. Another cause of this type of failure can be attributed to loose flange nuts. Hard non-flexible oil seal bearing lip will cause wear of flange seal bearing surface.

Prevent Recurrence: Prevent spline wear by normal operation of vehicle. Replace flange and oil seal if flange oil seal bearing surface is worn.

►gaskets—"O" rings—oil seals

Replace all gaskets, "O" rings and oil seals when axle has been disassembled. Make certain bearing lip of new encased-type oil seals is flexible. If lip seems hard and non-flexible, soak oil seal in oil before installing. *A hard, non-flexible oil seal bearing lip may wear the metal surface that it contacts.*

► axle housing

BENT AXLE HOUSING

Repair: Replace bent housing. Housing (A) could be straightened but if not done properly the same condition may reoccur.

Causes of Failure: Housing (A) was bent or sprung through accident. The dotted line indicates how the differential carrier was moved back from its original position. Repeated axle shaft and differential failures are caused by this type misalignment.

Housing (B) was bent by excessive loading. The dotted line shows how the center of the housing was sprung. Repeated axle shaft failures and excessive tire wear result from this type misalignment.

Prevent Recurrence: Prevent vehicle overloading and operate vehicle carefully.

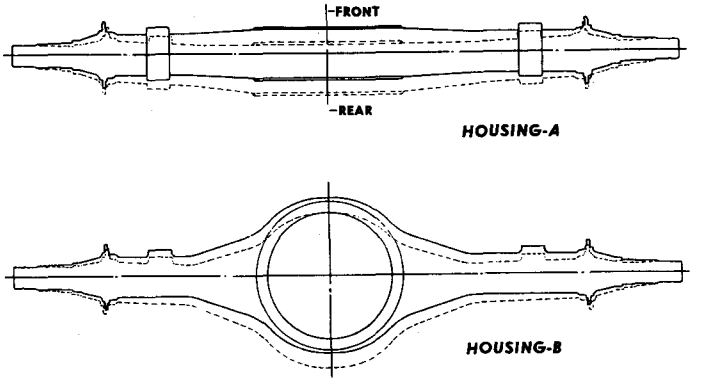
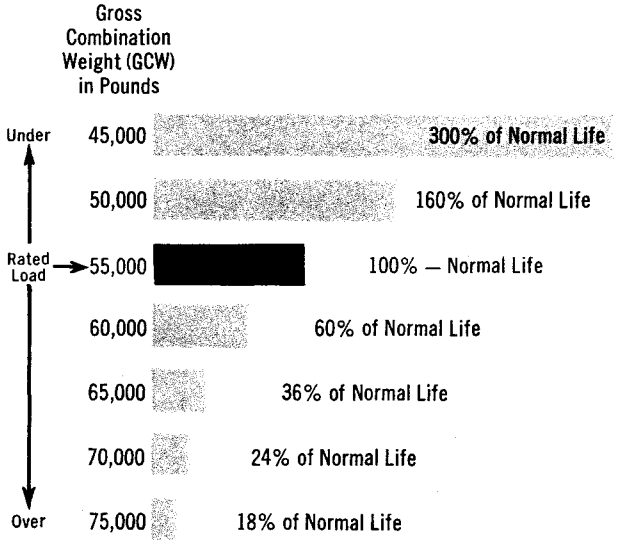


Fig. 215.

► average life of overloaded and underloaded gears

This graph shows the approximate percentage of life expectancy of axle gear sets and other axle parts. The figures are based upon dynamometer tests conducted at Eaton Manufacturing Company and are the direct result of accurately simulated load conditions.



These figures are based on axles with 55,000 lbs. gross combination weight (GCW) ratings. The same life expectancy holds true with axles rated at other GCW ratings.

► hints for longer axle life

Years of experience in building and servicing automotive axles has resulted in the conclusion that there are four major factors governing their performance.

APPLICATION. Misapplication of a vehicle generally reduces axle life. To ensure economical operation under such conditions as logging, mining and continuous operation in mountainous terrain, it is advisable that an axle one size larger than normally used for normal service be selected.

LOADS. Loads will affect both the housing and the differential assembly. An axle housing can take some bending and still spring back to its original shape. Shock loading, hitting an obstruction and other similar abuse can bend the housing past the yield point and result in extensive damage to axle components. Overloading an axle can put undue stress on the axle gears, thereby reducing axle life.

DRIVER. The driver of a vehicle must be considered, just as well as other factors, in determining desired performance. Correct operation of the axle, as well as other vehicle components, is the direct result of driver performance. Proper handling instructions for drivers can increase the economy of any truck operation.

LUBRICATION. The use of proper lubricants in an axle has proved to be one of the best preventions of axle failure. Extreme pressure lubricants containing additives, as required by Army Ordnance Specification MIL-L-2105, assures longer life for both gears and bearings. (See "Lubrication" Section of this manual.)

ADJUSTMENT OF EATON REAR AXLES

For dependable and long service life, the axle bearings and gears must be adjusted correctly. Gears operating out of position or bearings that are too tight or too loose will breakdown prematurely, regardless of their strength and design. This section of the manual contains instructions or references for correctly adjusting Eaton Rear Axles.

axle adjustment procedure

Measuring ring gear to drive pinion backlash and checking tooth contact pattern before disassembly, plus "punch marking" components for related position are recommended procedures for easier adjustment of axle after reassembly. If major axle parts are replaced, these identifying marks and reference measurements may not necessarily provide correct adjustment. However, usual return of parts to the identifying marks will serve as a reference to position parts as near as possible to correct adjustment.

The following is an outline of axle adjustment procedure and includes information on when adjustment should be performed and references to detailed instructions:

1. *Power Divider Input and Output Shaft Bearing Clearances.*
These adjustments are made during reassembly of power divider. (Refer to individual axle reassembly instructions.)

2. *Drive Pinion Bearing Preload.* This adjustment is made before installing drive pinion. (Refer to instructions on this page.)

3. *Drive Pinion Position Adjustment.* Initial or preliminary adjustment is made during reassembly (see page 108).

4. *Differential Bearing Preload.* This adjustment is made in combination with ring gear and drive pinion adjustments (see pages 110 and 111).

5. *Ring Gear to Drive Pinion Backlash.* Refer to page 110 and 111 for procedures.

6. *Ring Gear Tooth Contact.* Check ring gear tooth contact when adjusting ring gear and drive pinion (see pages 110 and 111). Refer to page 112 for checking tooth contact pattern. For interpretation of patterns, see pages 113 and 114.

7. *Ring Gear Thrust Block Clearance.* This adjustment is made after ring gear and drive pinion adjustments are completed and before differential carrier is installed in axle housing. (Refer to individual axle reassembly instructions.)

8. *Adjust Wheel Bearings.* Refer to page 111 for procedures.

drive pinion bearing preload adjustment

measure and adjust pinion bearing preload

If original pinion bearing spacer can be used in reassembly, this should provide a "close-to-correct" adjustment of pinion bearing preload. If original spacer cannot be used, start with spacer thickness recommended in table on page 109.

With drive pinion, bearings, bearing cage and other related parts (oil seal and retainer removed) assembled and lubricated as described in the axle reassembly instructions, measure and adjust pinion bearing preload. To check bearing preload, measure torque required to rotate bearing cage. This can be accomplished by the various methods described below.

torque wrench method

To check pinion bearing preload *with a torque wrench,* mount an adapter on pinion bearing cage (see fig. 216). Hold drive pinion in a vise or arbor press. If a vise is used, tighten drive pinion nut to torque setting shown in table on page 109. If an arbor press is used, apply pressure to setting shown in table on page 109.

Rotate bearing cage by hand several revolutions to assure normal bearing contact. Then, rotate bearing cage with a torque wrench and note torque reading as cage is rotated.

