

# SECTION 6

# BRAKES

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## STANDARD BRAKES

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## GENERAL DESCRIPTION

The brakes used (fig. 1) on both front and rear of all models are the Duo-Servo single anchor type which utilize the momentum of the vehicle to assist in the brake application. This self-energizing or self-actuating force is applied to both brake shoes at each wheel in both forward or reverse motion.

Wheel cylinders (fig. 2) are the double piston type permitting even distribution of pressure to each brake shoe. To keep out dust and moisture and to prevent gumming of the brake fluid, both ends of each wheel

cylinder are sealed with a rubber boot. The wheel cylinders have no external adjustments.

The main cylinder (fig. 3) consists of a piston which receives mechanical pressure from the push rod and exerts pressure on the fluid in the lines, building up the hydraulic pressure, which moves the wheel cylinder pistons.

The passenger car parking brake pedal (fig. 4) is located to the left of the steering column. A cable type linkage, directed over two pulleys, connects this pedal

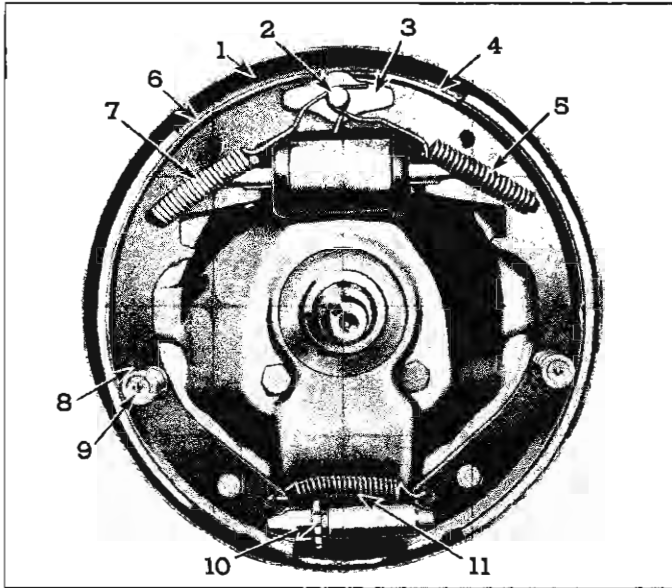


Fig. 1—Duo-Servo Brake

- |                     |                            |
|---------------------|----------------------------|
| 1. Backing Plate    | 7. Pull Back Spring        |
| 2. Anchor Pin       | 8. Hold Down Spring        |
| 3. Guide Plate      | 9. Hold Down Pin           |
| 4. Secondary Shoe   | 10. Adjusting Screw        |
| 5. Pull Back Spring | 11. Adjusting Screw Spring |
| 6. Primary Shoe     |                            |

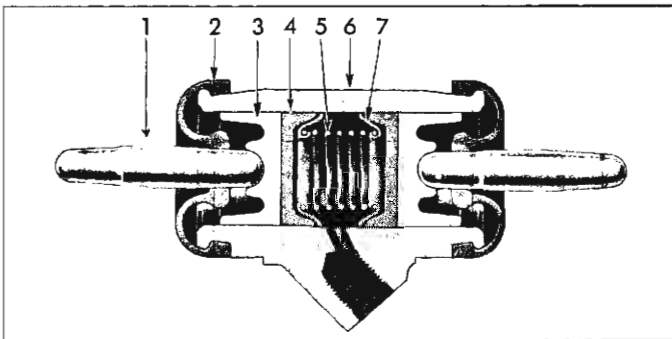


Fig. 2—Wheel Cylinder

- |                    |             |
|--------------------|-------------|
| 1. Connecting Link | 5. Spring   |
| 2. Rubber Boot     | 6. Housing  |
| 3. Piston          | 7. Expander |
| 4. Piston Cup      |             |

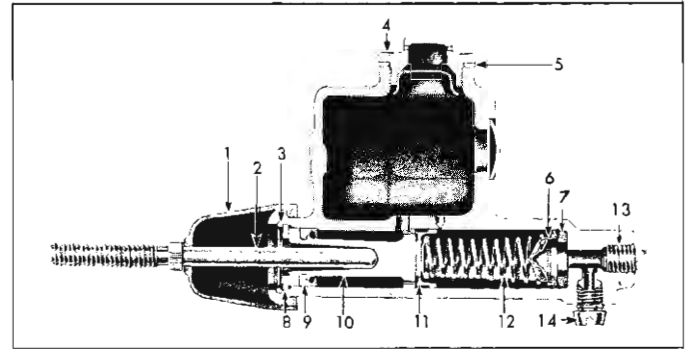


Fig. 3—Main Cylinder

- |                       |                   |                    |
|-----------------------|-------------------|--------------------|
| 1. Rubber Boot        | 6. Valve Assembly | 11. Primary Cup    |
| 2. Push Rod           | 7. Valve Seat     | 12. Spring         |
| 3. Lock Ring          | 8. Flat Washer    | 13. End Plug       |
| 4. Filler Plug        | 9. Secondary Cup  | 14. Outlet Fitting |
| 5. Filler Plug Gasket | 10. Piston        |                    |

to an idler lever, mounted in a bracket bolted to the under body approximately in the center of the vehicle.

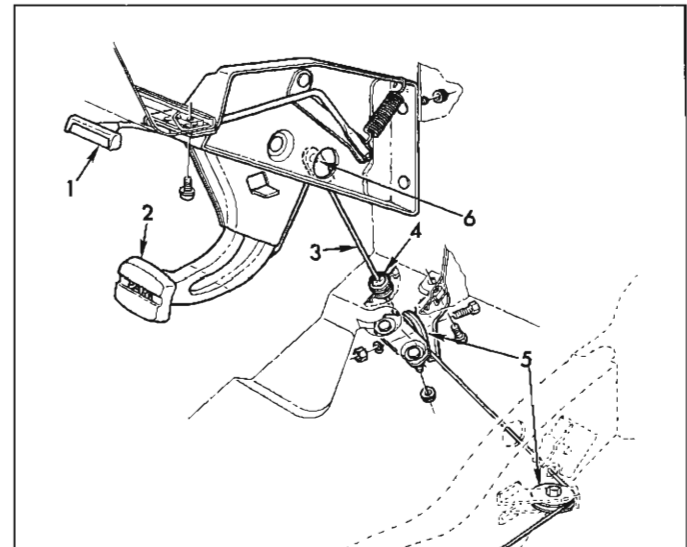


Fig. 4—Parking Brake Pedal and Release Lever

- |                  |                  |           |
|------------------|------------------|-----------|
| 1. Release Lever | 3. Forward Cable | 5. Pulley |
| 2. Pedal         | 4. Seal          | 6. Clevis |

## MAINTENANCE AND ADJUSTMENTS

In any service operation it is extremely important that absolute cleanliness be observed. Any foreign matter in the system will tend to clog the lines, ruin the rubber cups of the main and wheel cylinders and cause inefficient operation or even failure of the braking system. Dirt or grease on a brake lining will cause that brake to grab first on brake application and fade out on heavy brake application.

### HYDRAULIC BRAKE FLUID

Only G.M. Hydraulic Brake Fluid Super No. 11 should be used when bleeding brakes. This brake fluid

is satisfactory for any atmospheric temperature hot or cold and has all the qualities necessary for satisfactory operation, such as a high boiling point to prevent evaporation and tendency to vapor lock and remains fluid at low temperatures.

In the event that improper fluid has entered the system, it will be necessary to—

1. Drain the entire system.
2. Thoroughly and vigorously flush the system with clean alcohol, 188 proof, or a hydraulic brake system cleaning fluid such as "Declene."

3. Replace all rubber parts of the system, including brake hoses.
4. Refill the main cylinder to within  $\frac{1}{2}$ " to  $\frac{5}{8}$ " of opening with G.M. Hydraulic Brake Fluid Super No. 11.

### BLEEDING HYDRAULIC SYSTEM

The hydraulic brake system must be bled whenever a pipe line has been disconnected, when a leak has allowed air to enter the system or at any time the system has been opened. The system must be absolutely free from air at all times.

Bleeding should be done on the longest line first and the proper sequence to follow is left rear, right rear, right front and left front.

Bleeding of brake lines may be accomplished by one of two methods: Pressure or Manual.

#### Pressure Bleeding

1. Clean all dirt from top of main cylinder and remove filler plug.
2. Connect hose from bleeder tank to main cylinder filler plug opening and open valves at both ends of hose.

**NOTE:** Make sure fluid in tank is up to petcock above outlet and that tank is charged with 30 to 50 pounds air pressure.

