

# **SERVICE MANUAL**

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## **SERVICE MANUAL SECTION**

### **CAM AIR FOUNDATION BRAKES**

**Truck Model: 2000**

**Truck Model: 3000**

**Truck Model: 4000**

**Truck Model: 5000**

**Truck Model: 8000**

**Truck Model: 9100**

**Truck Model: 9200**

**Truck Model: 9300**

**Truck Model: 9400**

**Truck Model: 9600**

**Truck Model: 9700**

**Truck Model: 9800**

**s04005, Formerly CTS-5060**

**03/31/1996**



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## DESCRIPTION



### **WARNING – MATERIAL DUST DURING BRAKE SERVICING**

- A. Studies have indicated that exposure to excessive amounts of brake material dust (whether asbestos or non-asbestos, fiberglass, mineral wool, aramid, ceramic or carbon) may be a potential cancer-causing health hazard. Even though the Occupational Safety and Health Administration (OSHA) has not set any limits on non-asbestos dust exposure, there is some medical opinion that such non-asbestos fibers can cause cancer as well. Since most automotive friction materials normally contain a sizeable amount of this material, it is important that people who handle brake linings be aware of the problem and know the precautions to be taken.
- B. Areas where brake work is done should be set aside, if possible, and should be posted with a material dust exposure sign as follows:
  - BRAKE LINING FIBER DUST HAZARD
  - AVOID BREATHING DUST
  - WEAR ASSIGNED PROTECTIVE EQUIPMENT
  - DO NOT REMAIN IN AREA UNLESS YOUR WORK REQUIRES IT
  - BREATHING BRAKE LINING FIBERS MAY BE HAZARDOUS TO YOUR HEALTH
- C. OSHA standards should be consulted with respect to mandatory requirements as well as for suggested procedures to minimize exposure. (Reference: Title 29, Code of Federal Regulations, Section 1910.1001.)
- D. Whenever possible, work on brakes in a separate area away from other operations.
- E. Always wear a respirator approved by NIOSH or MSHA during all brake service procedures. Wear the respirator from removal of the wheels through assembly.
- F. NEVER use compressed air or dry brushing to clean brake parts or assemblies. OSHA recommends that you use cylinders that enclose the brake. These cylinders have vacuums with high efficiency (HEPA) filters and worker's arm sleeves. But, if such equipment is not available, carefully clean parts and assemblies in the open air.
- G. Clean brake parts and assemblies in the open air. During disassembly, carefully place all parts on the floor to avoid getting dust into the air. Use an industrial vacuum cleaner with a HEPA filter system to clean dust from the brake drums, backing plates and other brake parts. After using the vacuum, remove any remaining dust with a rag soaked in water and wrung until nearly dry.
- H. Grinding or machining brake linings. If you must grind or machine brake linings, take additional precautions because contact with fiber dust is higher during these operations. In addition to wearing an approved respirator, do such work in an area with exhaust ventilation.
- I. Cleaning the work area. NEVER use compressed air or dry sweeping to clean the work area. Use an industrial vacuum with a HEPA filter and rags soaked in water and wrung until nearly dry. Dispose of used rags with care to avoid getting dust into the air. Use an approved respirator when emptying vacuum cleaners and handling used rags.
- J. Worker clean-up. Wash your hands before eating, drinking or smoking. Do not wear your work clothes home. Vacuum your work clothes after use and then launder them separately, without shaking, to prevent fiber dust from getting into the air.

The term "Foundation" brake is given to those components at wheels which actually do the braking. This includes such items as brake shoes, linings, anchors, drums, spiders and/or backing plates. Although the slack adjusters, cam, cam rollers and spring brake chambers are not considered components of the foundation brakes, they will be covered in this section.

## 1. MAINTENANCE

A regular schedule for cleaning, lubrication, adjustment and inspection should be established, usually based on past experience and type of vehicle operation. It is difficult to determine an exact maintenance "time or mileage" interval since vehicles will be used in a wide variety of operations, applications and conditions.

To compensate for lining wear, brakes with manual slack adjusters should be adjusted frequently to maintain satisfactory operation and efficient braking. Vehicles equipped with automatic slack adjusters will need inspection only and service as necessary.

Drain air reservoirs regularly as required. Local conditions govern frequency. Dry climates require less attention than humid areas, where it may be necessary to drain reservoirs daily.

When draining air reservoirs, let all air bleed off and be sure all drainage stops.

For more details, refer to the appropriate air brake system section in GROUP 04 BRAKES in the CTS-5000 Master Service Manual.

### 1.1. PREVENTIVE MAINTENANCE

Every month or every 4,000 miles (6,000 km), brake chamber push rod travel should be checked. Push rod travel should be kept at a minimum without brakes dragging. Excessive travel of brake chamber push rod shortens the life of the diaphragm. Over- travel also slows braking response.

Once each year, or every 100,000 miles (160,000 km), brake chambers should be disassembled and cleaned, and a new diaphragm installed. Be sure to use the correct diaphragm return springs when reassembling chamber or uneven braking may result.



**WARNING – The tamper resistant spring brake has been factory sealed for your protection. There are no user- serviceable parts inside the spring brake chamber. If you experience any damage or failure to the spring brake chamber, replace the complete assembly. Never attempt to disassemble the spring brake chamber as serious personal injury or death could result from accidental sudden release of the high energy spring.**

After the brake chamber is installed, the brakes must be adjusted. Refer to BRAKE ADJUSTMENT.

### 1.2. BRAKE MAINTENANCE

Lack of proper brake maintenance can be a contributing factor to brake complaints. Proper brake balance between tractor and trailer, and periodic inspection of push rod travel and brake adjustment are essential for effective braking.

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Inspect the brake lining every 12,000 miles (19,000 km) or every 12 months, whichever occurs first. When brake lining or blocks are worn to 1/4 inch (6.35mm) thickness on drive axle brakes or 3/16 inch (4.75mm) thickness on steering axle brakes, the brake lining must be replaced.

If the brake lining is satisfactory, adjust brakes one wheel at a time, with all drums in place and all slack adjusters connected to chambers.

**NOTE – A 15 inch Q Plus is now available in addition to the 15 inch Q brake. The 15 inch Q brake cannot be converted to Q Plus because of the design difference in brake offset, bearing journals and cam head profile. 16 1/2 inch Q brakes can be converted to the Q Plus design by changing the shoe and lining assembly, camshaft and return spring. The differences between the Q Plus design and the Q brake are illustrated in Figure 1 .**

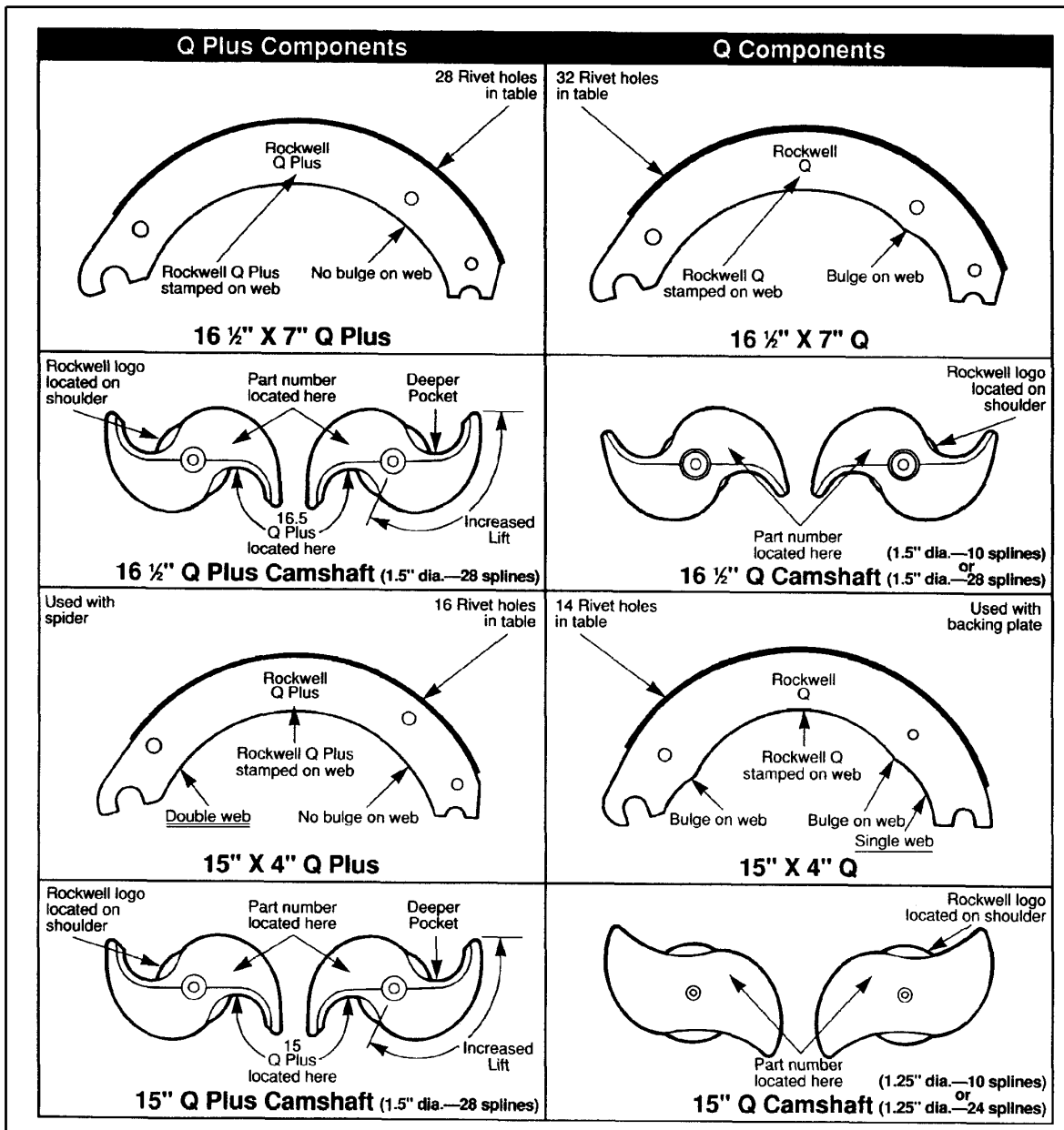


Figure 1 Identifying Rockwell Q Plus Brake Components



**WARNING** – It is very important that a standard Q brake camshaft never be used with Q Plus brake shoes. Q Plus brake shoes must be used with Q Plus camshafts. All Q Plus shoes and camshafts are marked with "Q Plus" for easy identification. If Q Plus shoes are used with standard Q camshafts, there is a possibility that the camshaft will "roll over" during brake application under certain operating conditions. This could result in brake failure and possible personal injury. Also, a new brake drum may not fit over the Q Plus brake shoes if the shoes are used with a standard Q brake camshaft.





**WARNING** – The tamper resistant spring brake has been factory sealed for your protection. There are no user-serviceable parts inside the spring brake chamber. If you experience any damage or failure to the spring brake chamber, replace the complete assembly. Never attempt to disassemble the spring brake chamber as serious personal injury or death could result from accidental sudden release of the high energy spring.