Correct bearing preload is indicated by torque of 15 to 35 in.-lbs. If bearing preload is incorrect, adjust by changing pinion bearing spacer. Use a thicker spacer to decrease preload or a thinner spacer to increase preload. *Do not use shim stock to increase thickness of spacer. Always use correct size spacer.*

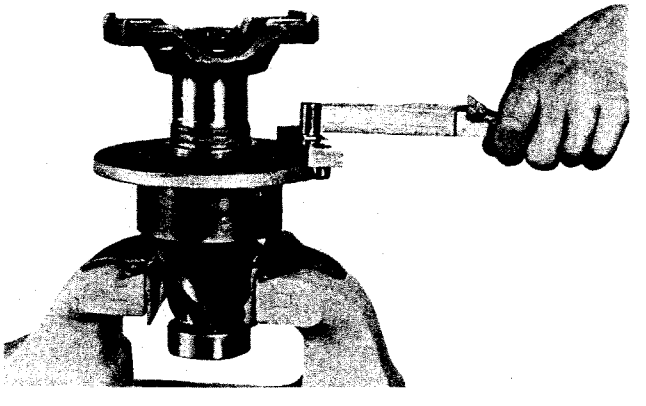


Fig. 216. Checking Drive Pinion Bearing Preload with Torque Wrench (pinion in vise).

drive pinion bearing preload adjustment (continued)

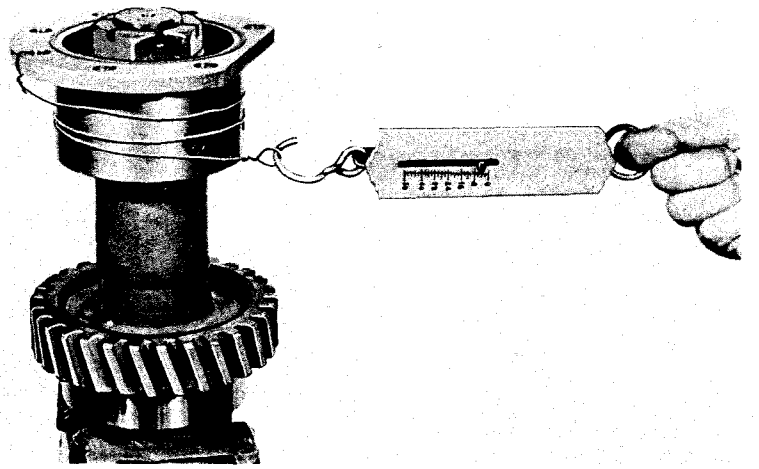


Fig. 217. Checking Drive Pinion Bearing Preload with a Spring Scale (pinion in vise) for Tandem Drive Axles.

spring scale method

To check pinion bearing preload *with a spring scale,* hold drive pinion in a vise or arbor press. If a vise is used, tighten drive pinion nut to torque setting shown in table on page 109. If an arbor press is used, apply pressure to setting shown in table on page 109.

Wrap a soft wire around bearing cage (see fig. 217 and 218), and pull on a line tangent to outside diameter of cage with pound scale attached to wire. Note scale reading and compare with correct preload range shown in table on page 109. If within range indicated, bearing preload adjustment is correct.

If bearing preload is incorrect, adjust by changing pinion bearing spacer. Use a thicker spacer to decrease preload and a thinner spacer to increase preload. *Do not use shim stock to increase thickness of spacer. Always use correct size spacer.*

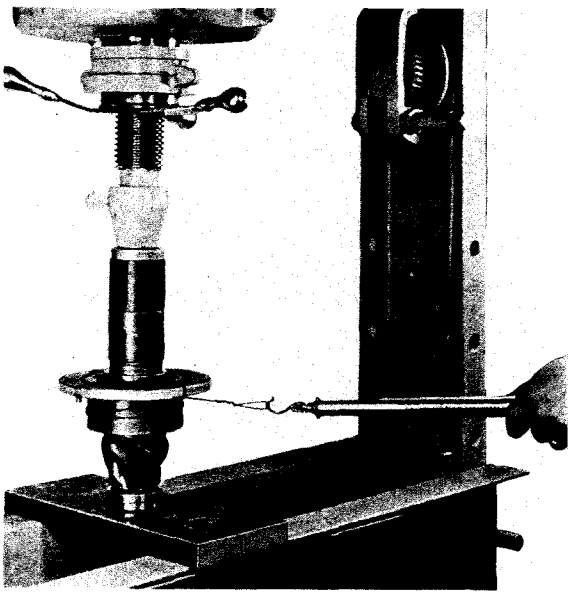


Fig. 218. Checking Drive Pinion Bearing Preload with a Spring Scale (pinion in press).

► drive pinion position adjustment

preset pinion position during reassembly

Drive pinion position in relation to ring gear is adjusted by removing or adding shims between pinion bearing cage and differential carrier or power divider case.

To assist in adjustment of ring gear and drive pinion, pinion should be positioned as near as possible to the correct position during reassembly. This can be accomplished by using the same size and quantity of shims removed during disassembly. This applies regardless if original or new ring gear and drive pinion set is used in reassembly.

The drive pinion position may also be set with a depth gauge. Refer to table on page 109 for basic dimension used for gauge setting.

► drive pinion adjustment specifications

	AXLE MODELS	Specifications for Drive Pinion Bearing Preload Adjustment				Drive Pinion Position Adjustment
		PINION BEARING SPACER THICKNESS	DRIVE PINION NUT TORQUE SETTING (ft.-lbs.)	ARBOR PRESS PRELOAD PRESSURE SETTING (tons)	SPRING SCALE READING (pounds) To obtain 15 to 35 in.-lbs. Torque	DEPTH GAUGE SETTING
SINGLE REDUCTION AXLES	1315	0.528	225-350	4-5	7-16	3.28125
	1614	0.637	325-450	5-6	6-14	3.5625
	1618	0.528	325-450	5-6	7-16	4.125
	1790A, 1862, 1880	0.639	400-600	7-8	6-14	4.2187
	1792, 1892	0.190	400-600	7-8	5-12	4.0625
	1910, 2010	0.185	500-700	9-10	5-11	4.600
	1918, 2018	0.185	600-800	10-11	5-11	4.600
2-SPEED AXLES	1350, 13800	0.530	225-350	4-5	7-16	3.6244
	13600	0.330	225-350	4-5	6-13	4.28125
	13602	0.330	225-350	4-5	6-13	4.28125
	13802	0.530	225-350	4-5	7-16	3.6244
	16500	0.530	325-450	5-6	7-16	4.125
	16600	0.328	325-450	5-6	5-12	4.8125
	16802	0.528	325-450	5-6	7-16	4.125
	17500, 18500	0.638	400-600	7-8	6-14	4.4062
	17800, 18802	0.638	400-600	7-8	6-14	4.4062
	19502, 20502	0.188	500-700	9-10	5-12	4.7812
	19800, 20800	0.188	600-800	10-11	5-11	4.7812
	22501	0.185	600-800	10-11	5-11	5.4375
PLANETARY DOUBLE PRODUCTION AXLES	45AR, 0502, 9502	0.188	500-700	9-10	5-12	4.7812
	2501	0.185	600-800	10-11	5-11	5.4375
	350, 3800	0.530	225-350	4-5	7-16	3.6244
	3802	0.530	225-350	4-5	7-16	3.6244
	6600	0.328	325-450	5-6	5-12	4.8125
	6802	0.528	325-450	5-6	7-16	4.125
	7800, 8802	0.638	400-600	7-8	6-14	4.4062
	9800, 0800	0.188	600-800	10-11	5-11	4.7812
TANDEM DRIVE AXLES	22MF	0.530	400-600	7-8	7-16	3.253
	22MR	0.530	325-450	5-6	7-16	3.253
	28MF	0.530	400-600	7-8	7-16	3.4725
	28MR	0.640	325-450	5-6	6-14	3.4725
	30DS, 30DT, 30DP	0.638	500-700	9-10	6-14	4.125
	30RS	0.528	325-450	5-6	7-16	4.125
	30RT, 30RP	0.528	325-450	5-6	7-16	4.125
	32MF	0.637	600-800	10-11	6-14	4.2187
	32MR	0.639	325-450	5-6	6-14	4.2187
	34DS, 34DT, 34DP	0.642	500-700	9-10	5-12	4.4062
	34RS	0.639	400-600	7-8	6-14	4.2187
	34RT, 34RP	0.638	400-600	7-8	6-14	4.4062
	36MF	0.638	600-800	10-11	6-14	4.875
	36MR	0.177	500-700	9-10	5-11	4.875
	38DS, 38DT, 38DP	0.642	500-700	9-10	5-12	4.4062
	38RS	0.639	400-600	7-8	6-14	4.2187
	38RP, 38RT	0.638	400-600	7-8	6-14	4.4062
	42DT, 42DP	0.642	500-700	9-10	5-12	4.4062
	42RT, 42RP	0.638	400-600	7-8	6-14	4.4062
	50MF	0.638	600-800	10-11	6-14	2.8125
	50MR	0.175	500-700	9-10	4-10	2.8125

► ring gear and drive pinion adjustments

(Refer to page 111 for Model 50M Tandem Drive Axles)

With differential bearings lubricated and differential bearing cap screws tightened *finger-tight* as indicated in axle reassembly instructions, adjust ring gear and drive pinion as indicated in the following instructions.