3. Remove bleeder valve screw, install bleeder hose through Tool J-7647 and slip hose onto bleeder valve as shown in Figure 5. Place other end of hose in a container having sufficient fluid to cover end of hose.
4. Open bleeder valve by turning  $\frac{3}{4}$  turn in a

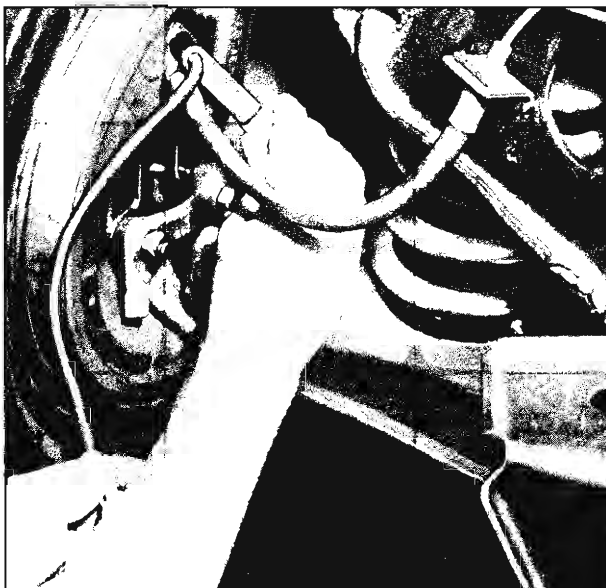


Fig. 5—Bleeding Operation at Wheel Cylinder

5. Counterclockwise direction and watch flow of fluid at end of bleeder hose.
6. Close bleeder valve tightly as soon as bubbles stop and fluid flows in a solid stream.
7. Repeat operations at each wheel.

#### Manual Bleeding

1. Clean all dirt from top of main cylinder and remove filler plug.
2. Install Tool J-0713 (fig. 6).
3. Remove bleeder valve screw, install bleeder hose through Tool J-7647 and slip hose onto bleeder valve as shown in Figure 5. Place other end of hose in a container having sufficient fluid to cover end of hose.
4. Open bleeder valve by turning  $\frac{3}{4}$  turn in a counterclockwise direction.

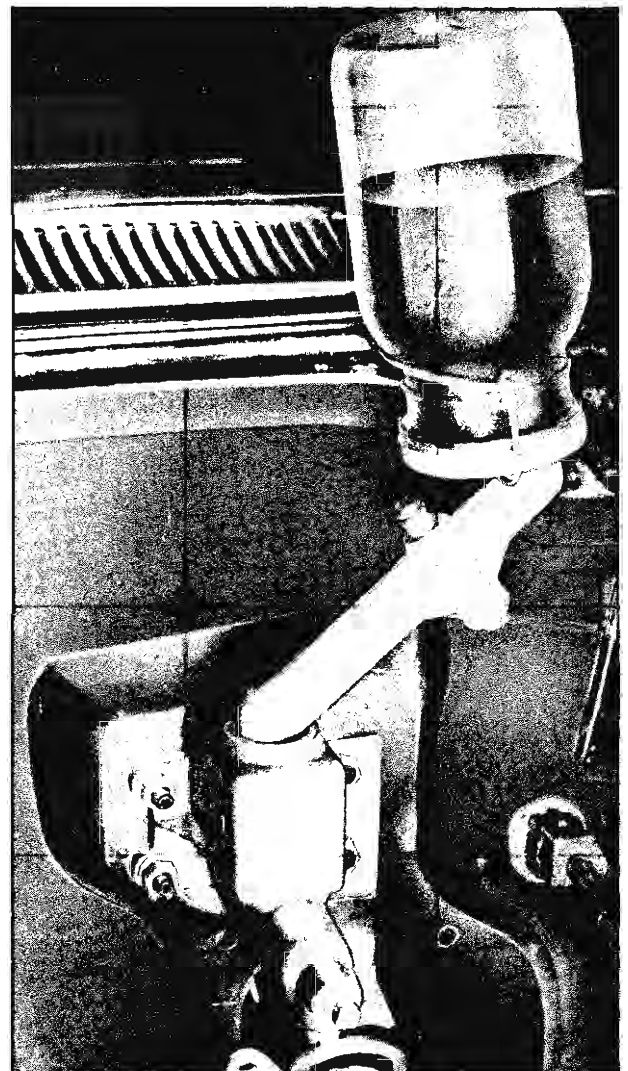


Fig. 6—Filling Main Cylinder Reservoir

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5. Depress foot pedal by hand, allowing it to return slowly. Continue this pumping action to force fluid through the lines and out at the bleeder drain, carrying with it any air in the system.
6. Close bleeder valve tightly as soon as bubbles stop and fluid flows in a solid stream.
7. Remove bleeder hose and install bleeder valve screw in bleeder valve.
8. Repeat above operations at each wheel.

### PUSH ROD TO MAIN CYLINDER CLEARANCE

This clearance very seldom needs adjustment. The brake pedal has a definite stop which is permanent and not adjustable. This stop consists of a rubber bumper at the release end of pedal travel. Before adjusting push rod to main cylinder clearance, make sure brake pedal returns to the fully released position freely, with no binding, and that the pedal retracting spring has not lost its tension.

1. Brake pedal clevis should be adjusted to give barely perceptible end play between main cylinder piston and the brake push rod.
2. Loosen check nut on the clevis.
3. Turn push rod in proper direction to secure the proper adjustment, barely perceptible movement of pedal before contact of push rod and main cylinder piston ( $\frac{1}{8}$ " to  $\frac{3}{8}$ " pedal movement should be felt.)
4. Tighten check nut on clevis.

### HYDRAULIC BRAKE TUBING

Hydraulic brake tubing used on all models is a double layer annealed steel, copper coated and tin plated tubing which resists corrosion and also stands up under the high pressures which are developed when applying the brakes. All models use  $\frac{3}{16}$ " tubing, except on the brake main cylinder pipe and front crossover pipe which are  $\frac{1}{4}$ ". In making up hydraulic brake pipes, it is important that the proper size flaring tool be used to flare the ends of the tubing for the compression couplings. Unless the tubing is properly flared, the couplings will leak and the brakes will become ineffective.

**CAUTION:** When necessary to replace brake tubing, always use special metal tubing which is especially designed to withstand high pressure and resist corrosion. For this reason, ordinary copper tubing is not satisfactory and should not be used.

This safety steel tubing must be double-lap flared at the ends in order to produce a strong leak-proof joint.

The brake tube flaring Tool J-8051 (fig. 7) is used to form the double-lap flare.

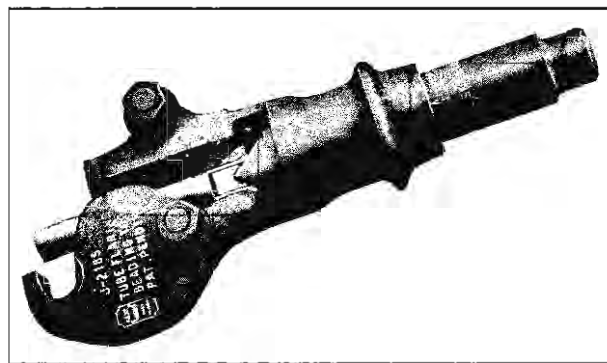


Fig. 7—Hydraulic Brake Tube Flaring Tool

Figure 8 shows two pieces of tubing-line with a single-lap flare "A" and the other with a double-lap flare "B". It will be noted that the single-lap flare split the tubing while the one shown in "B" has a heavy, well-formed joint.

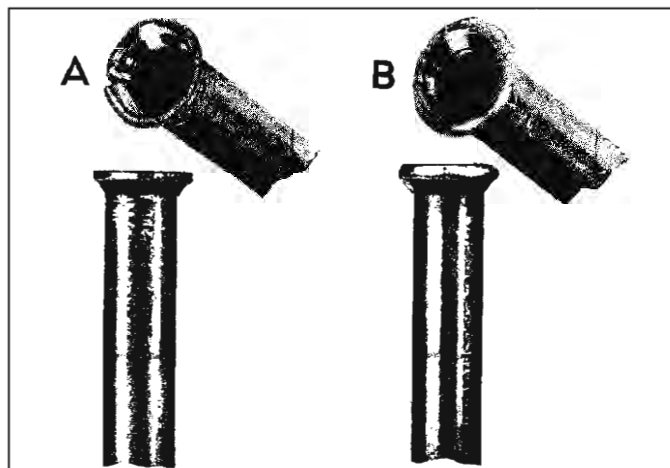


Fig. 8—Single and Double Lap Flared Tubing

The following procedure should be followed in making up hydraulic brake pipes:

#### Double Lap Flaring

1. Clamp the tubing in the proper size die blocks with the flat ends of the blocks toward the end of the tubing to be cut off. Cut the end of the tubing flush and square. Using a mill file, dress tubing and square ends.
2. Remove the tubing from the die block, and deburr the inside and outside edges.
3. Install compression couplings on tubing and dip end of tubing to be flared in hydraulic fluid. This lubrication results in better formation of the flare.
4. Place one-half of the die blocks in the tool body with the counterbored ends toward the ram guide. Now lay the tubing in the block with approximately  $\frac{1}{2}$ " protruding beyond the end. Fit the other half of the block into the tool body, close the latch plate and tighten the nuts "finger-tight."