## 2. TROUBLESHOOTING

**Table 1 Troubleshooting Chart**

CONDITION	POSSIBLE CAUSE	REMEDY
Insufficient brakes	Brakes need adjusting or relining.	Adjust, reline or replace as necessary.
Brakes apply too slowly	Brakes need adjusting or lubricating.	Adjust or lubricate as necessary.
Brakes release too slowly	Brakes need adjusting or lubricating.	Adjust or lubricate as necessary.
Brakes do not release	Sticking shoe guide pins, and/or anchor pins.	Repair or replace as necessary.
	Broken or weak return springs.	Repair or replace as necessary.
Brakes grab or erratic braking	Grease or lube on brake lining.	Reline brakes. If the lining is not badly saturated, clean lining with denatured alcohol, then sand the lining lightly with medium grit emery cloth and air dry.
	Sticking shoe guide pins and/or weak return springs.	Repair or replace as necessary.
	Broken or weak return springs.	Replace as necessary.
	No vehicle load.	Operate vehicle with caution when not under load condition.
	Loose drum or brake mounting.	Retorque fasteners.
Uneven brakes	Brakes need adjusting or relining.	Adjust or reline as necessary.
	Improper axle mounting.	Check and repair as necessary.
	Brake shoe return spring broken.	Replace as necessary.
	Brake drum out of round.	Refinish drum if possible without exceeding maximum diameter, or replace as necessary.
	Brake chamber diaphragm failure.	Repair or replace as necessary.
	Wrong or mixed brake lining.	Repair as necessary.
	Broken foundation brake parts.	Replace as necessary.

**Table 1 Troubleshooting Chart (cont.)**

CONDITION	POSSIBLE CAUSE	REMEDY
	Grease or lube on brake lining.	Reline brakes. If lining is not badly saturated, clean lining with denatured alcohol, then sand the lining lightly with medium grit emery cloth and air dry.
Brake too tight or dragging	Control arm on automatic slack adjuster not positioned properly.	Adjust as necessary.
	Push rod binding on chamber housing.	Repair or replace as necessary.
	Weak or broken chamber return spring.	Replace as necessary.
Excessive brake chamber push rod travel	Loose, broken or bent automatic slack adjuster.	Repair or replace as necessary.
	Worn camshaft bushing.	Replace as necessary.
	Worn linings or drum.	Replace as necessary.

### 3. DISASSEMBLY

Variations in disassembly procedures may be required as different types of brakes are used on International vehicles. Some typical brakes used are single and double anchor pin cam actuated types as well as wedge type actuated brakes. For particular service, refer to GROUP 04 - BRAKES in the CTS- 5000 Master Service Manual.

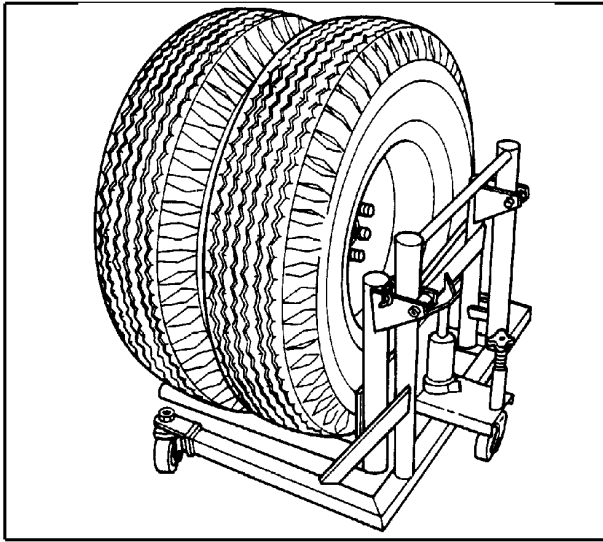
#### 3.1. WHEEL, HUB AND DRUM

1. Block wheels.
2. Position vehicle on floor stands.



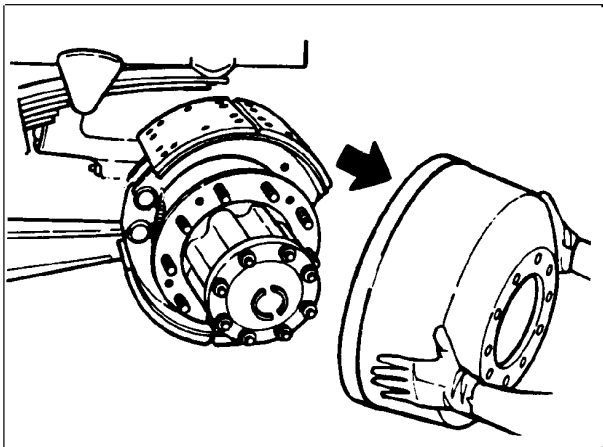
**WARNING – A jack must never be used to support vehicle while under chassis service is being performed. The jack may lower and serious personal injury could result. Always support vehicle with floor stands.**

3. If servicing a brake assembly with a spring (PARKING) brake, the spring brake must be CAGED. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.
4. It may be necessary to back off the brake adjustment to obtain enough clearance for drum removal. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual for procedures.
5. Remove brake drum assembly as determined by the type of drum mounting.
  - a. Inboard mounted drums will be secured to the hub assembly on the brake group side of hub. With this type drum mounting, the wheel, hub and drum are removed as one assembly ( Figure 2 ).



**Figure 2 Using Wheel Dolly to Remove Wheel, Hub and Drum Assembly**

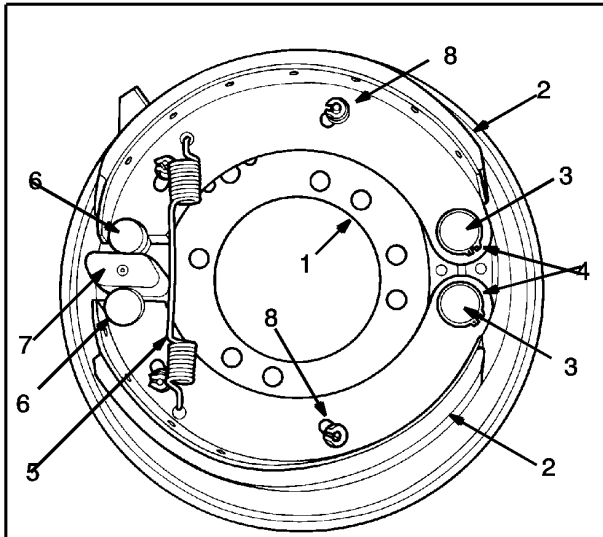
- b. Outboard mounted drums will be secured between the wheel and hub. When outboard mounted drum brake groups are serviced, the wheels are removed, then the drum can be removed without disturbing the hub assembly. This will eliminate servicing the wheel bearings ( Figure 3 ). For more detailed information, refer to GROUP 17 - WHEELS, RIMS AND TIRES in the CTS-5000 Master Service Manual.



**Figure 3 Removing Outboard Mounted Drum**

### 3.2. BRAKE GROUPS WITH BACKING PLATE

#### Rockwell "T" Series ( Figure 4 )



**Figure 4 Rockwell "T" Series Brake with Backing Plate**

1. BACKING PLATE
2. LINING AND SHOE
3. ANCHOR PINS
4. ANCHOR PIN RETAINERS
5. RETURN SPRING
6. ROLLERS
7. CAM
8. GUIDE PIN ASSEMBLY

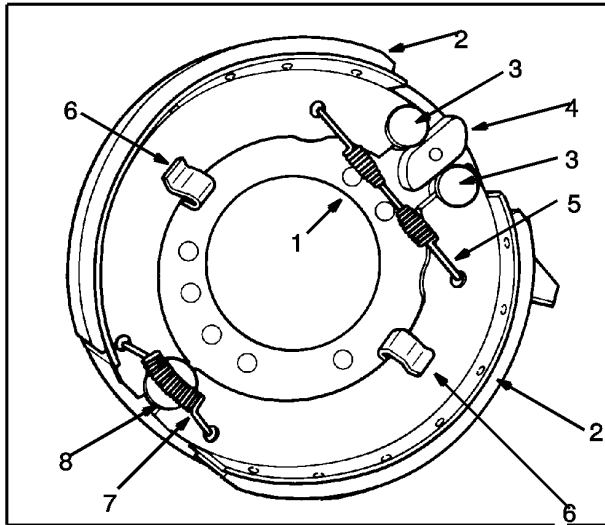
1. Remove shoe return spring by using brake pliers, or by using a pry bar or large screwdriver and lifting shoe off the cam. Then remove rollers and retainers (if equipped) from cam end of shoes. Removing rollers first will relieve most of the tension from the return spring, permitting the spring to be disconnected from the shoes.
2. Remove "C" washers (retainers) from guide pins. Then remove flat washers, cupped washers or coil spring from guide pin. Note position of the spring assembly.
3. Remove retainer lock rings from anchor pins. Then remove washers, felt retainers and felts from anchor pins.
4. Lift brake shoes from guide and anchor pins.
5. The brake shoe anchor pin may now be removed if so desired, by removing the nut and lock washer from the anchor pin, then forcing the anchor pin from the backing plate.

**NOTE – When removing the automatic slack adjuster, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.**

6. With manual slack adjusters, mark the position of slack adjuster in relation to the camshaft and remove clevis pin connecting the brake chamber push rod to the slack adjuster.

7. Remove the lock ring retaining the slack adjuster to the camshaft, then remove the slack adjuster from the camshaft. Note location of spacers and washers for reassembly purposes.
8. Remove camshaft from support bracket.

#### Eaton Brake ( Figure 5 )



**Figure 5 Eaton Brake with Backing Plate**

1. BACKING PLATE
2. LINING AND SHOE
3. ROLLERS
4. CAM
5. RETURN SPRING
6. SHOE RETAINER CLAMPS
7. RETAINER SPRING
8. ANCHOR PIN

1. Using a large screwdriver or suitable pry bar, lift upper shoe and remove cam roller and retainer (if equipped).
2. Remove lower cam roller using the same procedure used for the upper roller.
3. Remove shoe return spring using a suitable tool.
4. Rotate lower shoe downward and turn to allow disengagement of shoe from shoe retainer clamp. Remove lower shoe and retainer spring.
5. Lift upper shoe, rotate, and remove from shoe retainer clamp.
6. Remove cotter pin and clevis pin from air chamber push rod clevis.

**NOTE – When removing the automatic slack adjuster, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.**

7. With manual slack adjusters, mark position of slack adjuster in relation to camshaft.

8. With manual slack adjusters, if slack adjuster does not clear chamber push rod clevis, depress locking sleeve and turn adjuster nut until slack adjuster is clear of air chamber push rod clevis.
9. Remove snap ring, spacer, and washers retaining the slack adjuster to camshaft.
10. Remove slack adjuster from camshaft. If the slack adjuster is difficult to remove, use a suitable puller.