Refer to figures 222 or 223 for tooth contact pattern identification. Refer to figure 220 for tooth nomenclature.

1. Select the differential bearing adjuster located *on the same side as the ring gear teeth.* Loosen this adjuster until the first thread is exposed.

2. Tighten *opposite* bearing adjuster until there is zero backlash between ring gear and drive pinion. Tightening this adjuster moves ring gear toward drive pinion.

3. Rotate the ring gear, checking backlash clearances at various tooth sections. This procedure will determine any run-out or binding point that may exist. It will also permit proper seating of the bearings. If a run-out condition exists, the backlash must be adjusted from this point.

4. Loosen adjuster (same adjuster as Step 2) one notch. One notch is the lead of one adjuster lug to the lead of the next lug. Tighten *opposite* adjuster until the bearing cup is contacted. Seat the cup by tightening and loosening the adjuster against the cup within a range of two notches.

5. When the bearing cup is seated, locate the point where the adjuster just contacts the bearing cup. From this point continue to tighten the adjuster two or three notches. This will normally position ring gear within the specified 0.006 to 0.016 in. backlash, necessary for correct adjustment. This adjustment will also preload differential bearings. Tightening this adjuster moves ring gear away from drive pinion.

6. Tighten differential bearing cap screws to correct torque then measure ring gear movement with a dial indicator (see fig. 219) to determine specific backlash.

7. Paint ring gear teeth and check tooth contact pattern. Compare pattern with those illustrated in figure 222 or 223. If contact pattern similar to "A" is obtained, adjustment is correct.

8. If contact pattern indicates "Not Enough Backlash" (Pattern "B"), loosen bearing adjuster *opposite ring gear teeth* and tighten bearing adjuster *on same side as ring gear teeth* equal amounts. This will move ring gear away from drive pinion. Recheck tooth contact pattern. If not corrected, continue to turn adjusters *(the same number of notches)* until correct lengthwise pattern is obtained.

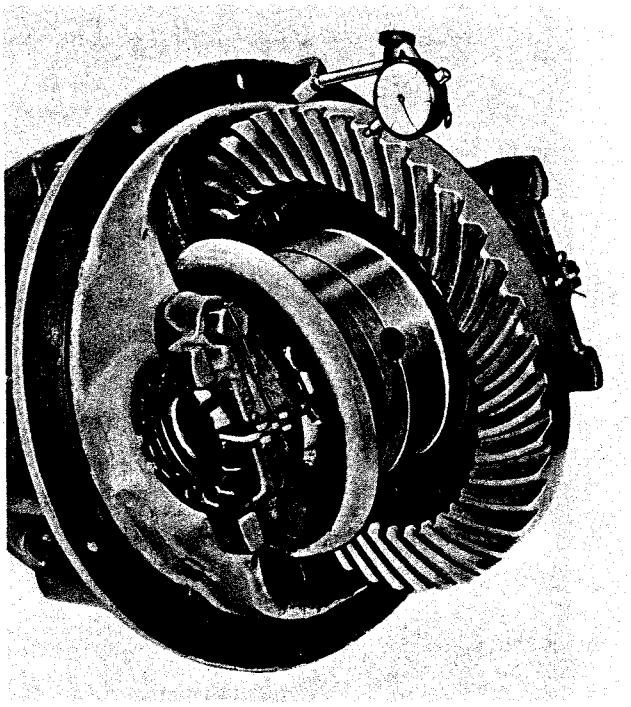


Fig. 219. Measuring Ring Gear Backlash with Dial Indicator.

9. If tooth contact pattern indicates "Too Much Backlash" (Pattern "C"), loosen bearing adjuster *on same side as ring gear teeth* and tighten *opposite* bearing adjuster equal amounts. This will move ring gear toward drive pinion. Recheck tooth contact pattern. If not corrected, continue to turn adjusters equal amounts until correct lengthwise pattern is obtained.

10. If tooth contact pattern indicates incorrect profile bearing (Patterns "D" or "E"), adjustment of drive pinion position is necessary. Add or remove pinion bearing cage shims to move drive pinion as pattern indicates. Adjustment of drive pinion may affect lengthwise bearing, necessitating readjustment of backlash for proper lengthwise bearing. Recheck tooth contact pattern.

11. When correct tooth pattern (Pattern "A") is obtained, install adjuster locks and cotter pins. Lockwire differential bearing cap screws.

► ring gear and drive pinion adjustments

Model 50M Tandem Drive Axles

For easier adjustment, it is recommended that the differential assembly and power divider assembly be removed from differential carrier. In the following instructions, it is assumed that only the countershaft assembly and bearings are installed in differential carrier.

Refer to figure 222 for tooth contact pattern reference. Refer to figure 220 for tooth nomenclature.

1. To adjust countershaft bearings, turn left-hand bearing adjuster until two or three threads are engaged. Tighten right-hand bearing cage until end play is removed from countershaft bearings.

2. To preload countershaft bearings, continue to tighten right-hand bearing cage until resistance is felt when rotating countershaft. *This preload adjustment can be maintained during ring gear adjustment by turning bearing adjuster and cage equal amounts.* Preload should be 10 to 22 in.-lbs.

3. Install power divider assembly.

4. To adjust ring gear backlash, loosen right-hand bearing cage and tighten left-hand bearing adjuster *(the same number of turns)* until 0.006 to 0.016 inch backlash is obtained. Measure backlash with a dial indicator (see fig. 219).

5. Paint ring gear teeth and check tooth contact pattern. Compare pattern with those illustrated in figure 222.

6. If contact pattern indicates "Not Enough Backlash" (Pattern "B"), loosen left-hand bearing adjuster and tighten right-hand bearing cage equal amounts. This will move ring gear away from drive pinion. Recheck tooth contact pattern. If pattern is not corrected, continue to move bearing cage and adjuster *(the same number of notches)* until proper lengthwise bearing pattern is obtained.

7. If contact pattern indicates "Too Much Backlash" (Pattern "C"), loosen right-hand bearing cage and tighten left-hand bearing adjuster equal amounts. This will move ring gear toward drive pinion. Recheck tooth contact pattern. If pattern is not corrected, continue to turn bearing cage and adjuster *(equal amounts)* until proper lengthwise bearing pattern is obtained.

8. If tooth contact pattern indicates profile bearing to be incorrect (Patterns "D" or "E"), adjustment of drive pinion position is necessary. Add or remove pinion bearing cage shims to move drive pinion as pattern indicates. When drive pinion position is changed, the adjustment may affect lengthwise bearing. If necessary, readjust backlash for proper lengthwise bearing. Recheck tooth contact pattern.

9. When correct tooth contact pattern (Pattern "A") is obtained in either Step 5, 6, 7 or 8, install countershaft bearing covers, gaskets and cap screws. Install differential assembly.

► wheel bearing adjustment

Wheel bearings should be adjusted to provide 0.001 to 0.010 in. end play. Adjust as follows:

Remove outer nut and lockwasher. Tighten inner nut, *(while turning wheel in both directions)*, until a slight bind on nut is present. Then back off inner nut 1/3 turn to permit wheel to rotate freely. Install lockwasher and outer nut. Lock nuts in this position.