5. Select the correct size upset flare punch. One end of this punch is counterbored or hollowed out to gauge the amount of tubing necessary to form a double lap flare. Slip the punch into the tool body with the gauge end toward the die blocks. Install the ram; then tap lightly until the punch meets the die blocks and they are forced securely against the stop plate (fig. 9).

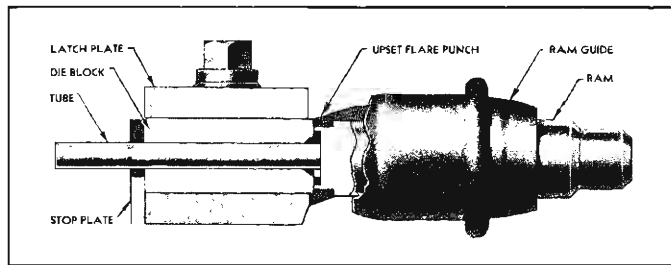


Fig. 9—Flaring Operation—Positioning Tubing

6. Using the supplied wrench, draw the latch plate nuts down tight to prevent the tube from slipping. Tightening the nuts alternately (beginning with the nut on the closed side) will prevent distortion of the plate. Remove the punch and the ram. Now reverse the punch and put it back into the tool body. Install the ram and tap it lightly until the face of the upset flare punch contacts the face of the die blocks (fig. 10). This completes the first operation. Remove the ram and the punch.

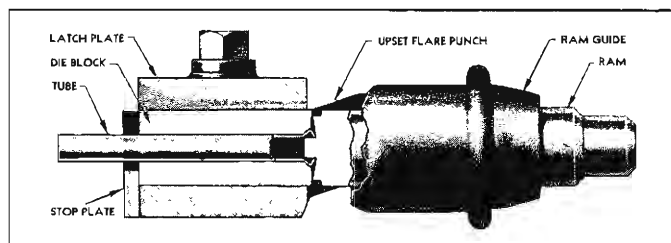


Fig. 10—Flaring Operation—First Flare

7. To complete the flare, insert the finish flare punch and the ram into the tool body. Tap the ram until a good seat is formed (fig. 11).

**NOTE:** The seat should be inspected at intervals during the finishing operation to avoid over-seating.

## BRAKE TUBE RETAINING CLIP INSTALLATION

After removal of the old clip from the frame, position the new clip in the location of the old clip. Index the "blind rivet" protrusion on the new clip into the clip hole in the frame. Insert the pointed end of Tool J-7777 into the "blind rivet" and press hard (hand pressure should do) to expand rivet.

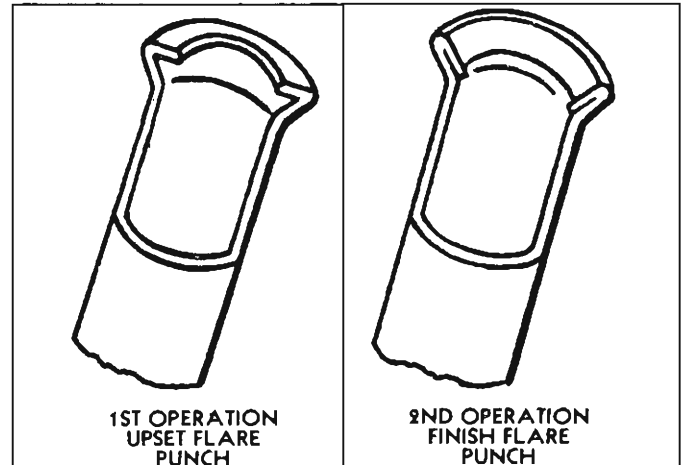


Fig. 11—Flaring Operation—First and Second Flare

## HYDRAULIC BRAKE ADJUSTMENT

Hydraulic brake adjustment is confined to a single operation on each brake assembly. A spring snap cover plate is pried from the back of the flange plate, exposing a hole through which Tool J-4707 is inserted to turn the single adjusting screw.

### Adjustment Front or Rear

1. Jack all wheels clear of floor.
2. Loosen the check nut at the brake cable equalizer to remove tension from brake cable.

**NOTE:** If cable has been adjusted too short, the rear brake shoes will be forced away from the anchor pins in brake release position, making correct shoe adjustment impossible.

3. Remove adjusting hole cover from brake flange plate. Expand brake shoes by turning adjusting screw with Tool J-4707 until a light uniform drag is felt on the brake drum (fig. 12).

**NOTE:** Moving the outer end of tool toward center of wheel, expands the shoes.



Fig. 12—Adjusting Brakes

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4. Turn adjusting screw back, to retract brake shoes, 12 notches to insure running clearance.
5. Repeat the above operations 3 and 4 at each wheel and replace hole covers.
6. After the hydraulic brakes are adjusted, adjust the parking brakes as outlined under, "Parking Brake Adjustment."
7. Lower car to floor and test brakes.

### PARKING BRAKE

The Parking Brake System incorporates a spring loaded pedal return and a ratcheting mechanism to permit a second stroke of the pedal if necessary. Thus, parking brake application is assured even if the rear service brakes are out of adjustment.

The pedal will return to normal position after each stroke; therefore, pedal position cannot be depended upon to indicate brake application. Instead when the parking brake is applied, the release handle will "pop out" about two inches, providing visual indication that the brakes are applied.

**CAUTION:** *If more than two strokes are necessary to set the parking brake, check both the service and parking brake adjustment.*

#### Adjustment

The parking brake must be adjusted each time the hydraulic service brakes are adjusted. When making a parking brake adjustment, the service brake must be properly adjusted first as a base for the parking brake adjustment.

1. Jack up both rear wheels.
2. Check the location of the idler lever with respect to the swivel rod bracket on the frame to be sure the front cable is correctly adjusted (fig. 13). To correct front cable adjustment, the equalizer must be disconnected, the check nuts on the forward cable tightened so the correct clearance may be established (ordinarily this clearance will be correct even after long periods of service).
3. Depress parking brake pedal six notches from initial position. (The release lever will be fully out).
4. Loosen the forward check nut on the equalizer

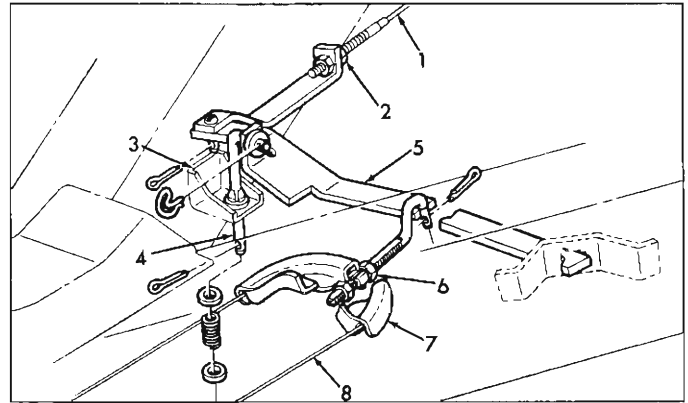


Fig. 13—Parking Brake System

- |                  |                |
|------------------|----------------|
| 1. Forward Cable | 5. Idler Lever |
| 2. Check Nut     | 6. Check Nut   |
| 3. Bracket       | 7. Equalizer   |
| 4. Swivel Rod    | 8. Rear Cable  |

and tighten the rear one until there is a slight drag on both rear wheels when rotating the drums.

5. Tighten the check nuts securely.
6. Set the parking brake pedal and arm back to full released position, at which point no brake shoe drag should be felt.

#### Inspection and Service

If complete release of the parking brake lever is not obtained unless the lever is forcibly returned to its released position, it indicates a need for forward cable adjustment or that there is a bind in the arm or cable.

Check parking brake arm assembly for free operation. If operation is sticky or a bind is experienced, correct as follows:

1. Check idler lever adjustment and correct if necessary according to Step 2, "Parking Brake Adjustment."
2. Clean and lubricate forward brake cable pulleys.

**NOTE:** These pulleys must be lubricated as outlined in Sec. 2, every 1000 miles.

3. Inspect brake pedal and shaft for straightness (replace if necessary).
4. Clean and lubricate parking brake lever assembly, which must operate freely.

## SERVICE OPERATIONS

### PARKING BRAKE CABLE REPLACEMENT

#### Removal

1. Remove rear check nut at rear end of forward brake cable (fig. 13), and pull rod end out of lever.
2. Remove the bolt from each of the cable pulleys.
3. Remove the cable from the parking brake arm

by pulling the cable ball out of the recess in the brake lever assembly clevis.

4. Pull cable down through hole and seal in toe-pan.

#### Installation

1. The front cable must be installed from the outside of the car by threading the ball end of the cable assembly through the  $\frac{1}{2}$ " hole in the toe pan then forcing the hole seal into the opening.

2. Insert the rod end of the hand brake cable through the two cable pulley housings and floor board from underneath the vehicle.