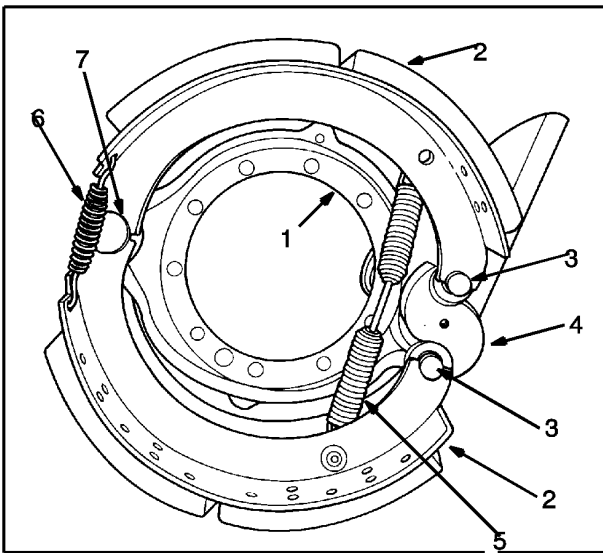
**NOTE – Do not use a hammer to remove the slack adjuster or camshaft.**

11. Remove camshaft from air chamber bracket.

### 3.3. BRAKE GROUPS WITH SPIDERS

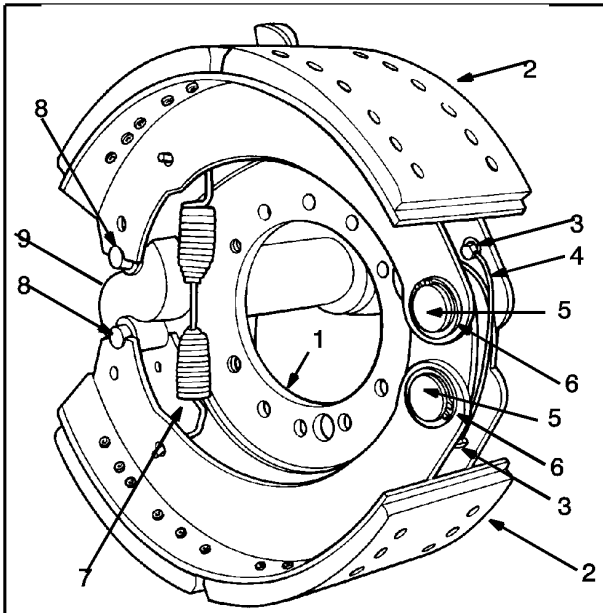
Three basic variations will be found in brake groups which use spiders.

1. Eaton brake groups ( Figure 6 ) use a fixed anchor pin with open end shoes at anchor end.
2. Rockwell "P" Series brake groups ( Figure 7 ) have removable anchor pins which utilize brake shoes with closed anchor pin openings (holes).
3. Rockwell "Q" Series brake groups ( Figure 8 ) have removable anchor pins with bushing and open end anchor location on brake shoes.



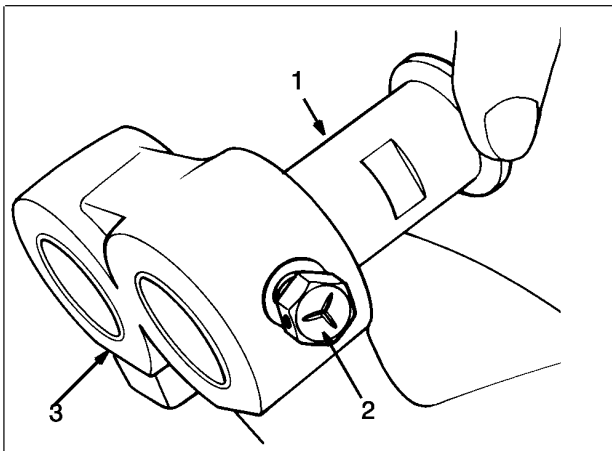
**Figure 6 Eaton Brake with Spider and Fixed Anchor Pins**

1. SPIDER
2. LINING AND SHOE
3. ROLLERS
4. CAM
5. RETURN SPRING
6. RETAINER SPRING
7. ANCHOR PIN



**Figure 7 Rockwell "P" Series Brake with Spider**

1. SPIDER
2. LINING AND SHOE
3. LOCK SCREWS
4. LOCK WIRE
5. ANCHOR PIN
6. LOCK RING AND WASHER ASSEMBLY
7. RETURN SPRING
8. ROLLERS
9. CAM



**Figure 8 Brake Spider With Removable Anchor Pins**

1. ANCHOR PIN
2. LOCK BOLT
3. SPIDER

**Eaton Brake ( Figure 6 )**

Remove brake shoes as follows.

1. Remove brake dust shields.
2. Using a suitable pry bar, pry each shoe (one at a time) away from the cam and lift out the rollers and retainers.
3. With the rollers removed, the shoe return spring will be loose and can be slipped off the links between the shoe webs.
4. The lower shoe will hang down. Remove the lower shoe from anchor pin retaining springs.
5. Remove the upper shoe and the two retaining springs.

**NOTE – When removing the automatic slack adjuster, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.**

6. With manual slack adjusters, mark the position of the slack adjuster in relation to the camshaft.
7. Disconnect the clevis pin connecting the brake chamber push rod to the slack adjuster.
8. Remove the lock ring retaining the slack adjuster to the end of the cam shaft. Note location of spacer washers for reassembly purposes.
9. Remove slack adjuster from camshaft.
10. Remove camshaft from spider and camshaft bracket.

**Rockwell "P" Series Brake ( Figure 7 )**

Remove brake shoes as follows.

1. Remove brake dust shields.
2. With a suitable bar, pry each shoe one at a time away from the cam and lift roller assemblies from end of shoes.
3. After the rollers are removed, the shoe return spring will be loose and can be slipped off the links between the shoe webs.
4. Remove anchor pin retainers (lock rings), seal retainers and felt seals.
5. Cut lock wire and remove anchor pin lock bolt ( Figure 8 ). The anchor pin can then be removed. As pins are forced out, the shoes will be free. Remove shoes.

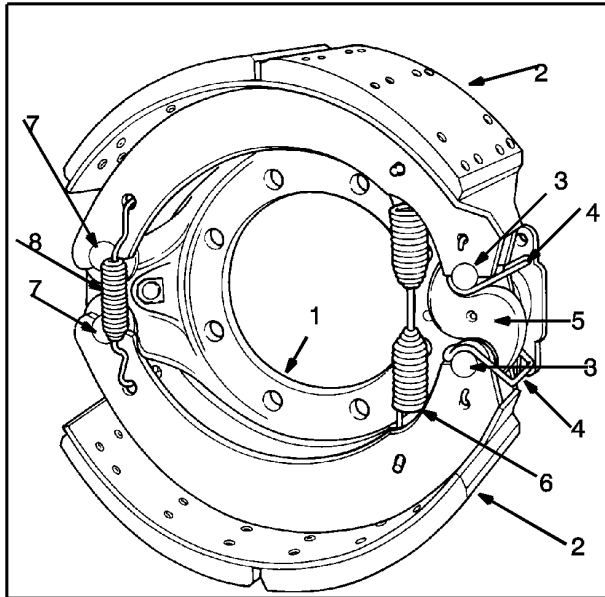
**NOTE – When removing the automatic slack adjuster, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.**

6. With manual slack adjusters, mark position of slack adjuster in relation to camshaft.
7. Remove clevis pin connecting brake chamber push rod to slack adjuster.



8. Remove lock ring retaining slack adjuster to end of camshaft. Note location of spacer washers for reassembly purposes.
9. Remove slack adjuster from camshaft.
10. Push or tap camshaft from spider and camshaft bracket.

**Rockwell "Q" Series Brake ( Figure 9 )**

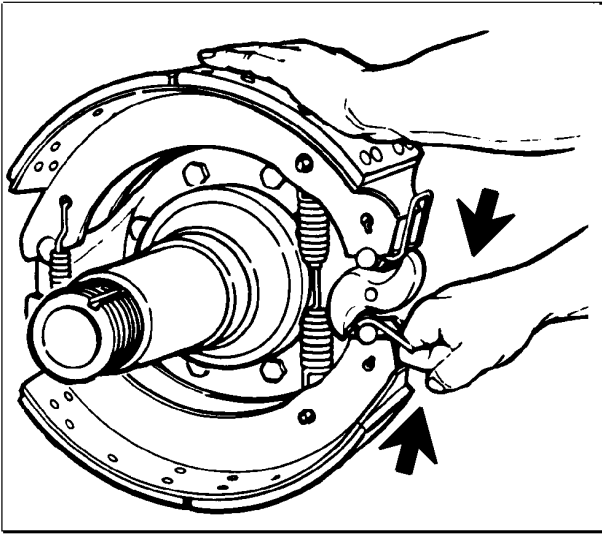


**Figure 9 Rockwell "Q" Series Brake With Spider and Removable Anchor Pins**

1. SPIDER
2. LINING AND SHOE
3. ROLLERS
4. ROLLER RETAINERS
5. CAM
6. RETURN SPRING
7. ANCHOR PINS
8. RETAINER SPRING

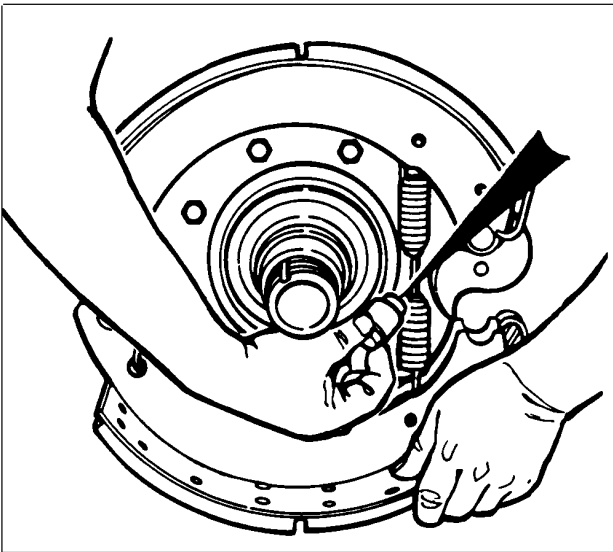
Remove brake shoes as follows.

1. Disconnect lower and upper cam roller retainers ( Figure 10 ).



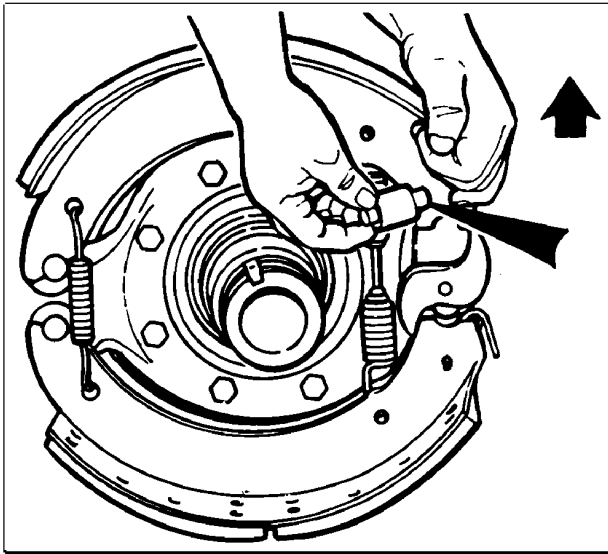
**Figure 10 Disconnecting Roller Retainers**