► tooth contact pattern

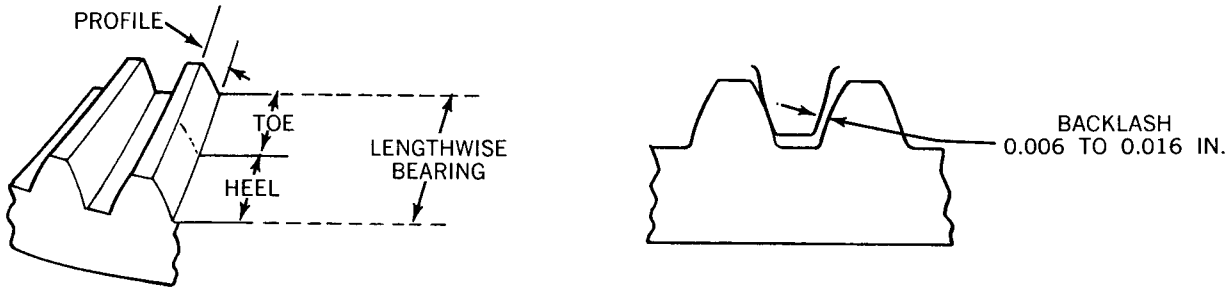


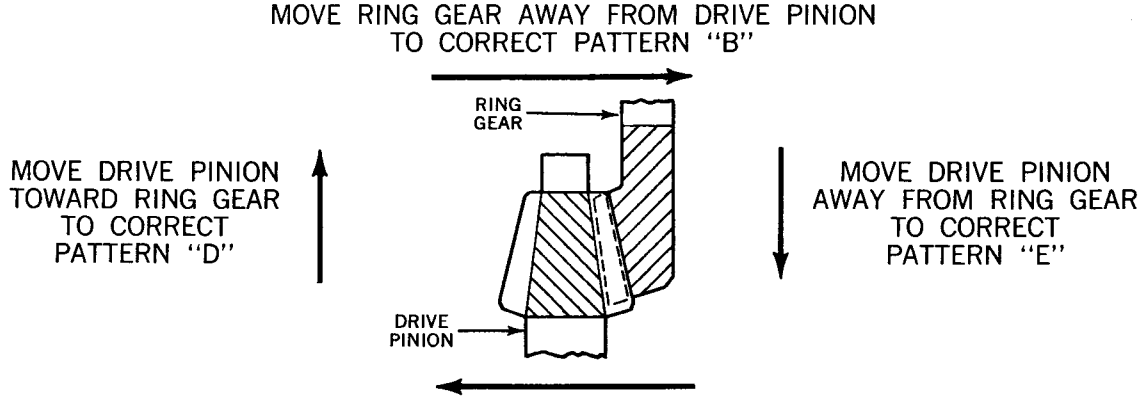
Fig. 220. Ring Gear Tooth Nomenclature

check tooth contact pattern

Tooth contact pattern consists of the lengthwise bearing and profile bearing. The lengthwise bearing is the bearing along the tooth of the ring gear. The profile bearing is the bearing up and down the tooth (See fig. 220). In determining correct ring gear tooth contact, these two types of bearings must be considered separately to obtain proper results in combination.

With differential bearings adjusted correctly, paint at least ten ring gear teeth with red lead or prussian blue. Turn ring gear by hand a few revolutions in both directions to obtain impressions (or patterns) of tooth contact. Compare contact patterns with those shown in figure 222 or 223. If tooth contact patterns are not correct, move ring gear and/or drive pinion as necessary to adjust for correct pattern. Keep in mind that ring gear movement affects lengthwise bearing and that drive pinion movement affects the profile bearing.

Adjust to obtain correct tooth contact on drive side of teeth. Under this condition, the coast side tooth contact is usually satisfactory.



See Figures 222 and 223 for Pattern Identification

Fig. 221. Ring Gear and Drive Pinion Movement to Obtain Correct Tooth Contact Pattern

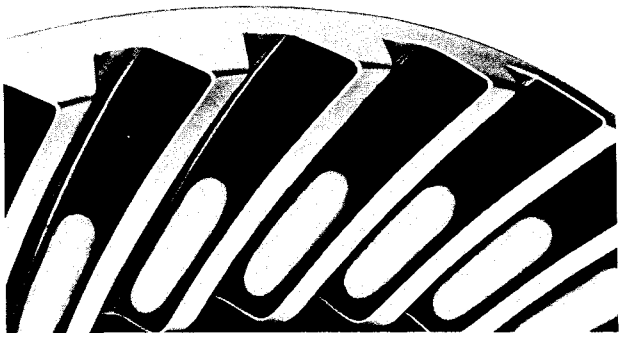
► ring gear and drive pinion tooth contact patterns

(Refer to Figure 223 for Model 22M, 28M and 36M Tandem Drive Axles)

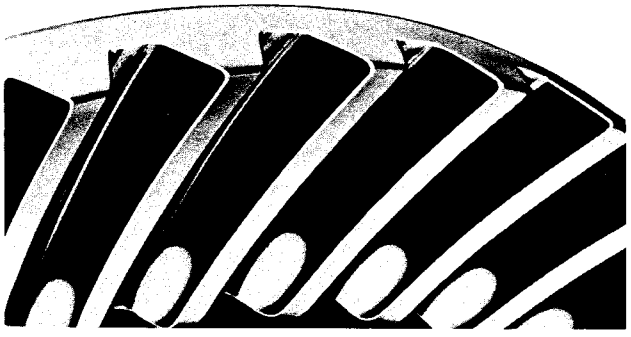
The ring gear tooth contact patterns illustrated are approximate shapes. Actual contact may vary, however the same general shape should be obtained. When adjusting gear sets that have been in service, tooth contact may vary because of wear. To obtain best results, strive to obtain a pattern coinciding with original patterns.

Pattern "A"
CORRECT TOOTH CONTACT

Correct adjustment is obtained when pattern of tooth bearing *(both lengthwise and profile)* appear as shown.

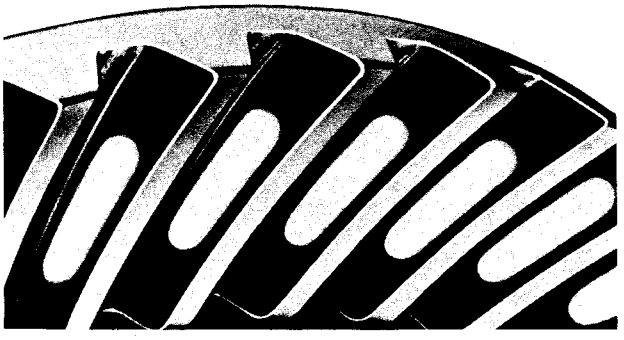


Pattern "A"



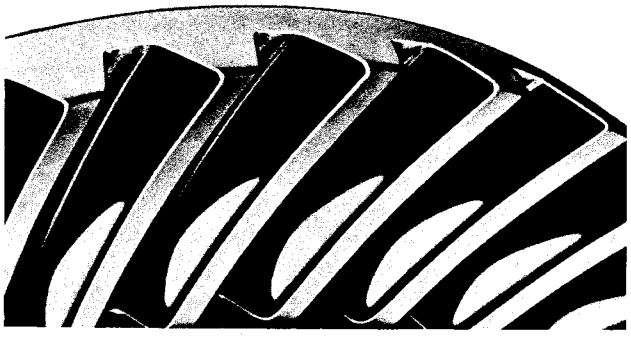
Pattern "B"
CONCENTRATED BEARING AT TOE

Not enough backlash . . . move ring gear *away* from drive pinion to increase lengthwise bearing. This may change the profile bearing to some extent and an adjustment of the pinion may be required.



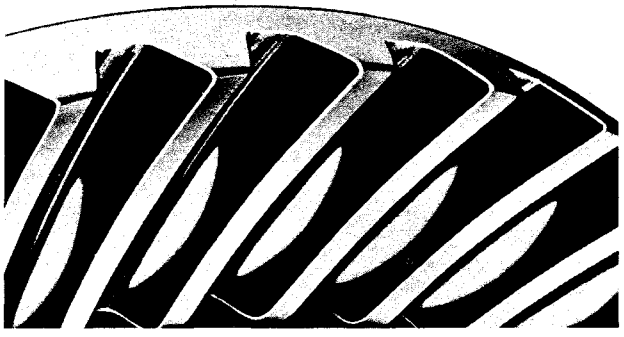
Pattern "C"
CONCENTRATED BEARING AT HEEL

Too much backlash . . . move ring gear *toward* drive pinion to obtain correct lengthwise bearing. This may change the profile bearing to some extent and an adjustment of the pinion may be required.