**NOTE: The cable pulleys must be removed to provide clearance for the cable rod to pass through the pulley housings.**

3. Lubricate and install the two cable pulleys.
4. Insert the cable ball end into the recess on the parking brake lever clevis.
5. Release the parking brake lever.
6. Install one check nut on rod end of cable.
7. Install the rod end through lever at swivel and install rear check nut on rod.
8. Adjust the parking brake system as outlined under "Parking Brake Adjustment."

## CLUTCH AND BRAKE PEDAL

### Removal

1. Remove cotter pin and clevis pin from brake pedal arm.
2. Push clutch pedal to floor and remove over-center spring from dash panel brace and clutch pedal arm.
3. Remove lock bolt nut and remove bolt from over-center spring lever (on brake pedal side of panel brace) and remove lever from shaft.
4. Remove clutch pedal push rod by removing retainer clip and washer and pushing rod out of clutch pedal arm.
5. Slide the clutch pedal arm assembly to the left and remove from panel brace. Brake pedal arm tension spring will then fall free.
6. Withdraw brake pedal.
7. Remove nylon bushings from brake pedal side of panel brace and from pivot shaft on upper end of clutch pedal arm.

### Inspection

1. Clean all metal parts with a good cleaning solvent.
2. Wipe the nylon bushings clean with a clean cloth.

**CAUTION: Nylon bushings should not be treated with cleansing agents of any nature.**

3. Inspect all nylon bushings for wear or damage. Replace if necessary.
4. Inspect all mating surfaces of bushings for wear or damage. Replace any parts if necessary.

### Installation

1. Install nylon bushing on clutch pedal pivot and one through panel brace on opposite side.
2. Set brake pedal arm and spring in place and install clutch pedal arm and pivot shaft. Make certain that spring indexes on panel brace (in stamped notch) and on brake pedal arm.
3. Align over-center spring lever lock bolt passage with notch in pivot shaft and slide lever onto shaft, then install lock bolt and nut in lever and shaft and install over-center spring.
4. Attach clutch pedal push rod and secure with washer and retainer clip.
5. Install main cylinder push rod clevis pin and cotter pin.

**NOTE: Check stop light switch position and adjust if necessary so that electrical contact is made when the pedal is depressed  $\frac{5}{8}$  inch.**

### Brake Shoe Replacement

In all cases of brake complaints denoting actual brake lining or shoe failure, the brake drums should be removed and before disassembly of the shoes from the flange plate, all linings should be inspected for wear, improper alignment causing uneven wear and oil and grease on the linings. If any of these conditions exist, it will be necessary to replace the shoes. If, in checking the linings, it is noticed that they have

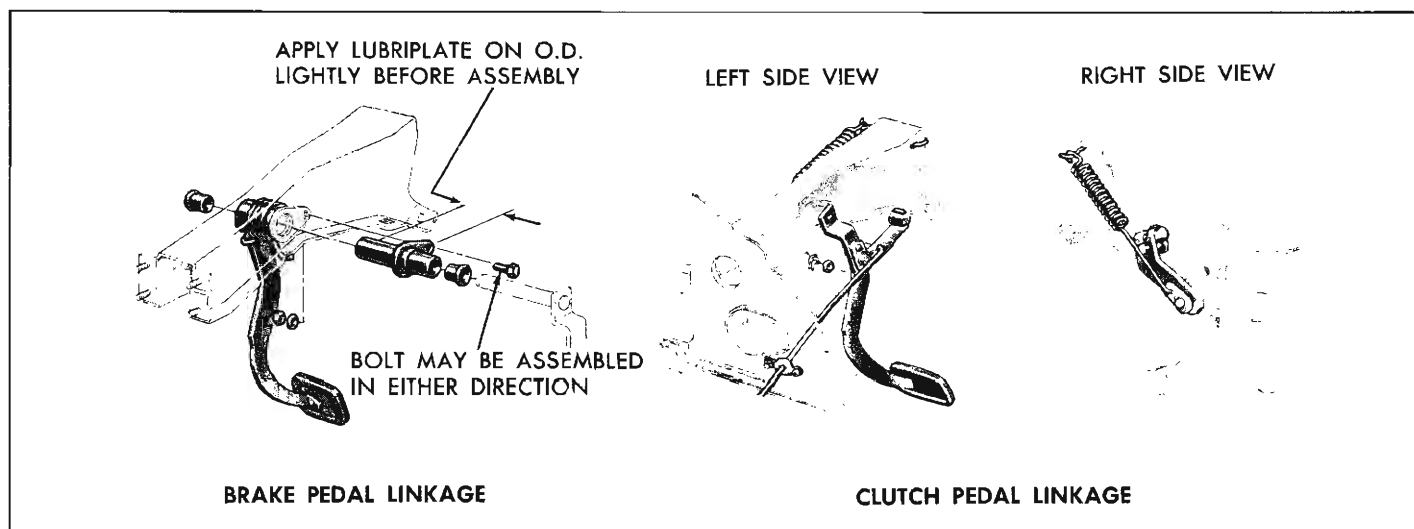


Fig. 14—Clutch and Brake Pedals

## BRAKES—STANDARD 6-8

the appearance of being glazed, this is a normal condition with the hard type lining used. **Do not use a wire brush or an abrasive on the lining to destroy this glazed surface as it is essential for proper operation.** When brake lining replacement is necessary, all shoes and linings should be replaced. In no case should a single lining and shoe be replaced; however, in exceptional cases, it may be satisfactory to replace the shoes and linings on both front or both rear wheels.

### Removal

1. Raise vehicle and place on stand jacks.
2. Loosen check nuts at forward end of parking brake cable sufficiently to remove all tension from brake cable.
3. Remove rear brake drums and front hub and drum assemblies.

**NOTE:** Since boots are recessed in grooves on wheel cylinders to prevent pistons from leaving cylinders, it is not necessary to install wheel cylinder clamps when brake shoes are removed; however, brake pedal must not be depressed while drums are removed.

4. Unhook brake shoe pull back springs from anchor pin using Tool J-8049 (fig. 15).

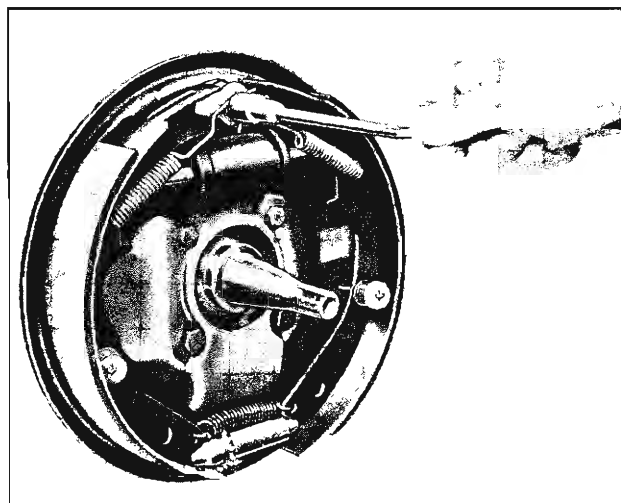


Fig. 15—Unhooking Pull Back Spring

**NOTE:** Be certain that the primary and secondary springs are kept separate as they have unequal tension. The secondary spring which is colored black has a spring rate of 50 lbs. The primary spring which is colored grey, has a spring rate of 40 lbs.

5. Remove brake shoe hold down pins and springs using a pair of needle nosed pliers (fig. 16).
6. Spread shoes to clear wheel cylinder connecting links and remove shoes from backing plate (fig. 17).

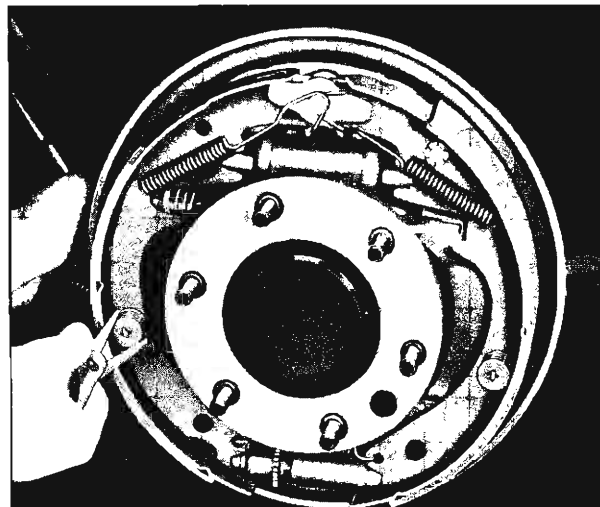


Fig. 16—Removing Hold Down Springs and Pins

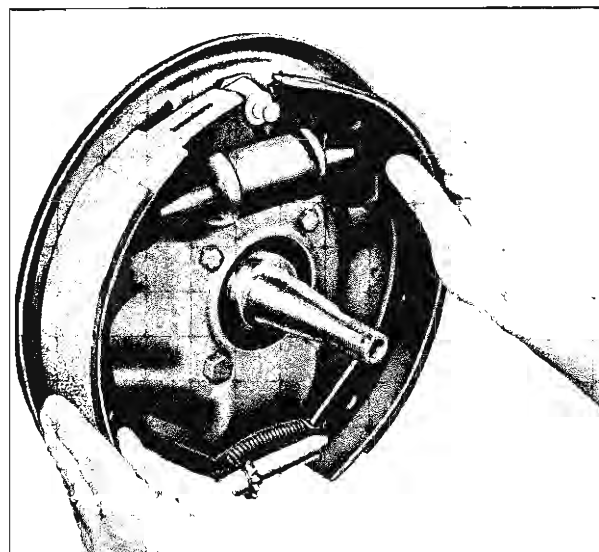


Fig. 17—Spreading Brake Shoes for Removal

7. Separate the brake shoes by removing adjusting screw and spring.
8. Remove parking brake lever from secondary brake shoe (rear only).
9. Clean all dirt out of brake drum using care to avoid getting dirt into front wheel bearings. Inspect drums for roughness, scoring or out-of-round. Replace or recondition drums as necessary.
10. Inspect wheel bearings and oil seal and replace any necessary parts.
11. Carefully pull lower edges of wheel cylinder boots away from cylinders and note whether interior is wet with brake fluid. Excessive fluid at this point indicates leakage past piston cups requiring overhaul of wheel cylinder.