2. Press down on lower brake shoe and remove lower cam roller assembly ( Figure 11 ).



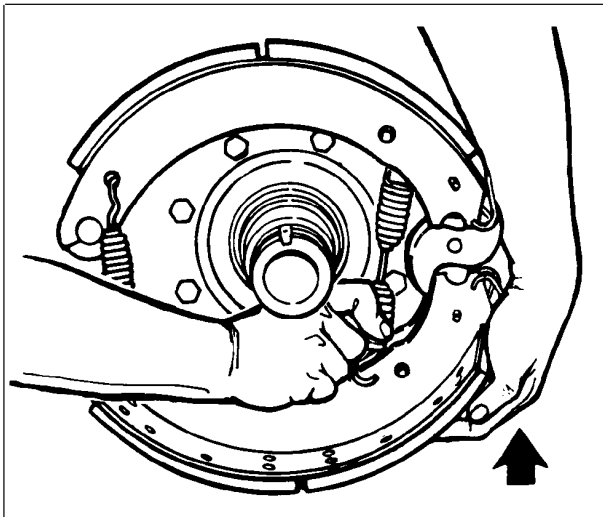
**Figure 11 Removing Lower Cam Roller**

3. Lift upper shoe and remove remaining roller assembly ( Figure 12 )



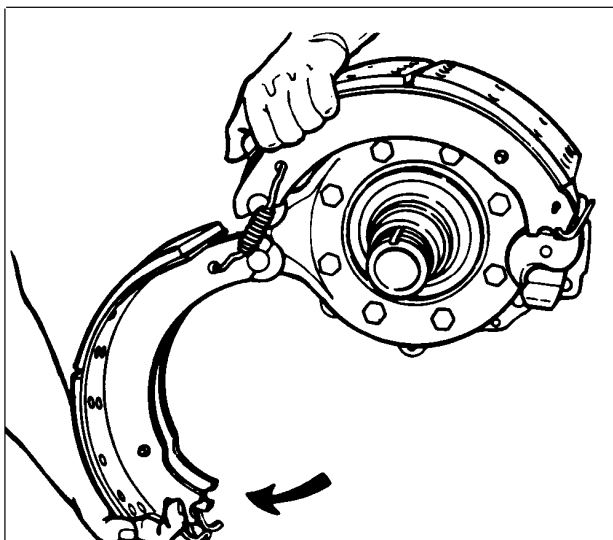
**Figure 12 Removing Upper Cam Roller**

4. After removing roller assemblies, the shoe return spring will be loose and can be slipped from the links between shoe webs ( Figure 13 )

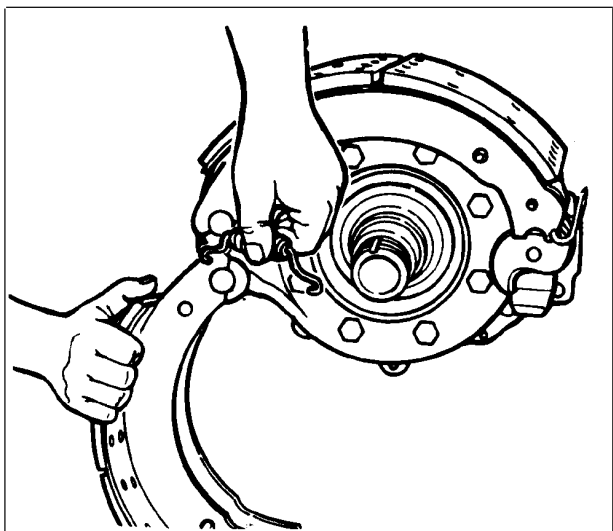


**Figure 13 Remove Shoe Return Spring**

5. Swing lower shoe back about 180 degrees to release the spring tension on the retainer springs ( Figure 14 ). Remove outer retainer spring ( Figure 15 ).



**Figure 14 Rotate Lower Shoe Approximately 180°**



**Figure 15 Removing Retainer Springs**

6. Remove both shoes from the spider, then remove retainer spring from shoes.

**NOTE – For vehicles with automatic slack adjusters, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.**

7. Mark position of manual slack adjuster in relation to camshaft. Also note position of adjusting screw.
8. Remove clevis pin connecting the brake chamber push rod to the slack adjuster.
9. Remove lock ring retaining slack adjuster to the end of camshaft.
10. Remove spacer, washer assembly, and slack adjuster from camshaft. Note location of spacer washers for reassembly purposes.

11. Push or tap camshaft from spider and camshaft bracket.

## 4. CLEANING AND INSPECTION

Thoroughly clean all parts except drums and brake linings in cleaning solvent and dry. The solvent will leave an oil residue that may affect brake performance.

**CAUTION – Refer to the warning,, which applies to brake lining material when servicing brakes.**

OSHA standards should be consulted with respect to mandatory requirements as well as for suggested procedures to minimize exposure.

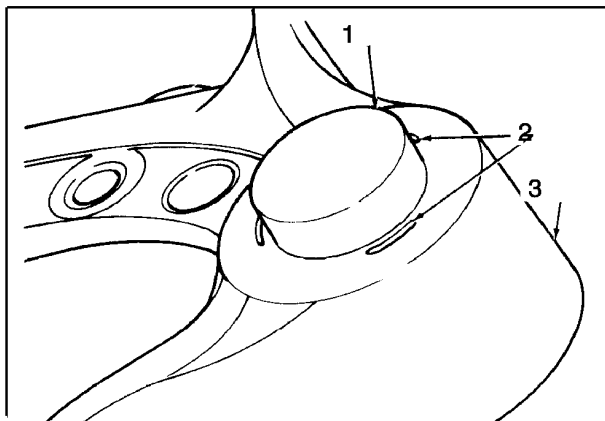
### 4.1. DRUM SHOE AND LINING

Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual for more detailed information.

### 4.2. ANCHOR PINS

The anchor pins should be inspected for signs of wear. In most cases rust will be the factor in servicing brake anchors. Clean all dirt and rust from anchors and apply a light coat of lubricant. Refer to GROUP 10 - LUBRICATION in the CTS-5000 Master Service Manual.

If anchor pins are worn, they must be replaced. Anchor pins can be replaced on all brake groups except Eaton. Eaton anchor pins are staked in place and are replaced with the spider ( Figure 16 ).



**Figure 16 Brake Spider With Fixed Anchor**

1. ANCHOR PIN
2. STAKE POINTS
3. SPIDER

### 4.3. BRAKE SHOE RETURN SPRINGS

Inspect brake shoe return springs for distortion such as nicks, twisted shanks or spread coils. Damaged springs must be replaced. It is recommended that the return spring be replaced whenever the shoes or linings are replaced.

#### **4.4. BACKING PLATE AND DUST SHIELDS**

Inspect backing plates and dust shields. If bent or twisted, they must be replaced.

#### **4.5. SPIDER**

Inspect spider for damage. If any cracks are found, the spider must be replaced.

#### **4.6. CAMSHAFT BUSHINGS AND ROLLERS**

Clean all dirt and rust from rollers and camshaft. In most cases rust will be the factor in servicing rollers. Check for dirt in splines on camshaft. Remove any small burrs from camshaft assembly to avoid damage to seals when cam is reinstalled.

Inspect camshaft, camshaft bushing or bearings and brake shoe rollers. If noticeable signs of wear exist, replace worn parts.

Do not remove camshaft bushings from spider and/or mounting bracket unless replacement is necessary.

For detailed service information, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.

### **5. REASSEMBLY**

#### **5.1. SERVICE INFORMATION**

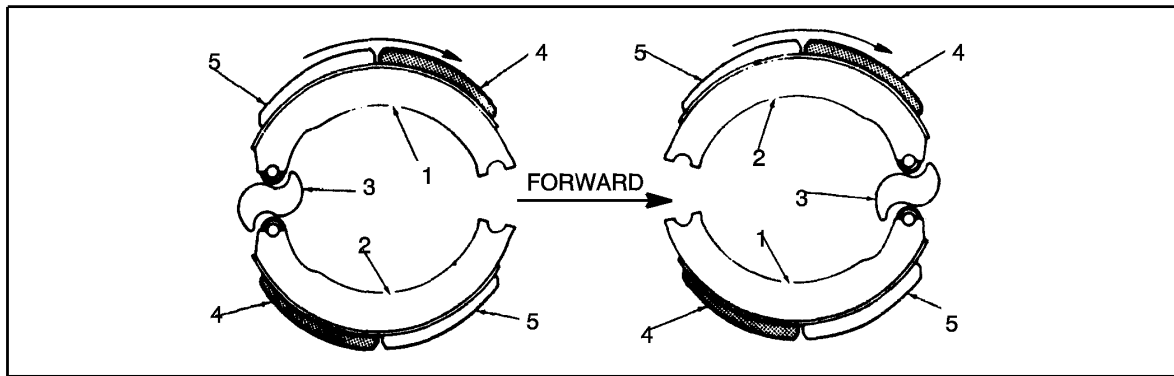
After various components of the brake assemblies have been serviced, brakes are reassembled by reversing the disassembly procedure.

It is recommended that newly installed brake linings be circle/cam ground before installing brake drums. Circle/cam grinding of linings to fit drum assures full contact between lining and drum. For more detailed information, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.

When reassembling various components which are secured with bolts and/or nuts such as backing plates, spiders, camshaft brackets or anchor pins, refer to the TORQUE CHART, for torque specifications.

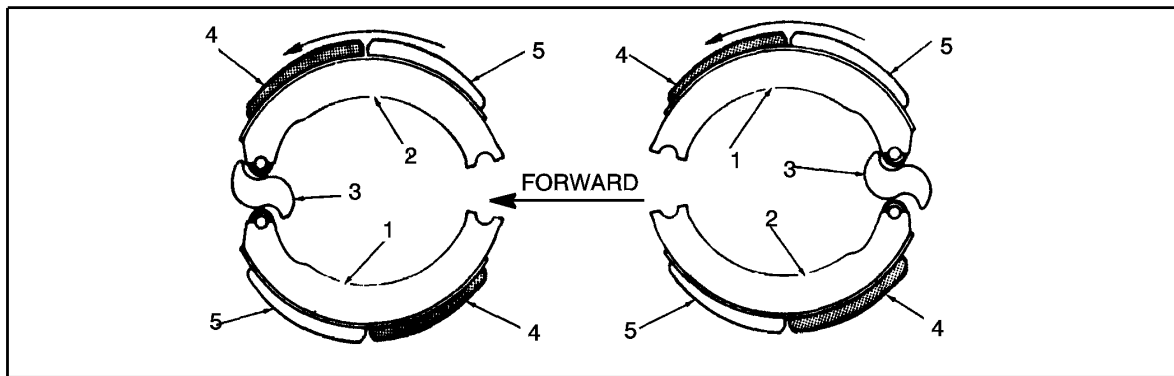
Brake shoes must be properly located to provide the designed efficiency of the brake group. The primary (forward) shoe is the first shoe just past the cam in forward direction of wheel rotation.

Brake shoes with combination brake block sets of semi-metallic and organic lining must be installed as shown in ( Figure 17 and Figure 18 ).



**Figure 17 Right Wheel Rotation (Arrow)**

1. PRIMARY (FORWARD) SHOE
2. SECONDARY (REVERSE) SHOE
3. CAM
4. SEMI-METALLIC BRAKE BLOCK
5. ORGANIC BRAKE BLOCK



**Figure 18 Left Wheel Rotation (Arrow)**

1. PRIMARY (FORWARD) SHOE
2. SECONDARY (REVERSE) SHOE
3. CAM
4. SEMI-METALLIC BRAKE BLOCK
5. ORGANIC BRAKE BLOCK

The brake blocks on each shoe consist of one semi-metallic material (shaded area) and one organic material (unshaded area).

The semi-metallic is identified by the metal particles embedded in the brake block. The organic material will not have the visible metal particles.

### Drums and Shoes

For complete details covering the servicing of drums and shoes, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.

### Anchor Pins

Anchor pins provide a point where shoes can be secured to the backing plate or spider and also permit positioning the shoe in respect to the drum.

Anchor pins are designed to withstand all braking force of slowing or stopping vehicle.