Pattern "D"
PROFILE BEARING HIGH

Pinion is out too far . . . remove shims to move drive pinion toward ring gear. Then move ring gear away from pinion to obtain correct lengthwise bearing.



Pattern "E"
PROFILE BEARING LOW

Pinion is in too far . . . add shims to move drive pinion away from ring gear. Then move ring gear toward pinion to obtain correct lengthwise bearing.

Fig. 222. Correct and Incorrect Tooth Contact Patterns
(Refer to figure 223 for Model 22M, 28M and 36M Tandem Drive Axles)

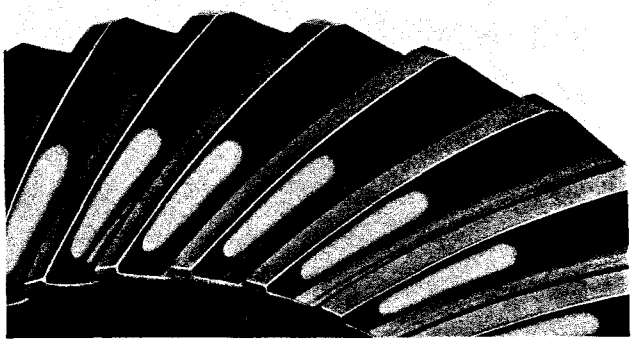
► ring gear and drive pinion tooth contact patterns

Model 22MF, 28MF, 36MF, 22MR, 28MR and 36MR Axles

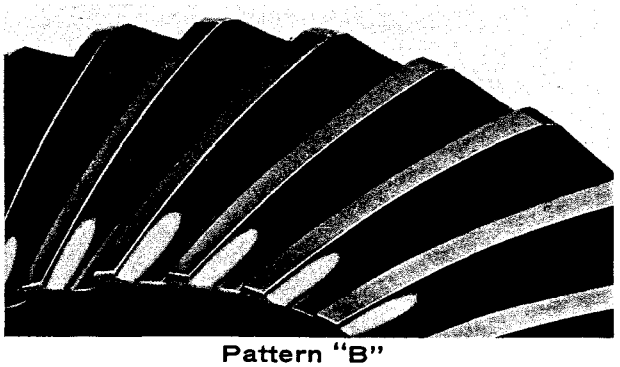
The ring gear tooth contact patterns illustrated are approximate shapes. Actual contact may vary, however the same general shape should be obtained. When adjusting gear sets that have been in service, tooth contact may vary because of wear. To obtain best results, strive to obtain a pattern coinciding with original patterns.

Pattern "A"
CORRECT TOOTH CONTACT

Correct adjustment is obtained when pattern of tooth bearing *(both lengthwise and profile)* appear as shown.

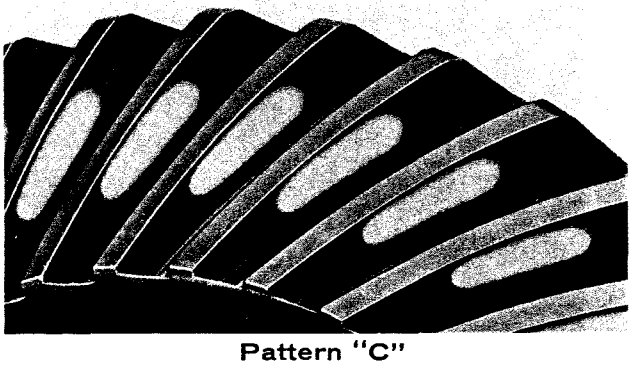


Pattern "A"



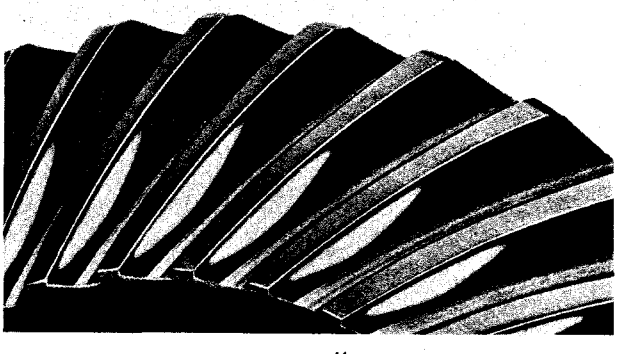
Pattern "B"
CONCENTRATED BEARING AT TOE

Not enough backlash . . . move ring gear *away* from drive pinion to increase lengthwise bearing. This may change the profile bearing to some extent and an adjustment of the pinion may be required.



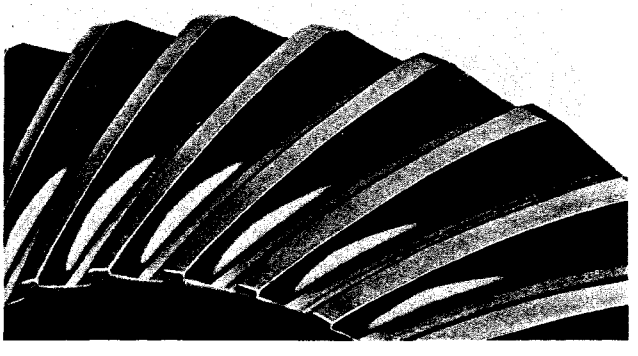
Pattern "C"
CONCENTRATED BEARING AT HEEL

Too much backlash . . . move ring gear *toward* drive pinion to obtain correct lengthwise bearing. This may change the profile bearing to some extent and an adjustment of the pinion may be required.



Pattern "D"
PROFILE BEARING HIGH

Pinion is out too far . . . remove shims to move drive pinion toward ring gear. Then move ring gear away from pinion to obtain correct lengthwise bearing.



Pattern "E"
PROFILE BEARING LOW

Pinion is in too far . . . add shims to move drive pinion away from ring gear. Then move ring gear toward pinion to obtain correct lengthwise bearing.

Fig. 223. Correct and Incorrect Tooth Contact Pattern
(Model 22MF, 28MF, 36MF, 22MR, 28MR and 36MR Axles)

► LUBRICATION OF EATON REAR AXLES

The ability of any truck axle to deliver quiet trouble-free operation over a period of years is largely dependent upon the use of gear lubricants of good quality and suitable body.

In Eaton axles the use of suitable oil becomes even more important in view of the heavier loads the truck and the gears are required to handle.

To insure long life for gears and bearings, use nothing but the best Extreme Pressure (E.P.) Lubricant — conforming to Military Specification MIL-L-2105.

The most satisfactory results will be obtained only when the lubricant is of the correct viscosity. Select viscosity according to the following table:

WEATHER TEMPERATURE	VISCOSITY
Below —10°F.	SAE 80
Up to 100°F.	SAE 90
Above 100°F. consistently	SAE 140

when to change

On all new axles, after the first 1000 miles of service, the original factory lubricant is to be drained and refilled using approved lubricant as outlined above. The axle lubricant level should be checked each 1000 miles thereafter.

Lubricant should be changed twice a year regardless of type of service. *Never add lubricant to axle unless it is the same make and grade as that which is already in axle.* If the same lubricant is not available, drain and refill as instructed under "Draining" and "Filling".

checking level

It is recommended that magnetic drain plugs be used in filler openings. Thus plug can be cleaned each time lubricant level is checked.

Single Reduction Axles. Remove rear filler hole plug. Lubricant should be level with bottom of rear filler hole.

2-Speed Axles. Remove rear filler hole plug. Lubricant should be level with bottom of rear filler hole.

Planetary Double Reduction Axles. Remove rear filler hole plug. Lubricant should be level with bottom of rear filler hole.