**NOTE:** A slight amount of fluid is nearly always present and acts as lubricant for the piston.



12. If working at rear wheels, inspect backing plate for oil leakage past axle shaft oil seals. Install new seals if necessary.
13. Check all brake flange plate attaching bolts to make sure they are tight. Clean all rust and dirt from shoe contact faces on flange plate, using fine emery cloth (fig. 18).

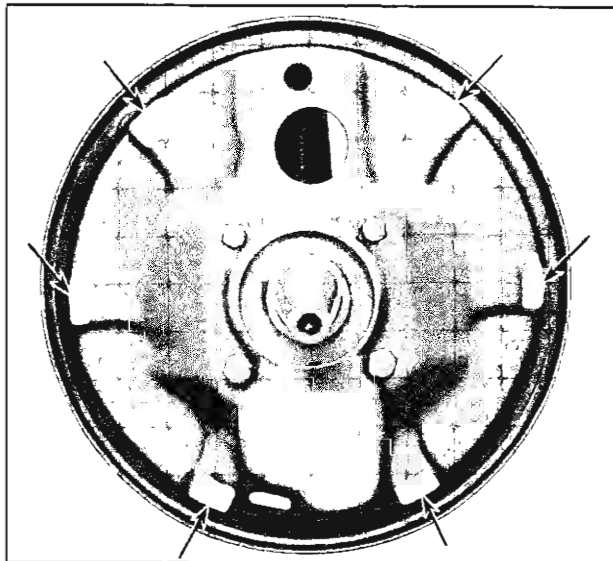


Fig. 18—Backing Plate Contact Faces

#### Installation

**CAUTION:** Make certain that when replacing with new shoe and lining assemblies, that the latest type linings are used. Otherwise, serious fade or permanent failure may occur.

1. Inspect new linings and make sure there are no nicks or burrs or bonding material on shoe edge where contact is made with brake flange plate or on any of the contact surfaces.

**NOTE:** Keep hands clean while handling brake shoes. Do not permit oil or grease to come in contact with linings.

2. If working on rear brakes, lubricate parking brake cable.
3. On rear brakes only, lubricate fulcrum end of parking brake lever and the bolt with Bendix or Delco brake lube or Lubriplate, then attach lever to secondary shoe with bolt, spring washer, lock-washer, and nut. Make sure that lever moves freely.
4. Lubricate threads and socket end of adjusting screw with Bendix or Delco brake lube or Lubriplate.
5. Connect brake shoes together with adjusting screw spring then place adjusting screw, socket and nut in position.

**CAUTION:** The socket and adjusting screw must be adjacent to the primary shoe (front) on the brakes on the left side and adjacent to the secondary shoe (rear) on the brakes on the right side.

6. Attach brake shoes to brake flange plates with the hold down pins and springs using a pair of needle-nosed pliers; at the same time engage shoes with wheel cylinder connecting links. The primary shoe (short lining) goes forward.
7. On rear brakes, connect cable to parking brake lever and install strut between lever and primary shoe as installation is made.
8. If old brake pull back springs are nicked, distorted, or if strength is doubtful, install new springs. Install guide plate over anchor, hook springs in shoes and using Tool J-8049, install spring connected to primary shoe over anchor (fig. 19), and then spring connected to secondary shoe over anchor.

**NOTE:** The brake shoe release springs are color coded for identification. The secondary spring is colored black, and the primary spring is colored grey.

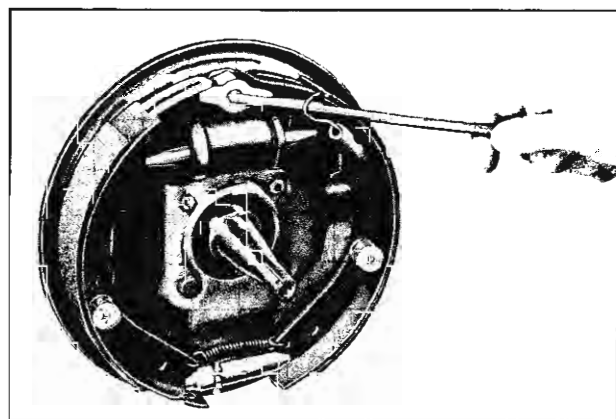


Fig. 19—Installing Pull Back Springs

9. Pry shoes away from backing plate and lubricate shoe contact surfaces with a thin coating of Bendix or Delco brake lube or Lubriplate. On rear wheels, sparingly apply this same lubricant where brake cable contacts brake flange plate.

**CAUTION:** Be careful to keep lubricant off facings.

10. Install brake drums. If working on front brakes, lubricate and adjust wheel bearings and install front and rear wheel and tire assemblies. Remove adjusting hole covers from backing plates.
11. Adjust all brakes and brake cables as outlined under "Maintenance and Adjustments."

**NOTE:** The fixed anchor pins have eliminated need for anchor pin adjustment.

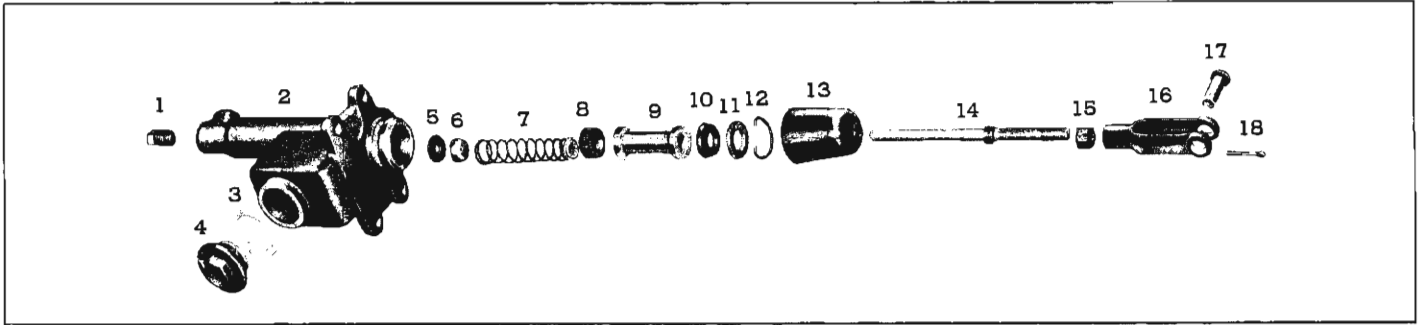


Fig. 20—Main Cylinder

- |                       |                   |                 |                |
|-----------------------|-------------------|-----------------|----------------|
| 1. Pipe Plug          | 6. Valve Assembly | 11. Piston Stop | 16. Clevis     |
| 2. Body               | 7. Spring         | 12. Lock Ring   | 17. Clevis Pin |
| 3. Filler Plug Gasket | 8. Primary Cup    | 13. Rubber Boot | 18. Cotter Pin |
| 4. Filler Plug        | 9. Piston         | 14. Push Rod    |                |
| 5. Valve Seat         | 10. Secondary Cup | 15. Lock Nut    |                |

**MAIN CYLINDER**

**Removal**

1. Disconnect hydraulic line from end of cylinder.
2. Remove cotter pin and clevis pin from brake pedal arm.
3. Remove the four retaining nuts and lock washers holding main cylinder to the front of the dash panel and remove the cylinder from the vehicle.

**Disassembly (See Figure 20)**

1. Remove push rod assembly from boot end of main cylinder.
2. Remove boot from end of main cylinder.
3. Remove lock ring, piston stop, secondary cup and piston from main cylinder.
4. Remove end plug, insert wire or other suitable tool and push out the primary cup, spring, valve assembly and valve seat.
5. Remove filler plug and gasket from top of main cylinder.

**Inspection**

1. Wash all parts in clean alcohol. Make sure that compensating port in main cylinder body and bleeder holes in piston are clean and open.