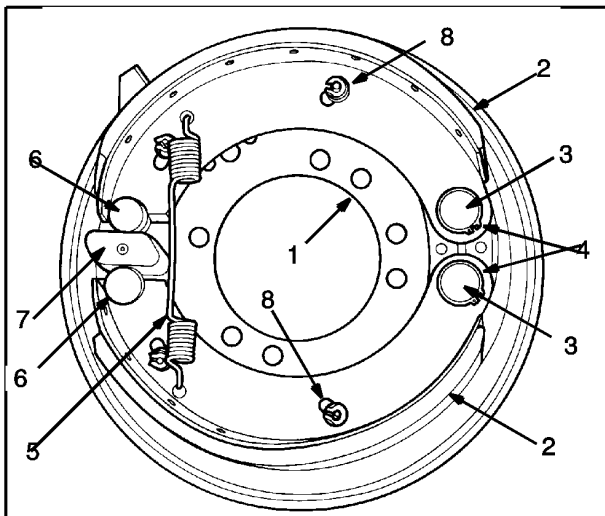
Anchor pins which are secured to the backing plate with a lock washer and nut are tightened by using two wrenches: one wrench is positioned on the nut while the second wrench is positioned over the flats on threaded area on anchor pin. For torque value, refer to TORQUE CHART, .

If staked anchor pins become worn, the complete spider will have to be replaced.

Anchor pins in spiders which are removable will be equipped with bushings which are serviceable. Replacement bushings are to have a clearance of .003 - .005 inch (.076 - .127mm) between bushing and pin.

## 5.2. BRAKE GROUPS WITH BACKING PLATES

### Rockwell "T" Series Brake ( Figure 19 )



**Figure 19 Rockwell "T" Series Brake with Backing Plate**

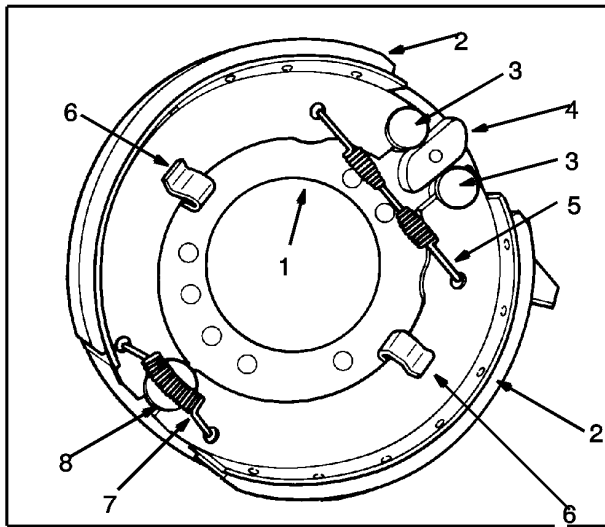
1. BACKING PLATE
2. LINING AND SHOE
3. ANCHOR PINS
4. ANCHOR PIN RETAINERS
5. RETURN SPRING
6. ROLLERS
7. CAM
8. GUIDE PIN ASSEMBLY

1. Install camshaft assembly. Make sure the spacer washers are reassembled in the same relative position from which they were removed.
2. Assemble the brake shoe rollers to the shoes if equipped with retainers.
3. Assemble guide pin washers and position shoes over anchor pins and guide pins.



4. Install guide pin washer/spring, "C" washer, anchor pin washer, and retainer assemblies.
5. Install brake shoe return spring.
6. Pull each shoe back and insert rollers. Installing rollers after shoe return springs are installed requires less effort than installing brake shoe return springs after the rollers are in place. However, if the rollers have retainers they must be assembled to the shoes as stated in step 2.
7. Reassemble slack adjuster on camshaft, aligning scribe marks and positioning spacer washers in reverse sequence from when adjuster was removed.
  - a. Use spacer washers to provide a maximum end play of .062 inch (1.59 mm) with adjuster ring installed.
8. Install slack adjuster retaining ring.
9. Install wheel and drum assembly and adjust wheel bearings. Refer to GROUP 17 - WHEELS, RIMS AND TIRES in the CTS-5000 Master Service Manual.
10. Adjust brakes as outlined in BRAKE ADJUSTMENT.

#### Eaton Brake ( Figure 20 )



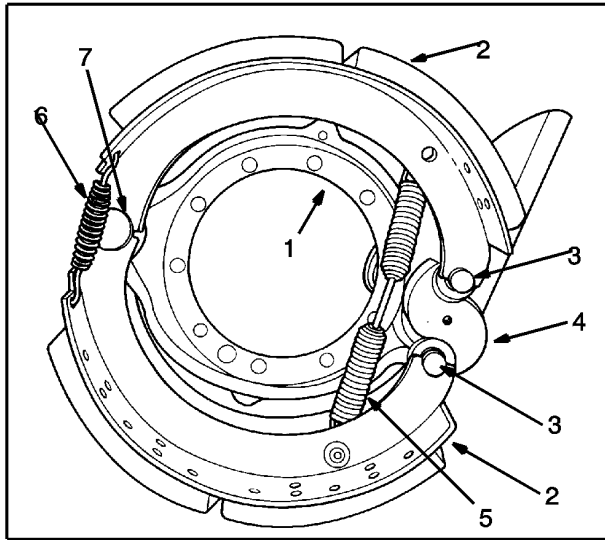
**Figure 20 Eaton Brake With Backing Plate**

1. BACKING PLATE
  2. LINING AND SHOE
  3. ROLLERS
  4. CAM
  5. RETURN SPRING
  6. SHOE RETAINER CLAMPS
  7. RETAINER SPRING
  8. ANCHOR PIN
1. Carefully slip camshaft into bracket. To ensure that the camshaft is properly installed, rotate cam in the direction of the air chamber push rod and check that the rollers would ride up on the convex side of the cam head.

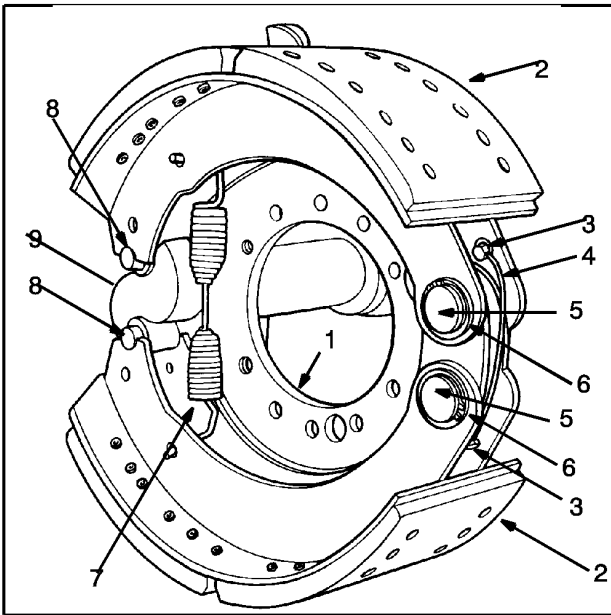
2. Install inner slack adjuster washer on cam.

**NOTE – The inner washer is the thick washer which measures .060 inch (1.52 mm) and the outer washer is the thin one that measures .030 inch (.76mm).**

3. Install slack adjuster on camshaft so adjuster nut faces away from the air chamber.
4. Install outer washer and snap ring.
5. While depressing locking sleeve, rotate adjusting nut counterclockwise until the slack adjuster and push rod clevis holes are aligned (manual slack adjuster).
6. Install clevis pin and cotter pin.
7. Place upper shoe on anchor pin and rotate down, fitting shoe into retainer clamp.
8. Place lower shoe on anchor pin and lift upwards, fitting shoe into retainer clamp.
9. Attach return spring and anchor pin retaining spring. Use brake pliers.
10. Using a large screwdriver, lift the brake shoes and install the brake cam rollers.
11. Install wheel and drum assembly and adjust wheel bearings. Refer to GROUP 17 - WHEELS, RIMS AND TIRES in the CTS-5000 Master Service Manual.
12. Adjust brakes as outlined in BRAKE ADJUSTMENT.

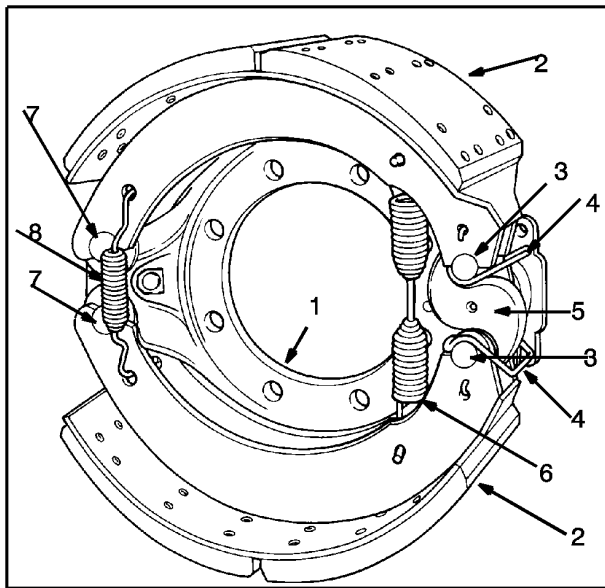
**5.3. BRAKE GROUP WITH SPIDERS ( FIGURE 21 , FIGURE 22 AND FIGURE 23 )****Figure 21 Eaton Brake With Spider and Fixed Anchor Pin**

1. SPIDER
2. LINING AND SHOE
3. ROLLERS
4. CAM
5. RETURN SPRING
6. RETAINER SPRING
7. ANCHOR PIN



**Figure 22 Rockwell "P" Series Brake With Spider**

1. SPIDER
2. LINING AND SHOE
3. LOCK SCREWS
4. LOCK WIRE
5. ANCHOR PIN
6. LOCK RING AND WASHER ASSEMBLY
7. RETURN SPRING
8. ROLLERS
9. CAM



**Figure 23 Rockwell "Q" Series Brake With Spider and Removable Anchor Pins**

1. SPIDER
2. LINING AND SHOE
3. ROLLERS
4. ROLLER RETAINERS
5. CAM
6. RETURN SPRING
7. ANCHOR PINS
8. RETAINER SPRING

1. Install camshaft assembly being sure spacer washers are assembled in reverse sequence as when removed.
2. Install anchor pins if removed (Rockwell "P" and "Q" Series brake groups).

"P" Series - Position shoes in place on the spider, then push the pin through shoe and into spider. Repeat anchor pin installation on remaining shoe. Install felt seals, seal retainers and lock rings on anchor pins. Also be sure the return spring links are positioned between shoe webs.

It is important that anchor pins which are secured with lock bolts are positioned so that the flats are aligned with bolt openings. Tighten bolts to 10 ft-lbs. (14 N•m). Install lock wires.

"Q" Series - Anchor pins are held in place by the shoes, eliminating snap rings, felts and set screws.

3. On brake groups with open end anchor ends on shoes like the Eaton and Rockwell Q, position shoes on anchors and install shoe retaining springs at anchor end of shoes ( Figure 21 and Figure 23 ).
4. Install brake shoe return spring.
5. Pry each shoe (one at a time) away from cam and install rollers. If rollers have retainers, be sure they are hooked on the roller assemblies.

6. Reassemble slack adjusters on camshaft aligning scribe marks and reposition spacer washers to the same location they were in before removal.
7. Install slack adjuster spacer washers and retaining ring. Make sure the retaining ring is the correct thickness. Two variations of ring grooves will be found: 1/16 inch (1.5875mm) and 1/8 inch (3.1750mm). The proper ring thickness must be used in the camshaft groove.
8. Install wheel and drum assembly and adjust wheel bearings. Refer to GROUP 17 - WHEELS, RIMS AND TIRES in the CTS-5000 Master Service Manual.
9. Adjust brakes as outlined in BRAKE ADJUSTMENT.