Tandem Drive Axles. Axle must be run first, then allowed to stand for 5 minutes. The reason being that the power divider and the forward rear axle use the same lubrication system and the 5 minute interval allows the lubricant to settle to the proper levels in the power divider case and axle housing. After the 5 minute interval, check the lubricant level in the rear filler hole of the forward rear axle only. It is not necessary to check oil level in power divider. If the level is up to the bottom of the filler hole, the power divider is also adequately lubricated. If the level is not up to the bottom of the filler hole, add the necessary lubricant. Check the rear rear axle lubricant level through the rear filler hole.

draining

All Type Axles. Draining is best accomplished immediately after the vehicle has completed a trip. The lubricant is then warm and will run freely allowing full drainage in minimum time. This is especially desirable in cold weather.

To drain, unscrew plug at bottom of housing and allow sufficient time for all the old oil to run out. On tandem drive axles, it is also necessary to unscrew plug at bottom of power divider for drainage of lubricant in power divider.

filling

Oil capacities for Eaton Axles are listed on page 116.

Single Reduction Axles. Fill axle through rear filler hole until oil flows from bottom of hole. After filling axle with the specified amount of lubricant, reinstall oil filler hole plug.

2-Speed Axles. Fill axle through rear filler hole with the specified amount of lubricant *(lubricant should be at the level of the bottom of filler hole),* then reinstall filler hole plug. If the carrier assembly oil channels are dry, one pint of lubricant should be added through the front filler hole.

Planetary Double Reduction Axles. Fill axle through rear filler hole with the specified amount of lubricant *(lubricant should be at the level of the bottom of filler hole),* then reinstall filler hole plug. If the carrier assembly oil channels are dry, one pint of lubricant should be added through the front filler hole.

"M" Series Tandem Drive Axles. Fill both axles with specified amount until level with bottom of rear filler hole, then add specified amount to power divider through filler hole located in power divider case.

"D" Series Tandem Drive Axles. Fill the forward drive axle until level with bottom of filler hole in rear cover. Then, add two pints through the forward filler hole located slightly offset to the right in top portion of differential carrier. *Do not use the rear hole at top of differential carrier as an oil filler hole.* Fill rear rear axle in accordance with instructions for single reduction, 2-speed or planetary double reduction, depending on type axle used.

►air-torsion spring or electric shift unit lubrication

lubricant

Air-Torsion Spring Shift Unit. Use SAE 10 motor oil for temperatures above 0°F. For temperatures below 0°F mix three parts of SAE 10 motor oil with one part of kerosene. This cold weather mixture can be safely used up to 32°F.

Electric Shift Unit. Use SAE 10 motor oil for temperatures above 0°F. For temperatures below 0°F, mix three parts of SAE 10 motor oil with one part of kerosene. This cold weather mixture can be safely used up to 32°F.

lubricant check and level. Each 10,000 miles or 3 months, remove pipe plug in housing cover to check lubricant level. Lubricant should be level with bottom of filler hole.

lubricant change. At least twice a year remove housing cover and drain old lubricant. Wash parts thoroughly and air dry. Reinstall cover. Remove pipe plug in cover. Fill through pipe plug opening until lubricant is level with bottom of filler hole.

►lubricant capacities

SINGLE REDUCTION AXLES

MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing	MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing	MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing
1315	19	19	1792-3	29	26	1910-1	34	—
1614-5	24	25	1862-3	29	26	1918-9	34	—
1618-9	24	25	1880-1	29	26	2010-1	38	—
1790A-1A	29	26	1890-1, 2, 3	29	26	2018-9	38	—

2-SPEED AXLES

MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing	MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing	MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing
1350	19	19	16600-1	24	25	19500-1, 2, 3	34	—
13600	19	19	16802-3	24	25	19800-1	34	—
13602	19	19	17500-1	29	26	20500-1, 2, 3	38	—
13800	19	19	17800-1	29	26	20800-1	38	—
13802	19	19	18500-1, 2, 3	29	26	22500-1	35	—
16500-1	24	25	18800-1, 2, 3	29	26			

PLANETARY DOUBLE REDUCTION AXLES

MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing	MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing	MODEL	CAPACITY* (pints) Forged Housing	CAPACITY* (pints) Fabricated Housing
350	19	19	7800-1	29	26	0800-1	38	—
3800	19	19	8802-3	29	26	2500-1	35	—
3802	19	19	9502-3	34	—	45AR	38	—
6600-1	24	25	9800-1	34	—			
6802-3	24	25	0502-3	38	—			

TANDEM DRIVE AXLES

MODEL	CAPACITY* (pints) Forged Housing	MODEL	CAPACITY* (pints) Forged Housing	MODEL	CAPACITY* (pints) Forged Housing
22MF	12	32M (Power Divider)	3	38DP	29
22M (Power Divider)	9	32MR	32	38D-3	29
22MR	12	34DS	29	38RS	32
28MF	17	34DT	29	38RT	32
28M (Power Divider)	9	34DP	29	38RP	32
28MR	17	34D-3	29	38R-3	32
30DS	30	34RS	32	42DT	31
30DT	30	34RT	32	42DP	31
30DP	30	34RP	32	42RT	29
30D-3	30	34R-3	32	42RP	29
30RS	27	36MF	24	50MF (in Rear filler hole)	20
30RT	27	36M (Power Divider)	3	(in Front filler hole)	2
30RP	27	36MR	24	50M (Power Divider)	6
30R-3	27	38DS	29	50MR (in Rear filler hole)	20
32MF	29	38DT	29	(in Front filler hole)	2

*Capacities listed are approximate. The amount of lubricant will vary with angle of axle as installed in the vehicle chassis.

► TORQUE REQUIREMENTS FOR EATON REAR AXLES

This section includes tightening torque requirements for bolts, nuts and cap screws as used on Eaton Axles. Ring gear rivet pressures are also included.

The information is divided into individual tables covering specific axles. The axle model no. and attaching part locations are cross-indexed to thread size and recommended torque value.

Correct tightening torque values are extremely important to assure long Eaton Axle life and dependable performance. Under-tightening of attaching parts is just as harmful as over-tightening.

Special attention should be given to tightening the inspection cover cap screws when a cork cover gasket is used. Cork gaskets should be asembled "DRY". Use of lubricant or sealer will cause gasket to slide out when cap screws are tightened. Excessive torquing of cap screws may buckle cover between mounting holes and create a lubricant leak.

Exact compliance with recommended torque values given herein will assure the best results.

► single reduction axles

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL		1315	1614 1618	1790A 1862	1792 1880 1892	1910 2010	1918 2018
Drive Pinion Nut		225-350 1-20	325-450 1⅛-18	400-600 1¼-12	400-600 1¼-12	500-700 1½-18	600-800 1¾-12
Pinion Bearing Cage to Differential Carrier		115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	160-175 ⅝-11	160-175 ⅝-11
Differential Carrier to Axle Housing	Cap-Screw	45-55 7/16-14	75-85 ½-13	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	—
	Stud Nut	—	—	—	220-240 ⅝-18	220-240 ⅝-18	220-240 ⅝-18
Differential Case		55-65 7/16-14	90-105 ½-13	90-105 ½-13	90-105 ½-13	135-155 ⅜-12	135-155 ⅜-12
Inspection Cover to Axle Housing		35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14
Differential Bearing Cap to Carrier		150-170 ⅝-11	210-250 11/16-11	(L.H.) 210-250 11/16-11 (R.H.) 150-170 ⅝-11	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10
Differential Bearing Adjuster Lock		—	115-125 ⅜-12 Model 1618 only	—	160-175 ⅝-11 Model 1880 only	—	—
Oil Collector Drum to Differential Case		—	—	—	45-55 7/16-14 Model 1880 only	—	—
Ring Gear to Differential Case	Rivet Pressures in Tons	44-48	47-50	47-50	47-50	—	—
	Bolt and Nut	50-60 7/16-20	85-95 ½-20	85-95 ½-20	85-95 ½-20	155-170 ⅝-18	155-170 ⅝-18