**NOTE:** Before washing parts, hands must be clean. Do not wash hands in gasoline or oil before cleaning parts. Use soap and water to clean hands.

2. Inspect cylinder bore to make sure it is smooth.
3. Inspect primary and secondary cups, valve and valve seat for damage or swelling. Swelling of rubber parts is due to the use of improper brake fluid or washing parts in gasoline or kerosene.

**NOTE:** The primary cup has a brass support ring vulcanized in its base to prevent it from imbedding in the bleeder holes during braking action.

4. Check piston fit in cylinder bore (fig. 21). The clearance between piston and wall of the cylinder should be from .001"-.005".

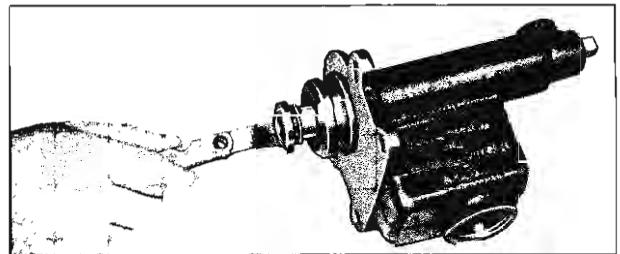


Fig. 21—Checking Main Cylinder Piston Fit

5. Check clearance between the edge of the primary cup and the center of the compensating port, (fig. 22). To check this clearance, proceed as follows:
  - a. Install piston stop and lock in place with snap ring.

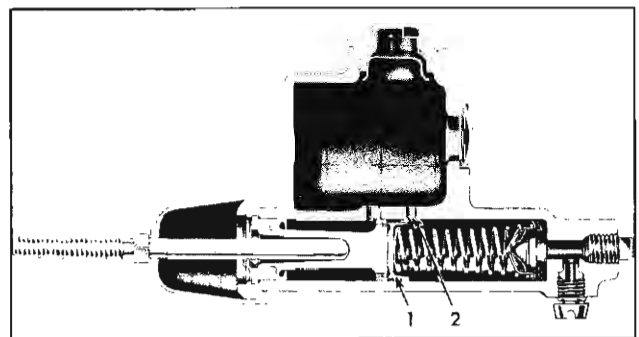


Fig. 22—Main Cylinder

- |                |                      |
|----------------|----------------------|
| 1. Primary Cup | 2. Compensating Port |
|----------------|----------------------|

- b. Assemble secondary cup on piston and install assembly in body. Place primary cup in the body with the flat side of the cup against the piston.
- c. Push the piston cup against the piston stop and check clearance between edge of primary cup

and center of the compensating port. This clearance should be a minimum of .035". If clearance is less than .035", the primary cup must be replaced.

**NOTE:** This check is made easiest by using a wire inserted through the reservoir of the body and extending into the piston chamber (fig. 23).

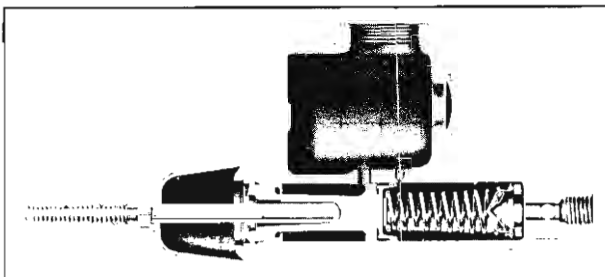


Fig. 23—Checking Compensating Port Clearance

6. After clearance is checked, again completely disassemble main cylinder.

#### Assembly

Whenever a hydraulic brake main cylinder is overhauled, care must be taken to reassemble the valve and seat correctly. Improper assembly of the check valve seat rubber washer will result in its distortion. When the check valve seat is distorted, there will be no check valve seal and there will be a loss of brake pedal travel, also, the pedal will have to be depressed or pumped one or more times before actual car braking occurs.

1. Install valve seat, valve assembly and spring into main cylinder.
2. Dip primary cup into clean brake fluid and install into main cylinder with the flat side toward push rod end. Make certain it seats over end of spring.
3. Dip secondary cup in clean brake fluid and install on piston.
4. Assemble secondary cup and piston in the body so that the bleeder hole end of the piston will be toward the end pipe plug when the assembly is complete.
5. Install the piston stop and snap ring.
6. Install the rubber push rod boot, making certain this seal is tight on the body. This seal must be tight to keep water and other foreign matter from entering the main cylinder through the piston stop.
7. Install the pipe plug and tighten securely.
8. Install the push rod, locknut, and clevis on to the main cylinder.

#### Installation

1. Install the main cylinder in place on the dash panel and tighten the mounting nuts securely. Make

certain the push rod clevis is straddling the brake pedal.

2. Install clevis pin through clevis and brake pedal and insert cotter pin.
3. Connect hydraulic brake line to cylinder.
4. Refill main cylinder and bleed all brake lines as outlined in this section.
5. Adjust brake pedal clevis as outlined under Push Rod to Main Cylinder Clearance.

## WHEEL CYLINDER

### Removal

1. Raise vehicle and place on stand jack.
2. Remove wheels. Back off brake adjustment and remove drums.
3. Disconnect brake system wheel cylinder pipe or hose from fitting at flange plate.
4. Disconnect brake shoe retracting spring from brake shoes.
5. Remove two capscrews which hold rear wheel cylinder to brake flange plate and remove rear wheel cylinder.
6. Remove anchor pin which holds front wheel cylinder to flange plate and remove front wheel cylinder.

### Disassembly (See Figure 24)

1. Remove the cylinder boots.
2. Remove the pistons, rubber cups and spring.
3. Wash all parts in clean alcohol.

**NOTE:** Before washing parts, hands must be clean. Do not wash hands in gasoline or oil before cleaning parts. Use soap and water to clean hands.

### Inspection

1. Inspect cylinder bore, making sure that it is smooth. A scored or damaged cylinder must be replaced.
2. Check rubber cups for damage or swelling due to improper brake fluid. Replace the cups when

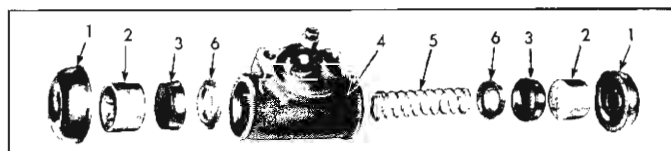


Fig. 24—Wheel Cylinder

- |                |               |             |
|----------------|---------------|-------------|
| 1. Rubber Boot | 3. Piston Cup | 5. Spring   |
| 2. Piston      | 4. Housing    | 6. Expander |

## BRAKES—STANDARD 6-12

necessary. Improper brake fluid will cause the cups to swell as much as 40 per cent.

3. Check fit of the piston in the cylinder bore, using a feeler gauge (fig. 25). This clearance should be from .003" to .006". If clearance exceeds .006" replace piston and cup with repair kit if bore is not damaged. Replace cylinder assembly if bore is scored or damaged.

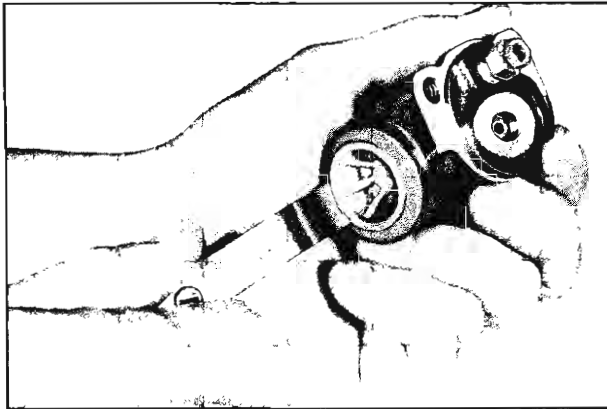


Fig. 25—Checking Wheel Cylinder Piston Fit

### Assembly

1. Dip pistons and rubber cups in hydraulic brake fluid.
2. Place the spring in the center of the housing.
3. Install rubber cups at each end of spring with cupped side toward spring.
4. Install pistons with flat side of pistons against flat side of rubber cups.
5. Replace boots.

### Installation

1. Mount front wheel cylinders to the brake flange plate by installing the threaded anchor pin (fig. 26) through the wheel cylinder housing and tighten to 65 foot pounds with a torque wrench (fig. 27).