## **6. BRAKE ADJUSTMENT**

### **6.1. AUTOMATIC SLACK ADJUSTERS**

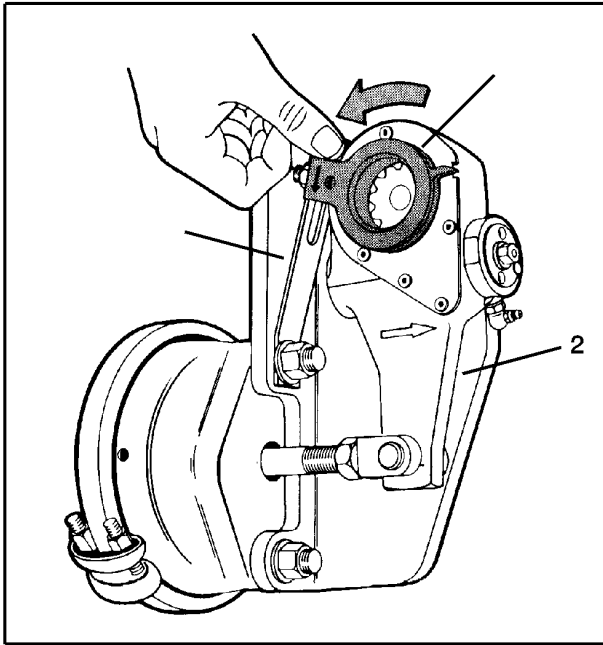
Automatic slack adjusters maintain proper cam brake chamber stroke adjustment and lining drum clearance during the normal service life of brake lining.

**NOTE – When servicing brakes with spring (PARKING) brake chamber, the chamber must be CAGED. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.**

**NOTE – Brakes are adjusted with vehicle on floor stands.**

### **6.2. HALDEX AUTOMATIC SLACK ADJUSTER**

Refer to Figure 24 for the following procedure, steps 1 through 4.

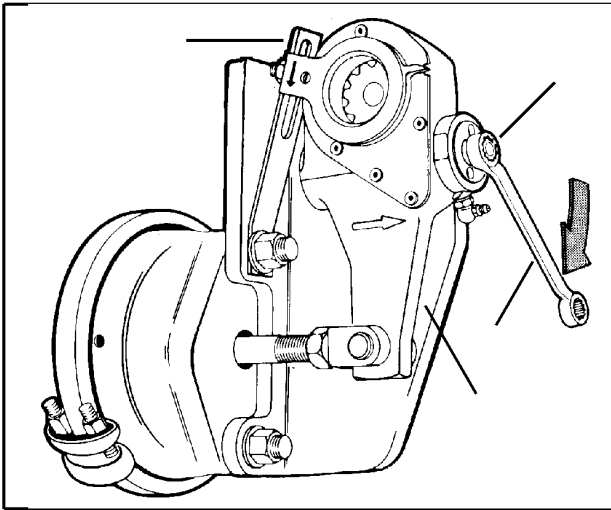


**Figure 24 Installation Of Control Arm**

- 1. CONTROL ARM
- 2. AUTOMATIC SLACK ADJUSTER ASSEMBLY
- 3. ANCHOR BRACKET

1. Rotate the control arm away from the adjusting hex towards the air chamber, until it comes to a definite internal stop as illustrated.
2. Most adjusters will be equipped with an installation indicator. Indicator must fall within the slot for proper installation.
3. **If the control position is wrong, tight brakes will occur.**
4. Tighten all anchor bracket fasteners if loosened or removed. Make sure the control arm does not move while tightening the anchor bracket fasteners.

Refer to Figure 25 for steps 5 through 9.



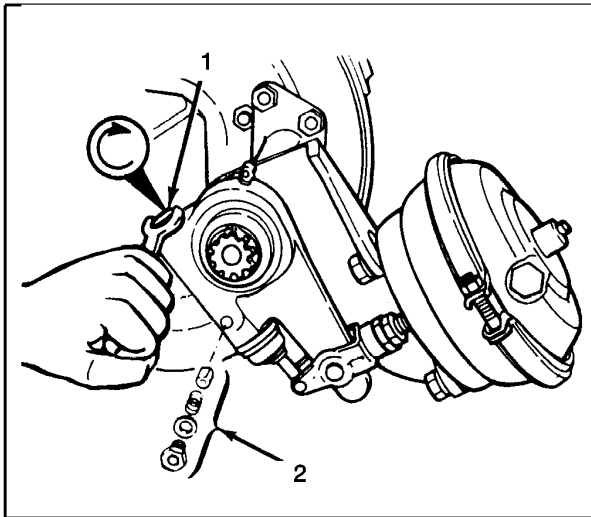
**Figure 25 Manual Adjusting**

1. HEX ADJUSTING NUT
  2. WRENCH
  3. AUTOMATIC SLACK ADJUSTER
  4. ANCHOR BRACKET
5. The adjuster must be manually adjusted at this time.
  6. Rotate the adjusting hex clockwise until the lining contacts the drum.
  7. Back off the adjuster hex, turning the hex counterclockwise 1/2 turn.
  8. A minimum of 13 ft-lbs. is necessary to overcome the internal clutch. A ratcheting sound will be heard.
  9. **Final inspection.** With full air pressure, release spring and service brake and check that the installation indicator is within the slotted area. Remove clevis pin and check that the clevis hole and adjuster hole remain in alignment. If the air chamber push rod was pulled into the air chamber, repeat steps 1, 2 and 3. After final inspection, install cotter pin into clevis pin. Refer to Brake Adjustment Stroke Table, for push rod stroke adjustment.
  10. If spring parking brake was serviced, uncage parking brake. Refer to GROUP 04 - AIR BRAKES in the CTS-5000 Master Service Manual.
  11. Remove floor stands. Road test vehicle for correct brake operation before putting vehicle back into service.

### 6.3. ROCKWELL AUTOMATIC SLACK ADJUSTERS

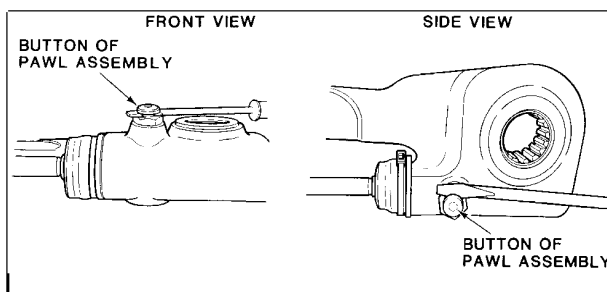
**NOTE** – There are two different pawl designs on the Rockwell automatic slack adjuster. Figure 26 illustrates a pawl design that has to be removed before manually adjusting the brakes. Figure 27 illustrates a later design which has a pawl button that when raised will disengage the pawl, so the pawl does not have to be removed to manually adjust the brakes.





**Figure 26 Rockwell Pawl Assembly**

1. MANUAL ADJUSTING NUT
2. PAWL ASSEMBLY



**Figure 27 "Pull" Pawl Button On Rockwell Automatic Slack Adjuster**

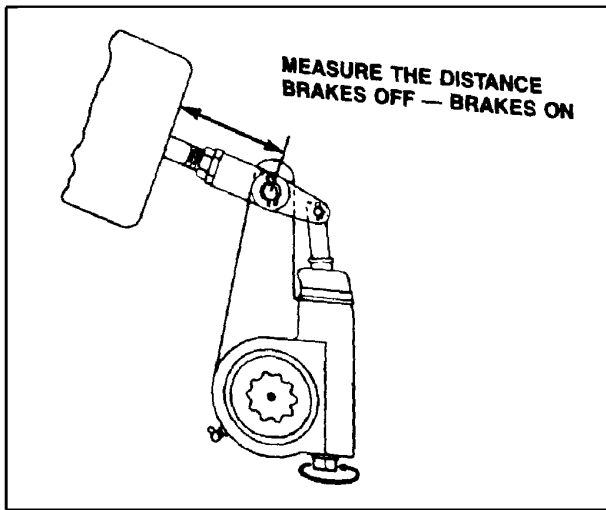
**CAUTION – On slack adjusters that DO NOT HAVE THE "PULL" PAWL BUTTON, if you do not remove the pawl assembly, you will damage the pawl teeth when you turn the manual adjusting nut.**

1. Remove the adjusting pawl assembly ( Figure 26 ).
2. On vehicles with the "pull" button design pawl, insert a small screwdriver under pawl button. Lift button at least 1/32 inch to disengage pawl assembly ( Figure 27 ). Remove screwdriver to engage pawl when finished with adjustment.

**CAUTION – If the pawl button is not lifted (disengaged) when adjusting nut is turned, the pawl adjuster will be damaged.**

3. Rotate the adjuster nut until the lining contacts the drum.
4. Turn the adjusting nut in the opposite direction 1/2 turn.

5. Measure the distance from the center of the large clevis pin to the bottom of the chamber ( Figure 28 ).



**Figure 28 Rockwell Clevis Adjustment**

6. Use a pry bar to move the slack adjuster so that the lining is against the drum. Measure the same distance again. The difference between this measurement and the measurement in step 4 is the "free stroke."
7. Turn the adjusting nut until the "free stroke" is between 5/8 - 3/4 inch (15.9 - 19.1mm).
8. Check the adjustment. Apply the brakes and hold the pressure. With the pressure at 85 psi, again measure the distance from the center of the large clevis pin to the bottom of the chamber.
9. The difference between the measurements in steps 4 and 7 is the adjusted chamber stroke. Turn the adjusting nut so that the adjusted stroke is as short as possible, but not so short that the "free stroke" is too short and the linings drag. The adjusted stroke **must not** be greater than the dimensions shown in Brake Adjustment Stroke Table.

**Table 2 Brake Adjustment Push Rod Stroke (All Automatic Slack Adjusters)**

MAXIMUM STROKE AT WHICH BRAKES MUST BE ADJUSTED. 80 - 90 PSI AIR PRESSURE IN THE AIR CHAMBER. CLAMP TYPE AIR CHAMBERS. CAM BRAKES.	
Chamber	Stroke Length Not to
Type (Size)	Exceed:
12	1-3/8 Inches
16	1-3/4 Inches
20	1-3/4 Inches
24	1-3/4 Inches
24 long stroke	2 Inches
30	2 Inches
36	2-1/4 Inches

10. Install the pawl assembly and tighten the capscrew to 15-20 ft-lbs. (20-27 N•m).

11. On vehicles with the "pull" pawl button design, remove the screwdriver.

**NOTE – The "pull" button pawl design assembly is interchangeable with the older design as a complete assembly only.**

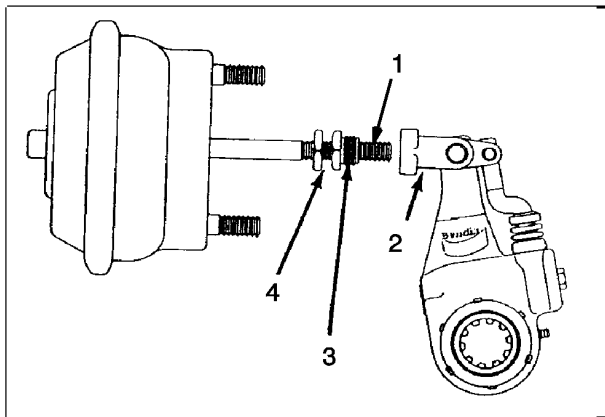


**WARNING – The tamper resistant spring brake has been factory sealed for your protection. There are no user serviceable parts inside the spring brake chamber. If you experience any damage or failure to the spring brake chamber, replace the complete assembly. Never attempt to disassemble the spring brake chamber as serious personal injury or death could result from accidental sudden release of the high energy spring.**

12. If the axle has a spring (PARKING) brake chamber, release CAGED spring. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.
13. Test vehicle for correct brake operation before putting vehicle back into service.