torque requirements

► 2-speed axles

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL		1350 13800 13802	13600 13602	16500 16600 16802	17500 17800	18500 18802	19502 20502	19800 20800	22501
Drive Pinion Nut		225-350 1-20	225-350 1-20 325-450 1⅛-18	325-450 1⅛-18	400-600 1¼-12	400-600 1¼-12	500-700 1½-18	600-800 1¾-12	600-800 1¾-12
Pinion Bearing Cage to Differential Carrier		115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	160-175 ⅝-11	160-175 ⅝-11
Gear Support Case		60-75 7/16-20	60-75 7/16-20	85-105 ½-20	135-150 ⅝-18	135-150 ⅝-18	135-150 ⅝-18	135-150 ⅝-18	170-190 ⅝-18
Differential Carrier to Axle Housing	Cap Screw	45-55 7/16-14	45-55 7/16-14	75-85 ½-13	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	—	160-175 ⅝-11
	Stud Nut	—	—	—	—	220-240 ⅝-18	220-240 ⅝-18	220-240 ⅝-18	170-190 ⅝-18
Differential Case		55-65 7/16-14	55-65 7/16-14	55-65 7/16-14	90-105 ½-13	90-105 ½-13	90-105 ½-13	90-105 ½-13	135-155 ⅜-12
Inspection Cover to Axle Housing		35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14
Differential Bearing Cap to Carrier		150-170 ⅝-11	150-170 ⅝-11	210-250 11/16-11	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10	425-500 ⅞-9
Differential Bearing Adjuster Lock		115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	275-300 ¾-10
Electric or Air-Torsion Spring Shift Unit to Carrier		35-40 7/16-20	35-40 7/16-20	35-40 7/16-20	35-40 7/16-20	35-40 7/16-20	35-40 7/16-20	35-40 7/16-20	85-95 ½-20

► planetary double reduction axles

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL		350 3800 3802	6600 6802	7800	8802	9502 0502	9800 0800	2501	45AR
Drive Pinion Nut		225-350 1-20	325-450 1⅛-18	400-600 1¼-12	400-600 1¼-12	500-700 1½-18	600-800 1¾-12	600-800 1¾-12	500-700 1½-18
Pinion Bearing Cage to Differential Carrier		115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	115-125 ⅜-12	160-175 ⅝-11	160-175 ⅝-11	115-125 ⅜-12
Gear Support Case		60-75 7/16-20	85-105 ½-20	135-150 ⅜-18	135-150 ⅜-18	135-150 ⅜-18	135-150 ⅜-18	170-190 ⅝-18	135-150 ⅜-18
Differential Carrier to Axle Housing	Cap Screw	45-55 7/16-14	75-85 ½-13	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	—	160-175 ⅝-11	—
	Stud Nut	—	—	—	220-240 ⅝-18	220-240 ⅝-18	220-240 ⅝-18	170-190 ⅝-18	220-240 ⅝-18
Differential Case		55-65 7/16-14	55-65 7/16-14	90-105 ½-13	90-105 ½-13	90-105 ½-13	90-105 ½-13	135-155 ⅜-12	90-105 ½-13
Inspection Cover to Axle Housing		35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14	35-50 7/16-14
Differential Bearing Cap to Carrier		150-170 ⅝-11	210-250 11/16-11	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10	425-500 ⅞-9	350-425 13/16-10
Differential Bearing Adjuster Lock		115-125 ⅜-12	115-125 ⅜-12	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	275-300 ¾-10	160-175 ⅝-11
Shift Box Cover to Carrier		45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	75-85 ½-13	45-55 7/16-14

torque requirements

► "D" series tandem drive axles (forward rear axles)

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL		30DS	30DT	30DP	34DS 38DS	34DT 38DT	34DP 38DP	42DT	42DP
Input Shaft Nut		175-425 1½-18	175-425 1½-18	175-425 1½-18	175-425 1½-18	175-425 1½-18	175-425 1½-18	175-425 1½-18	175-425 1½-18
Input Shaft Bearing Cover		75-85 ½-13	75-85 ½-13	75-85 ½-13	75-85 ½-13	75-85 ½-13	75-85 ½-13	75-85 ½-13	75-85 ½-13
Differential Carrier Cover to Carrier		115-125 ⅝-12	115-125 ⅝-12	115-125 ⅝-12	115-125 ⅝-12	115-125 ⅝-12	115-125 ⅝-12	115-125 ⅝-12	115-125 ⅝-12
Drive Pinion Nut		500-700 1½-18	500-700 1½-18	500-700 1½-18	500-700 1½-18	500-700 1½-18	500-700 1½-18	500-700 1½-18	500-700 1½-18
Pinion Bearing Cage to Differential Carrier		135-155 ⅝-12	135-155 ⅝-12	135-155 ⅝-12	135-155 ⅝-12	135-155 ⅝-12	135-155 ⅝-12	135-155 ⅝-12	135-155 ⅝-12
Gear Support Case		—	85-105 ½-20	85-105 ½-20	—	135-150 ⅝-18	135-150 ⅝-18	135-150 ⅝-18	135-150 ⅝-18
Ring Gear to Differential Case	Rivet Pressures in Tons	47-50	—	—	47-50	—	—	—	—
	Bolt and Nut	85-95 ½-20	—	—	85-95 ½-20	—	—	—	—
Differential Carrier to Axle Housing	Cap Screw	—	—	—	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11
	Stud Nut	110-130 ½-20	110-130 ½-20	110-130 ½-20	220-240 ⅝-18	220-240 ⅝-18	220-240 ⅝-18	220-240 ⅝-18	220-240 ⅝-18
Inspection Cover to Axle Housing	Stud Nut*	70-85 7/16-20	70-85 7/16-20	70-85 7/16-20	70-85 7/16-20	70-85 7/16-20	70-85 7/16-20	70-85 7/16-20	70-85 7/16-20
Differential Case		90-105 ½-13	55-65 7/16-14	55-65 7/16-14	90-105 ½-13	90-105 ½-13	90-105 ½-13	90-105 ½-13	90-105 ½-13
Differential Bearing Cap to Carrier		210-250 11/16-11	210-250 11/16-11	210-250 11/16-11	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10
Differential Bearing Adjuster Lock		115-125 ⅝-12	115-125 ⅝-12	115-125 ⅝-12	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11
Output Shaft Nut		175-325 1¼-12	175-325 1¼-12	175-325 1¼-12	175-325 1¼-12	175-325 1¼-12	175-325 1¼-12	175-325 1¼-12	175-325 1¼-12
Inter-Axle Differential Case		50-60 7/16-20	50-60 7/16-20	50-60 7/16-20	50-60 7/16-20	50-60 7/16-20	50-60 7/16-20	50-60 7/16-20	50-60 7/16-20
Oil Collector Drum to Differential Case		—	—	—	45-55 7/16-14	—	—	—	—
Lockout Shift Lever Bracket to Differential Carrier Cover	Vacuum or Mechanical	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14
	Air	30-40 7/16-14	30-40 7/16-14	30-40 7/16-14	30-40 7/16-14	30-40 7/16-14	30-40 7/16-14	30-40 7/16-14	30-40 7/16-14

* Single cap screw should be torqued to 45-55 ft.-lbs.