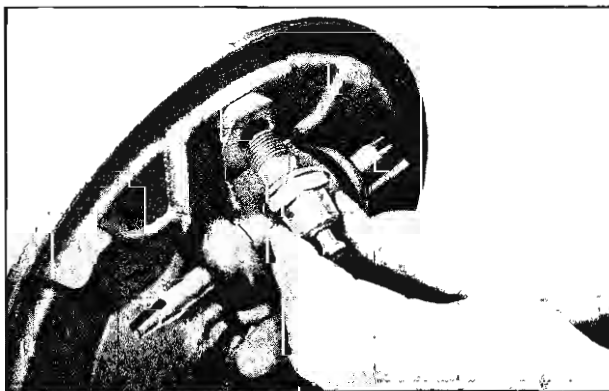


Fig. 26—Installing Front Anchor Pin

**CAUTION:** Peen over the flat washer on the anchor pin to prevent the anchor pin from loosening during operation.

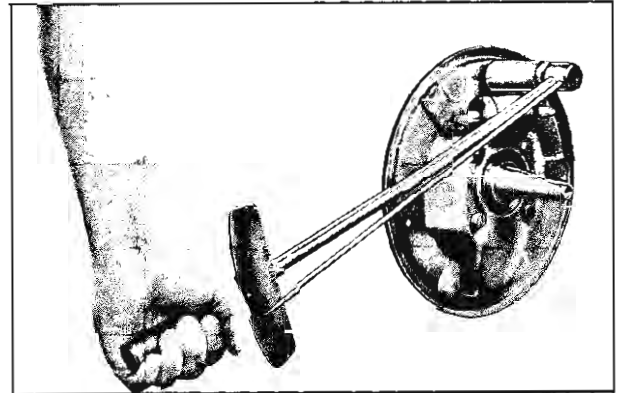


Fig. 27—Applying Correct Torque on Anchor Pin

2. Mount the rear wheel cylinder to the brake flange plate, install two cap screws, tighten securely and install the two connecting links.
3. On both front and rear, replace the brake shoe retracting springs.
4. Connect the hose or line to the wheel cylinder.
5. Install the rear brake drums and install the wheels.
6. Install front drum and adjust wheel bearings as outlined in Section 3.
7. Bleed all brake lines.
8. Adjust brakes as outlined previously in this section.

## BRAKE DRUM

Front and rear brake drums are both removable, that is, the front drum is removable without disturbing the wheel hub, and the rear drum may be removed without disturbing the axle shaft.

### Removal

1. Jack up front end of vehicle and remove wheel.
2. Remove brake drum assembly.
3. Jack up rear end of vehicle and remove wheel.
4. Remove brake drum from flange of axle shaft.

### Inspecting and Reconditioning

Whenever brake drums are removed they should be thoroughly cleaned and inspected for cracks, scores, deep grooves, and out-of-round. Any of these conditions must be corrected since they can impair the efficiency of brake operation and also can cause premature failure of other parts.

Smooth up any slight scores by polishing with fine emery cloth. Heavy or extensive scoring will cause excessive brake lining wear and it will probably be necessary to rebores in order to true up the braking surface.

An out-of-round drum makes accurate brake shoe adjustment impossible and is likely to cause excessive wear of other parts of brake mechanism due to its eccentric action.

A drum that is more than .008" out-of-round on the diameter is unfit for service and should be re-bored. Out-of-round, as well as taper and wear can be accurately measured with an inside micrometer fitted with proper extension rods.

If drum is to be re-bored for use with standard size brake facings which are worn very little, only enough metal should be removed to obtain a true smooth braking surface.

If drum has to be re-bored more than .020" over the standard diameter, it should be re-bored to .060" diameter oversize and the brake facing should be replaced with .030" oversize facings.

A brake drum must not be re-bored more than .060" over the maximum standard diameter, since removal of more metal will effect dissipation of heat and may cause distortion of drum. Chevrolet brake facing is not furnished larger than .030" oversize and this will not work efficiently in drums bored more than .060" oversize.

Brake drums may be refinished either by turning or grinding. Best brake performance is obtained by

turning drums with a very fine feed. To insure maximum lining life, the refinished braking surface must be smooth and free from chatter or tool marks, and run-out must not exceed .005" total indicator reading.

### Cleaning

New brake drums in parts stock are given a light coating of rust proofing oil to prevent the formation of rust on the critical braking surfaces during the time that the drums are in storage.

This rust proofing oil must be carefully removed before the drum is placed in service to prevent any of this oil from getting on the brake shoe facings, which might cause an extreme brake grab condition.

It is recommended that a suitable volatile, non-toxic, greaseless type solvent be used to clean the oil from the braking surface of the new brake drums before they are placed in service to insure the cleanest possible surface.

Gasoline or Kerosene should not be used as there is danger that a portion of the diluted oily substance may be left on the braking surface that may later cause difficulty.

### Installation

1. On front, install drum to wheel hub.
2. On rear, assemble drum over axle shaft studs.
3. Replace wheel assembly, adjust brakes and lower vehicle to floor.

## TROUBLES AND REMEDIES

### BRAKE SYSTEM

Symptom and Probable Cause	Probable Remedy
<b>Pedal Spongy</b>	
a. Air in brake lines.	a. Bleed brakes.
<b>All Brakes Drag</b>	
a. Improper pedal to push rod clearance blocking compensator port.	a. Adjust clearance.
b. Compensating port in main cylinder restricted.	b. Overhaul main cylinder.
c. Mineral oil in system.	c. Flush entire brake system and replace all rubber parts.
<b>One Brake Drags</b>	
a. Loose or damaged wheel bearings.	a. Adjust or replace wheel bearings.
b. Weak, broken or unhooked brake retractor spring.	b. Replace retractor spring.
c. Brake shoes adjusted too close to brake drum.	c. Correctly adjust brakes.
d. Parking brake adjustment too tight.	d. Readjust parking brake.
<b>Excessive Pedal Travel</b>	
a. Normal lining wear or improper shoe adjustment.	a. Adjust brakes.
b. Fluid low in main cylinder.	b. Fill main cylinder and bleed brakes.
<b>Brake Pedal Applies Brakes but Pedal Gradually Goes to Floor Board</b>	
a. External leaks.	a. Check main cylinder, lines and wheel cylinder for leaks and make necessary repairs.
b. Main cylinder leaks past primary cup.	b. Overhaul main cylinder.
<b>Brakes Uneven</b>	
a. Grease on linings.	a. Clean brake mechanism; replace lining and correct cause of grease getting on lining.
b. Tires improperly inflated.	b. Inflate tires to correct pressure.
<b>Excessive Pedal Pressure Required, Poor Brakes</b>	
a. Grease, mud or water on linings.	a. Remove drums—clean and dry linings or replace.
b. Full area of linings not contacting drums.	b. Free up shoe linkage, sand linings or replace shoes.
c. Scored brake drums.	c. Turn drums and install new linings.

# BENDIX POWER BRAKES

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## GENERAL DESCRIPTION

The Master-Vac (fig. 28) is a self-contained hydraulic and vacuum unit for power braking, utilizing engine intake manifold vacuum and atmospheric pressure for its power.

The Master-Vac power brake permits the use of a low brake pedal as well as less pedal effort than is required with the conventional (non-power) hydraulic brake system. It utilizes the hydraulic master cylinder of the conventional hydraulic brake system. Only two external line connections are necessary: one a vacuum line connection to the engine intake manifold through a vacuum reservoir and vacuum check valve; the other, a hydraulic line connection into the hydraulic brake system. It is mounted on the engine side of the fire wall and connected to the brake pedal through an auxiliary lever and rod.

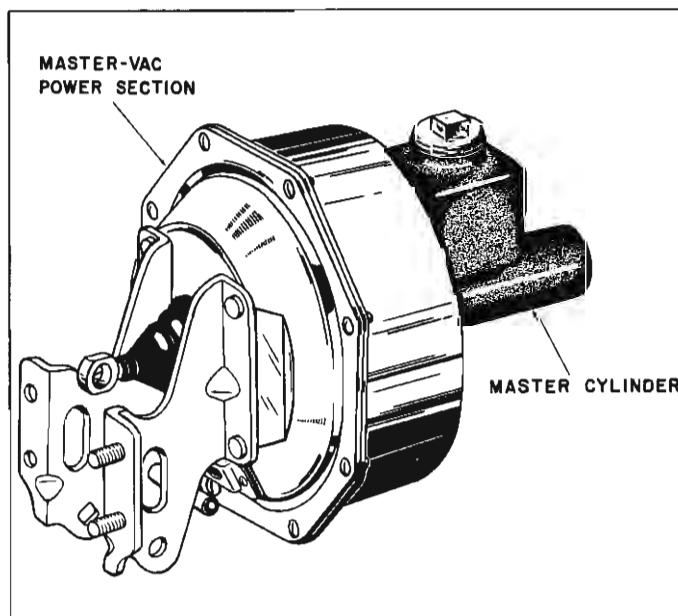


Fig. 28—Bendix Power Brake Unit

## MAINTENANCE AND ADJUSTMENTS

### INSPECTIONS

1. Check the vacuum lines and connection at the engine intake manifold and check valve for possible vacuum loss.
2. Inspect the hydraulic lines and connections at the wheel cylinders for possible hydraulic leaks.
3. Check brakes for scored drums, grease, or brake fluid on linings, worn or glazed linings, and make necessary brake adjustments.
4. Check the vacuum lines and connections at the vacuum inlet tube assembly, check vacuum attachment at vacuum reservoir.
5. Inspect the hydraulic lines and connection attached to the power brake hydraulic cylinder output port for hydraulic leaks.
6. Check the brake fluid level in the hydraulic reservoir. The reservoir should be filled to within  $\frac{1}{2}$ "

of the top of the filler cap opening. Inspect the reservoir cover for fluid leaks at gasket.