#### 6.4. BENDIX AUTOMATIC SLACK ADJUSTERS

1. If the slack adjuster is equipped with the easy-on yoke, position the actuator jam nut approximately 2 inches from the end. Thread the easy-on yoke adapter on the push rod until it is about 3/4 inch from the end of the push rod. Turn the manual adjustment hex clockwise until the end of the actuator push rod protrudes beyond the threaded bore of the yoke approximately 1/8 inch ( Figure 29 ). Thread the adapter into the yoke and tighten to 10 ft-lbs. (13.6 N•m).

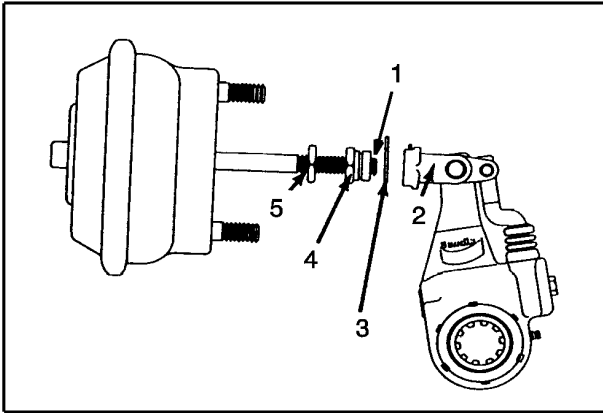


**Figure 29 Bendix Easy-On Yoke Assembly**

1. 3/4" OUT
2. YOKE
3. ADAPTER
4. JAM NUT

2. If the slack adjuster is equipped with the quick connect yoke ( Figure 30 ), position the actuator jam nut approximately 1-1/2 inches from the end. Thread the quick connect adapter bushing on the push rod until approximately 1/8 inch of the push rod protrudes from the end of the adapter bushing. Install the retaining ring on the adapter bushing making certain it is in the adapter bushing groove. Turn the manual adjustment hex clockwise until the adapter bushing begins to enter the yoke. Fully compress the "legs"

of the retaining ring and continue turning the manual adjustment hex until the adapter is completely in the yoke. Allow the retaining ring to expand into the corresponding groove in the yoke. Make certain the retaining ring is seated in both the yoke and adapter bushing groove by manually pulling on the arm, attempting to separate the adapter bushing and yoke.

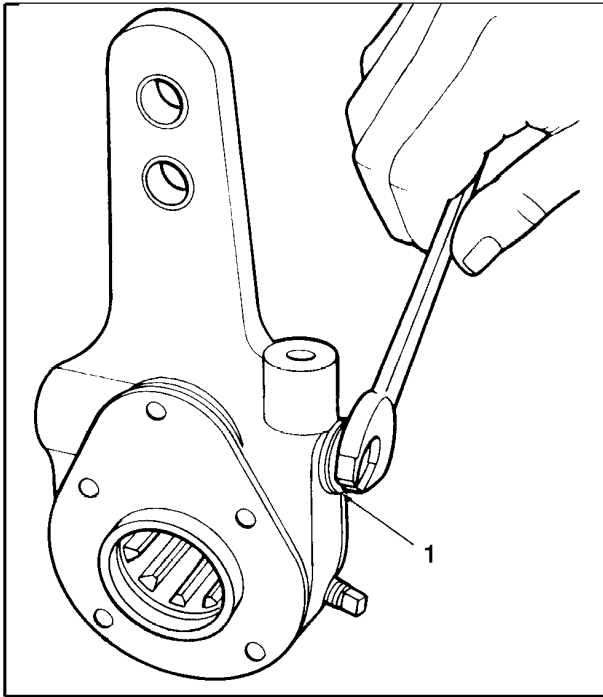


**Figure 30 Bendix Quick Connect Yoke Assembly**

1. 1/8" OUT
  2. YOKE
  3. RETAINING RING
  4. ADAPTER
  5. JAM NUT
3. Run the actuator push rod jam nut down against the adapter. Hold the adapter bushing hex with a wrench and tighten the jam nut to 25 - 33 ft-lbs. (33.9 - 44.7 N•m) for the 1/2" x 20 thread and 33 - 50 ft-lbs. (44.7 - 67.8 N•m) for the 5/8" x 18 thread.
  4. Manually adjust the brakes. The wheel to be adjusted should turn freely. Turn the manual adjustment hex clockwise until the brakes begin to drag. Back off the adjustment, counterclockwise, until the wheel turns freely.
  5. Uncage the spring parking brake(s). Refer to GROUP 04 - AIR BRAKES in the CTS-5000 Master Service Manual.
  6. Remove floor stands. Test vehicle for correct brake operation before putting vehicle back into service.

## 6.5. ADJUSTING MANUAL SLACK ADJUSTERS

1. Block wheels not being adjusted.
2. With wheel raised and parking brake released so that the wheel will rotate freely, check brake chamber push rod to make certain that it is in a fully released position. To do this, disconnect push rod at slack adjuster. If push rod moves toward "released" brake chamber, depress lock sleeve on slack adjuster and turn adjusting nut to rotate slack adjuster toward push rod until clevis pin can be reinstalled. Install clevis pin and cotter pin ( Figure 31 ).



**Figure 31 Manual Slack Adjuster Locking Sleeve on Adjusting Nut**

**1. LOCKING SLEEVE**

3. Disengage locking sleeve on slack adjuster worm shaft or adjusting screw by depressing spring loaded sleeve with a wrench ( Figure 31 ).

**NOTE – Figure 31 illustrates the locking sleeve in its disengaged position. Be sure sleeve is held in, disengaging the adjusting screw when making adjustments.**

4. Turn vehicle wheel and at the same time rotate adjusting screw until brake shoes are tight against drum. Then turn adjusting screw 1/4 turn in opposite direction. Wheel should rotate freely with no drag on brake lining.
5. Apply brakes and hold full brake application to fully seat brake shoes against drum and note the angle between slack adjuster and push rod. This angle should be close to 90 degrees as possible ( Figure 32 ).

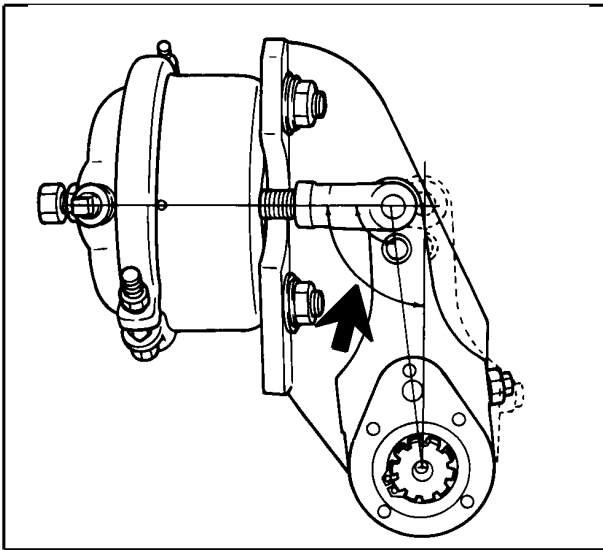


Figure 32 Brake Chamber and Slack Adjuster Adjustment Angles

## 6.6. SLACK ADJUSTER OPERATION TEST (ALL)

Slack adjusters should rotate freely without binding when the brakes are applied. When the brakes are released, all slack adjusters must return to the released position freely and without binding. The slack adjusters must be adjusted so that the angles formed by the brake chamber push rod and center of slack adjuster are near 90 degrees as described in Step 5 above.

## 7. ADJUSTING PUSH ROD

**NOTE** – If the foregoing adjustment or relining of brake shoes does not achieve an angle near 90 degrees between push rod and slack adjuster with brakes applied, then the maximum force against the slack adjuster cannot be obtained. Readjust the push rod ( Figure 33 ).

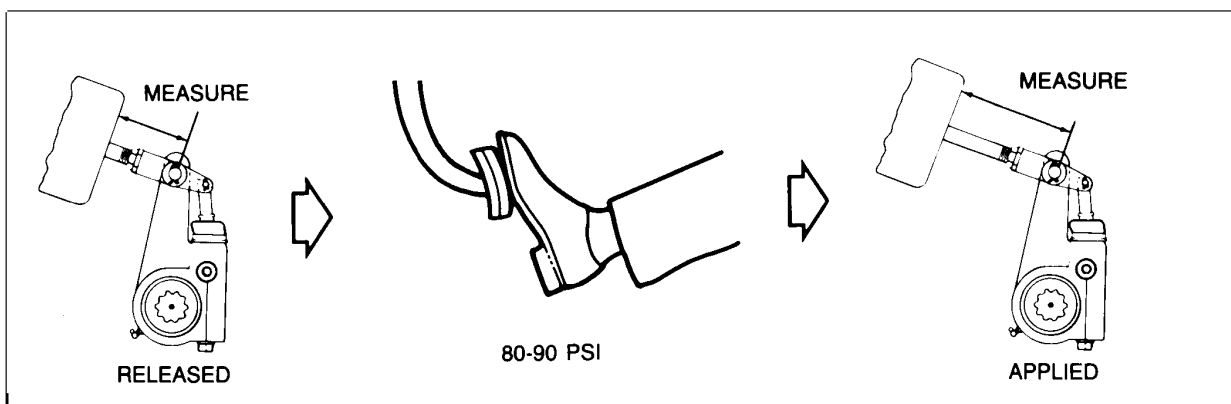
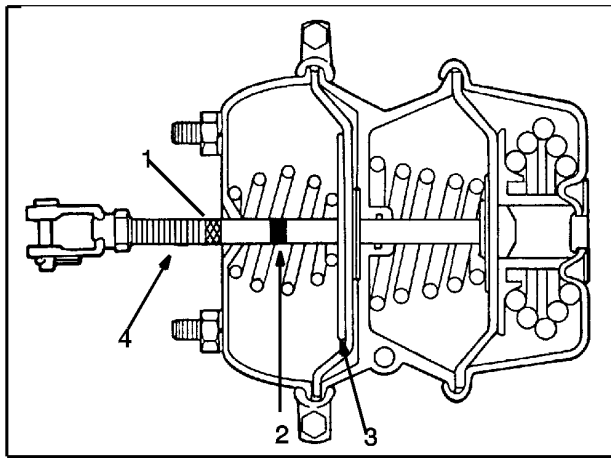


Figure 33 Measure Adjusted Chamber Stroke

**NOTE** – If servicing a chamber with a spring (PARKING) brake, the spring chamber must be CAGED. Uncage brake after all adjustments are completed. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.