(continued)

"D" series tandem drive axles (forward rear axles)

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL	30DS	30DT	30DP	34DS 38DS	34DT 38DT	34DP 38DP	42DT	42DP
Air-Torsion Spring Shift Unit or Shift Box Cover to Carrier	45-55 7/16-14	35-40 7/16-20	45-55 7/16-14	45-55 7/16-14	35-40 7/16-20	45-55 7/16-14	35-40 7/16-20	45-55 7/16-14

► "D" series tandem drive axles (rear rear axles)

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL		30RS	30RT	30RP	34RS 38RS	34RT 38RT	34RP 38RP	42RT	42RP
Drive Pinion Nut		325-450 1 1/8-18	325-450 1 1/8-18	325-450 1 1/8-18	400-600 1 1/4-12	400-600 1 1/4-12	400-600 1 1/4-12	400-600 1 1/4-12	400-600 1 1/4-12
Pinion Bearing Cage to Differential Carrier		115-125 9/16-12	115-125 9/16-12	115-125 9/16-12	115-125 9/16-12	115-125 9/16-12	115-125 9/16-12	115-125 9/16-12	115-125 9/16-12
Gear Support Case		—	85-105 1/2-20	85-105 1/2-20	—	135-150 9/16-18	135-150 9/16-18	135-150 9/16-18	135-150 9/16-18
Ring Gear to Differential Case	Rivet Pressures in Tons	47-50	—	—	47-50	—	—	—	—
	Bolt and Nut	85-95 1/2-20	—	—	85-95 1/2-20	—	—	—	—
Differential Carrier to Axle Housing Stud Nut		110-130 1/2-20	110-130 1/2-20	110-130 1/2-20	220-240 5/8-18	220-240 5/8-18	220-240 5/8-18	220-240 5/8-18	220-240 5/8-18
Differential Case		90-105 1/2-13	55-65 7/16-14	55-65 7/16-14	90-105 1/2-13	90-105 1/2-13	90-105 1/2-13	90-105 1/2-13	90-105 1/2-13
Oil Collector Drum to Differential Case		—	—	—	45-55 7/16-14	—	—	—	—
Inspection Cover to Axle Housing		—	—	—	—	—	—	45-55 7/16-14	45-55 7/16-14
Differential Bearing Cap to Carrier		210-250 11/16-11	210-250 11/16-11	210-250 11/16-11	*(L.H.) 210-250 11/16-11 * (R.H.) 150-170 5/8-11	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10	350-425 13/16-10
Differential Bearing Adjuster Lock		115-125 9/16-12	115-125 9/16-12	115-125 9/16-12	160-175 5/8-11	160-175 5/8-11	160-175 5/8-11	160-175 5/8-11	160-175 5/8-11
Air-Torsion Spring Shift Unit or Shift Box Cover to Carrier		45-55 7/16-14	35-40 7/16-20	45-55 7/16-14	45-55 7/16-14	35-40 7/16-20	45-55 7/16-14	35-40 7/16-20	45-55 7/16-14

* For 34RS and 38RS with 2-speed carrier, torque cap screws to **350-425** (13/16-10) ft. lbs.

► "M" series tandem drive axles (forward rear axles)

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL		22MF	28MF	32MF	36MF	50MF
Companion Flange Nut (Input Shaft)		175-275 1⅛-18	175-275 1⅛-18	175-275 1⅛-18	175-425 1½-18	175-450 1¾-12
Input Shaft Inner Nut		175-275 1⅛-18	175-275 1⅛-18	175-275 1⅛-18	175-450 1¾-12	175-450 1¾-12
Inter-Axle Differential Case		30-40 ⅜-24	30-40 ⅜-24	50-60 7/16-20	50-60 7/16-20	50-60 7/16-20
Drive Pinion Nut		400-600 1¼-18	400-600 1¼-18	600-800 1¾-12	600-800 2-12	600-800 1¾-12
Output Shaft Front Nut		175-275 1⅛-18	175-275 1⅛-18	175-275 1⅛-18	175-450 1¾-12	175-450 1¾-12
Companion Flange Nut (Output Shaft)		175-275 1⅛-18	175-275 1⅛-18	175-275 1⅛-18	175-425 1½-18	175-425 1½-18
Power Divider Case Cover to Case		75-85 ½-13	75-85 ½-13	85-95 ½-20	125-135 9/16-18	125-135 9/16-18
Pinion Bearing Cage to Power Divider Case		75-85 ½-13	75-85 ½-13	115-125 9/16-12	125-135 9/16-18	115-125 9/16-12
Differential Case		85-95 ½-20	85-95 ½-20	90-105 ½-13	135-155 9/16-12	150-170 9/16-18
Ring Gear to Differential Case Rivet Pressures in Tons		34-38	40-42	47-50	39-41	—
Service Replacement Bolt and Nut		—	—	—	125-135 9/16-18	—
Bearing Covers to Power Divider Case and Cover		75-85 ½-13	75-85 ½-13	75-85 ½-13	85-95 ½-20	75-85 ½-13
Power Divider Case to Differential Carrier		85-95 ½-20	85-95 ½-20	85-95 ½-20	170-190 ⅝-18	170-190 ⅝-18
Differential Carrier to Axle Housing	Cap Screw	50-60 7/16-20	85-95 ½-20	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11
	Stud Nut	50-60 7/16-20	85-95 ½-20	220-240 ⅝-18	220-240 ⅝-18	220-240 ⅝-18
Differential Bearing Cap to Carrier		125-135 9/16-18	125-135 9/16-18	210-250 11/16-11	350-425 13/16-10	425-500 ⅞-9
Lockout Shift Lever Bracket to Power Divider Case	Vacuum or Mechanical	30-40 ⅜-24	30-35 ⅜-16	45-55 7/16-14	45-55 7/16-14	45-55 7/16-14
	Air	30-40 ⅜-24	30-35 ⅜-16	30-40 7/16-14	30-40 7/16-14	30-40 7/16-14
Drive Pinion Inner Bearing Sleeve Set Screw		75-85 ½-13	75-85 ½-13	75-85 ½-13	75-85 ½-13	75-85 ½-13
Oil Collector or Oil Collector Disc (Cap Screw)		8-10 ¼-20	8-10 ¼-20	15-20 5/16-18	15-20 5/16-18	50-60 7/16-20
Countershaft Bearing Cover to Differential Carrier		—	—	—	—	30-35 ⅜-16

(continued)

"M" series tandem drive axles (forward rear axles)

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL	22MF	28MF	32MF	36MF	50MF
Ring Gear to Countershaft	—	—	—	—	100-120 ½-20
Herringbone Gear to Differential Case	—	—	—	—	190-210 ⅝-18
Oil Reservoir to Differential Carrier	—	—	—	—	45-55 7/16-14

►"M" series tandem drive axles (rear rear axles)

Torque Settings (ft-lbs.)—Thread Size

EATON AXLE MODEL		22MR	28MR	32MR	36MR	50MR
Drive Pinion Nut		325-450 1⅛-18	325-450 1⅛-18	325-450 1⅛-18	500-700 1½-18	500-700 1½-18
Pinion Bearing Cage to Differential Carrier		115-125 9/16-12	115-125 9/16-12	115-125 9/16-12	160-175 ⅝-11	160-175 ⅝-11
Differential Carrier to Axle Housing	Cap Screw	50-60 7/16-20	85-95 ½-20	160-175 ⅝-11	160-175 ⅝-11	160-175 ⅝-11
	Stud Nut	50-60 7/16-20	85-95 ½-20	220-240 ⅝-18	220-240 ⅝-18	220-240 ⅝-18
Differential Case		85-95 ½-20	85-95 ½-20	100-120 ½-20	90-105 ½-13	150-170 9/16-18
Differential Bearing Cap to Carrier		125-135 9/16-18	125-135 9/16-18	(L.H.) 150-170 ⅝-11 (R.H.) 210-250 11/16-11	350-425 13/16-10	425-500 ⅞-9
Ring Gear to Differential Case Rivet Pressures in Tons		34-38	40-42	47-50	39-41	—
Service Replacement Bolt and Nut		—	—	85-95 ½-20	125-135 9/16-18	—
Oil Lubricator to Differential Case		15-20 5/16-18	15-20 5/16-18	45-55 7/16-14	15-20 5/16-18	—
Oil Seal Retainer to Pinion Bearing Cage		—	—	—	30-35 ⅜-16	—
Oil Collector Disc to Countershaft		—	—	—	—	50-60 7/16-20
Countershaft Bearing Cover to Differential Carrier		—	—	—	—	30-35 ⅜-16
Ring Gear to Countershaft		—	—	—	—	100-120 ½-20
Herringbone Gear to Differential Case		—	—	—	—	170-190 ⅝-18
Oil Reservoir to Differential Carrier		—	—	—	—	45-55 7/16-14

SPECIAL BULLETINS

Special Bulletins are available, by request, for units not included in this manual. At this writing, the following publications are available:

Form No.	Title
A-298	Air Shift System
A-299	Vacuum Shift System
A-473	Failure Analysis
A-534	Vehicle Speed Chart

Request Bulletins from:

EATON MANUFACTURING COMPANY
Axle Division
739 East 140th Street • Cleveland 10, Ohio

Attention: TECHNICAL SERVICE