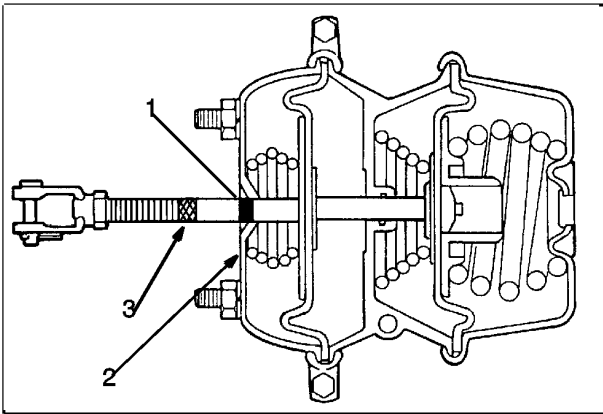
1. Disconnect slack adjuster and push rod.
2. Loosen lock nut on clevis and thread clevis onto push rod toward brake chamber for several turns.
3. Reconnect slack adjuster and push rod with clevis pin.
4. Apply brakes fully and check angle between slack adjuster and push rod. If 90 degrees or slightly more is not obtained, adjust push rod length until angle is satisfactory. If adjusting push rod with caged brakes, use a pry bar to move slack adjuster so that the lining is against the drum and check angle. Repeat adjustment until angle is satisfactory ( Figure 32 and Figure 33 ).

Some spring brake type chambers have an orange-colored alert stroke indicator marked on the push rod ( Figure 34 and Figure 35 ). For more detailed information, refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.



**Figure 34 Spring Brake Fully Retracted**

1. LEADING EDGE OF DIAMOND KNURL
2. STROKE INDICATOR (ORANGE BAND)
3. PUSH ROD DISC
4. THREADED PORTION OF SERVICE PUSH ROD



**Figure 35 1/2 Inch of Stroke Remaining, 3/4 Inch on 36 Type Spring Brake, Brake Fully Applied**

1. LEADING EDGE OF STROKE INDICATOR
2. MOUNTING FACE OF SERVICE HOUSING
3. DIAMOND KNURL

## 8. CAMSHAFT, BUSHINGS AND SEALS

The camshaft is actuated by movement of the slack adjuster. The rotating movement of the cam forces the shoe rollers away from the cam, thus forcing shoe into contact with drum.

The removal procedure for camshaft assembly is covered in DISASSEMBLY. When removing camshaft from backing plate or spider, note position of spacing washers to insure correct reinstallation.

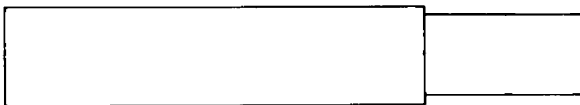
Do not remove camshaft bushings from spider and/or mounting bracket unless replacement is necessary.

Do not interchange right and left side camshafts.

Removal of the brake chamber bracket will be required to replace the bushing in some instances.

To check bushing to determine if replacement is required, insert the camshaft into the bushing and check side play. If there is more than .020 inch (.5080mm) on Eaton brakes or .030 inch (.7620mm) on Rockwell brakes, the bushings need to be replaced.

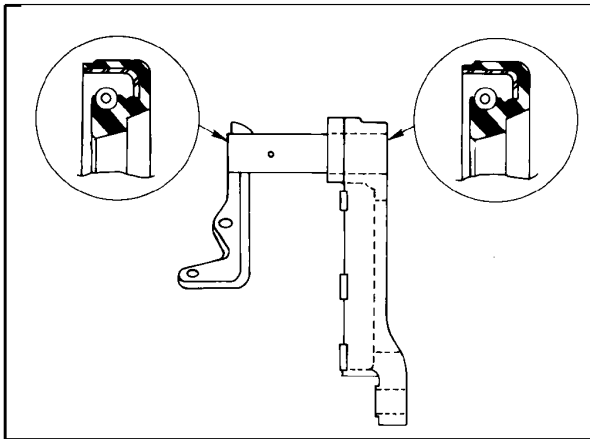
Install new bushings with a suitable tool like that shown in Figure 36 .



**Figure 36 Recommended Type of Camshaft Bushing Removing Tool**

Install and lubricate new seals. Use NLGI number 1 or equivalent. Install seals with lip of seal toward slack adjuster ( Figure 37 ).

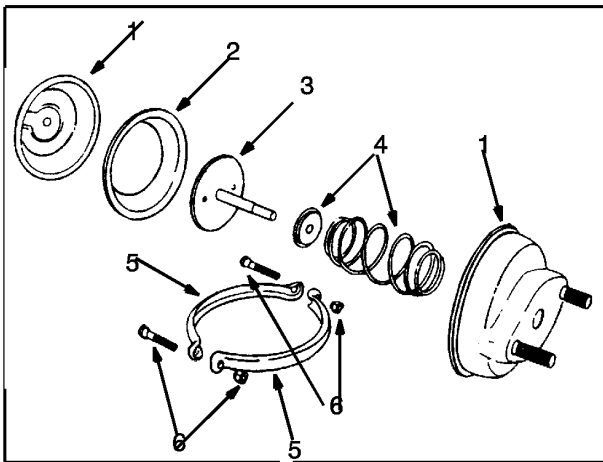




**Figure 37 Camshaft Seal Installation**

## 9. BRAKE CHAMBER

Brake chambers transform the energy of compressed air into mechanical force and motion to apply brakes. One chamber is used at each wheel to operate brakes ( Figure 38 ).

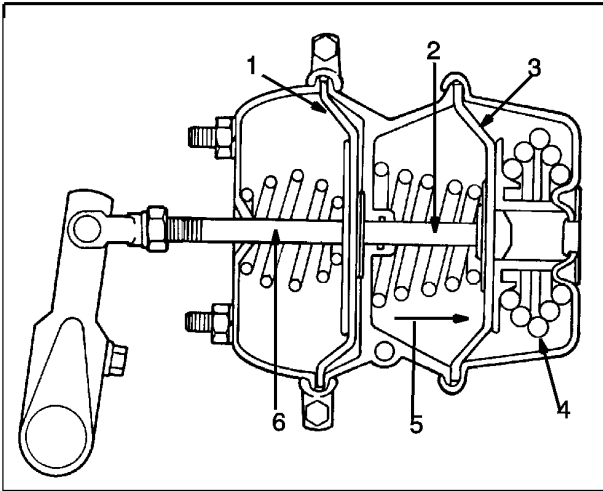


**Figure 38 Typical Air Brake Chamber**

1. PRESSURE PLATE HOUSING
2. DIAPHRAGM
3. PLATE WITH PUSH ROD
4. PUSH ROD SPRING ASSEMBLY
5. CLAMP RINGS
6. NUTS AND BOLTS

Air pressure entering the brake chamber behind the diaphragm and push rod outward, which rotates slack adjuster, brake camshaft and the cam, in turn applying the brakes. The higher the air pressure admitted to the chamber, the greater the force pushing the brake shoes against the drum.

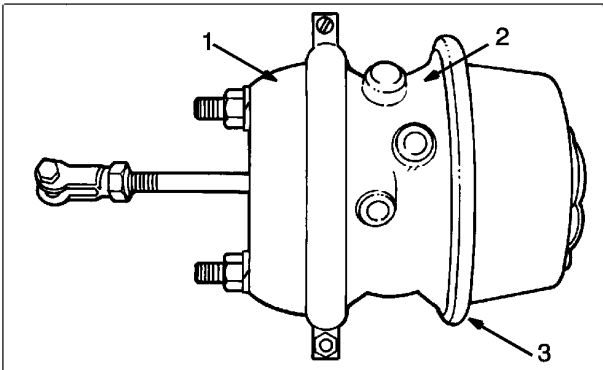
The brake chamber consists of two dish-shaped metal sections: the pressure plate assembly and non-pressure plate, which are separated by a rubber diaphragm. The assembly is held together by a metal, two-segment clamp. In front of the diaphragm are the push rod, push rod spring and retainer ( Figure 38 and Figure 39 ).



**Figure 39 Brake Chamber With Spring Brake (Parking)**

1. SERVICE BRAKE DIAPHRAGM
2. SPRING BRAKE PUSH ROD
3. SPRING BRAKE DIAPHRAGM
4. POWER SPRING
5. AIR PRESSURE
6. SERVICE BRAKE PUSH ROD

When air pressure is released from the brake chamber, brake shoe return springs and brake chamber release springs move shoes, slack adjusters and brake chamber back to the released position ( Figure 40 ). If the brakes do not return properly and have a drag on the linings, check the shoes and/or chamber return springs.



**Figure 40 Double Diaphragm Spring Brake**

1. SERVICE BRAKE CHAMBER
2. SPRING BRAKE CHAMBER
3. PERMANENTLY SEALED CHAMBER - NO SAFETY EARS OR CLAMP

The purpose of the spring (parking) brake is to provide a parking brake and an emergency brake which will stop the vehicle if air pressure drops ( Figure 39 and Figure 40 ).

## 9.1. REMOVE



**WARNING** – The tamper resistant spring brake has been factory sealed for your protection. There are no user serviceable parts inside the spring brake chamber. If you experience any damage or failure to the spring brake chamber, replace the complete assembly. Never attempt to disassemble the spring brake chamber as serious personal injury or death could result from accidental sudden release of the high energy spring.

1. Block wheels.
2. Cage spring (PARKING) brake if equipped. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.
3. Disconnect air hoses/lines from chamber.
4. Disconnect chamber push rod clevis from slack adjuster.
5. Remove fasteners securing the brake chamber to the mounting bracket. Remove chamber.

## 9.2. INSTALL

1. Place chamber on mounting bracket.
2. Install fasteners securing chamber to bracket. Refer to TORQUE CHART. for torque specifications.
3. Install slack adjuster to chamber push rod clevis.
4. If equipped with spring (parking) brake, UNCAGE spring. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual.
5. Connect air hoses/lines to chamber.
6. Adjust brakes, refer to BRAKE ADJUSTMENT.
7. Check for air leaks.

## 9.3. AIR LEAK TEST

Apply the service brake and apply soap solution to the chamber clamp area, hose or line fittings and push rod opening. If leakage is noted, tighten fitting connections as necessary. Tighten clamp ring bolts if leakage is still present. Tap chamber clamps with a hammer in several positions and retighten clamp bolts. If air leak is still present, recondition or replace the chamber. Refer to GROUP 04 - BRAKES in the CTS-5000 Master Service Manual for more detailed service information.

## 10. LUBRICATION

Brake camshaft and slack adjusters should be lubricated every five months or 18,000 miles (29,000 km). Refer to GROUP 10 - LUBRICATION in the CTS-5000 Master Service Manual.

## 11. TORQUE CHART

Tighten brake group mounting bolts to the torque values listed from the nut side. Since some mounting holes in the steering knuckles are of conical design, the knuckle bolts must utilize conical mounting nuts to coincide with mounting holes in the knuckle. These conical nuts have a smooth cone surface and the torque values are considerably higher than the torque values for regular nuts or prevailing type lock nuts.

**Table 3 Torque Chart**

	TORQUE	
Bolt Size	Ft-lbs.	N•m
Front Axle Brake Group Mounting Bolts With Conical Type Nuts		
1/2"	110 - 120	149 - 163
5/8"	220 - 240	298 - 325
3/4"	275 - 300	373 - 407
Front & Rear Axle Brake Group Mounting Bolts with Regular Nuts or Prevailing Torque Type Lock Nuts		
1/2"	75 - 85	102 - 115
9/16"	115 - 125	156 - 170
5/8"	160 - 175	217 - 237
3/4"	275 - 300	373 - 407
Brake Chamber Mounting Nuts		
7/16"	34 - 42	45 - 56
5/8"	105 - 125	142 - 170
Anchor Pin Lock Bolt		
3/8"	19 - 27	26 - 37
Anchor Pin		
3/4" UNF (Eaton)	95 - 130	129 - 176
3/4" UNF (Rockwell)	185 - 350	251 - 475
Camshaft Bracket Mounting		
1/2"	65 - 85	88 - 115