7. Check air cleaner on brake cylinder and replace hair filter if necessary.
8. Inspect the air cleaner and vacuum inlet tube assembly for loose screws. Check for loose unit mounting bolts.
9. Check brake pedal for binding and misalignment between pedal and push rod.

### LUBRICATION

The power brake system is lubricated at the time of assembly and needs no further lubrication.

### BLEEDING INSTRUCTIONS

The power brake system may be bled manually or with a pressure bleeder as outlined previously. Use only G.M. Super 11 or its equivalent. Do not use the vacuum assist while bleeding. The engine should not be running and the vacuum reserve should be reduced to zero by applying the brake several times with the engine off before starting the fluid bleeding procedure.

### AIR CLEANER SERVICE

The air cleaner used with power brake should be cleaned at least twice a year. To clean, remove air cleaner and wash thoroughly in cleaning solvent and allow to dry before reinstalling.

## SERVICE OPERATIONS

### Removal

1. Disconnect clevis at brake pedal assembly (fig. 29).

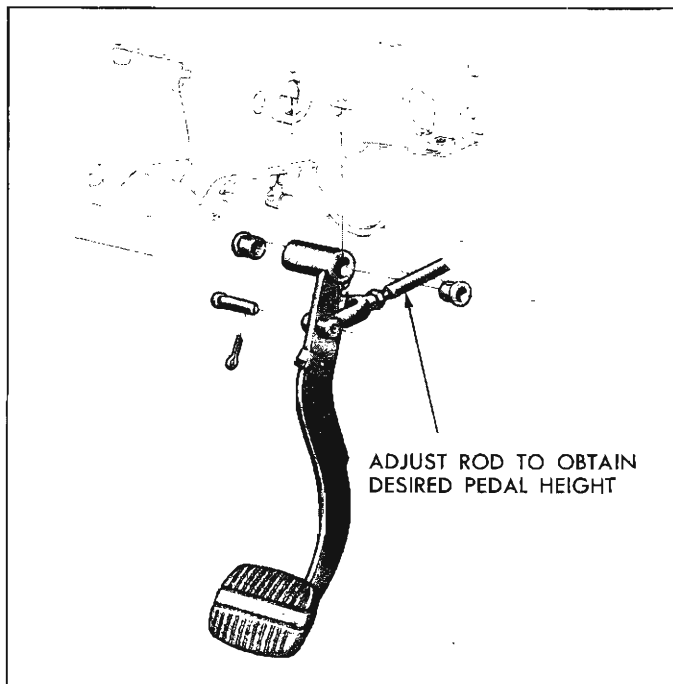


Fig. 29—Power Brake Push Rod to Brake Pedal Attachment

**NOTE:** If clearance hole through fire wall is not large enough it may be necessary to remove clevis yoke from push rod. Note approximate location of yoke on rod.

2. Remove vacuum hoses from power brake unit (fig. 30).
3. Disconnect hydraulic line from master cylinder.
4. Remove the four nut and lock washers securing

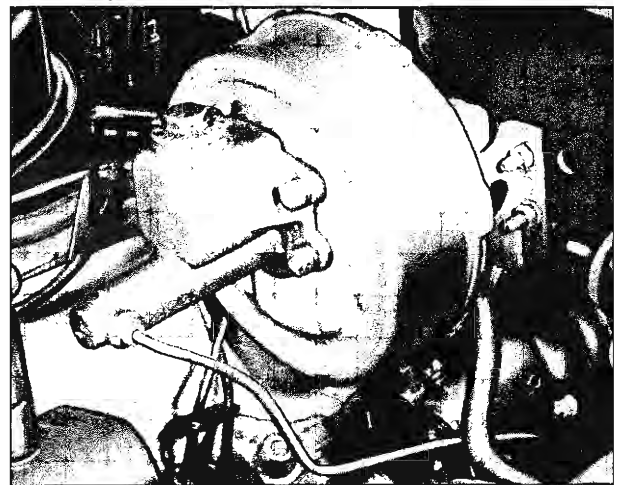


Fig. 30—Power Brake to Dash Mounting (Moraine Unit Shown)

the unit to the firewall. Withdraw power brake unit.

If the linkage is to be removed from the power brake unit, proceed as follows:

5. Remove the cotter pin, clevis pin and flat washer from the end of the brake pedal push rod. Carefully remove the push rod as a wave washer is used between the rod and the bracket.
6. Remove the cotter pin, clevis pin and flat washer from the end of the power brake operating rod. Remove the wave washer.
7. Remove the cotter pin then tap out the pivot pin. Remove the two operating levers and the pivot collar. Tap the one operating lever to remove it from the collar.

### Disassembly

The following procedure applies when the complete Master-Vac (vacuum power section plus master cylinder) is removed as a unit from the vehicle (fig. 31).



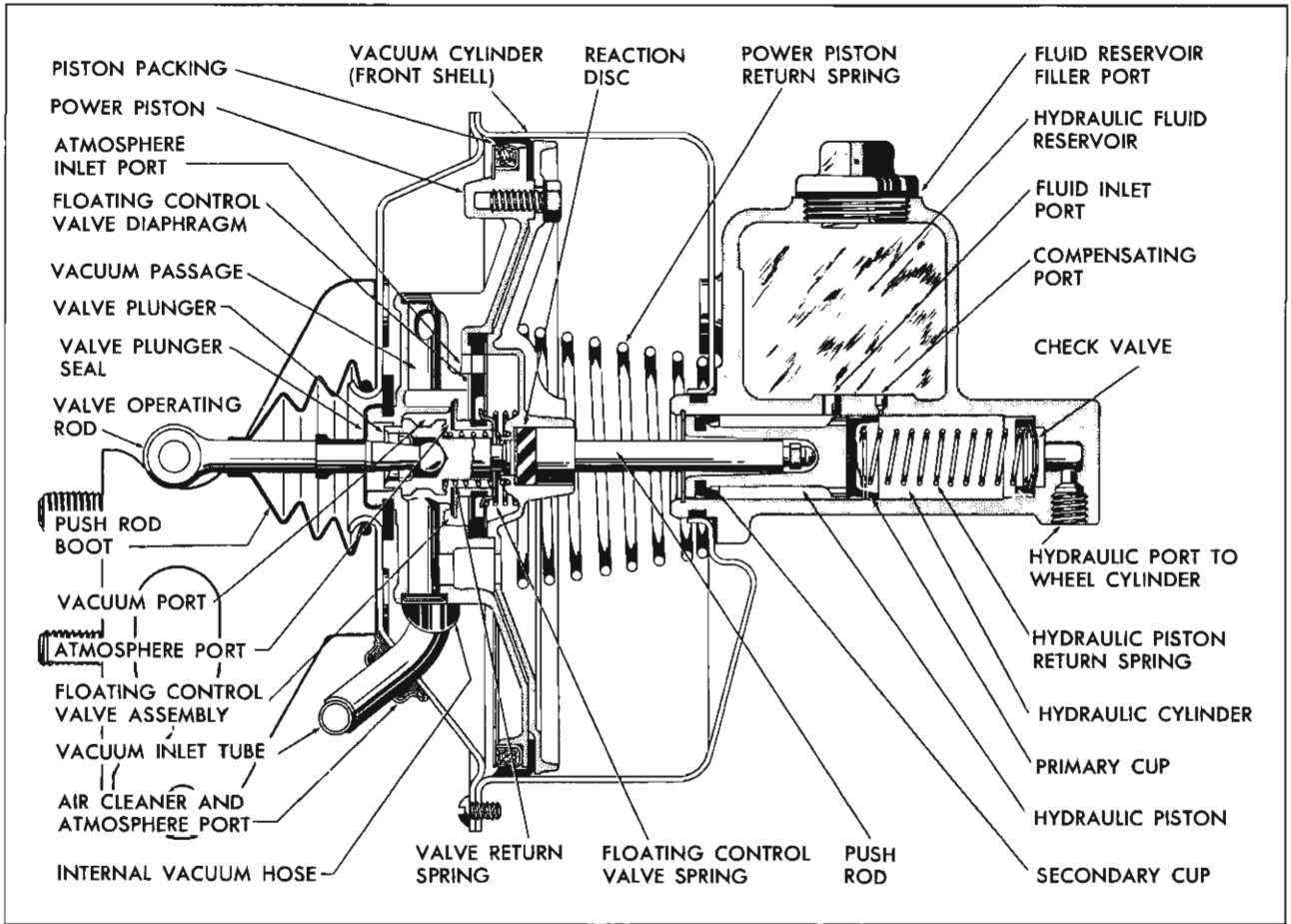


Fig. 31—Cutaway View of Bendix "Master-Vac" Power Brake

1. Remove four master cylinder attaching nuts (1) and lockwashers (2) from master cylinder attaching studs (6, fig. 32).
2. Remove master cylinder (3) from vacuum power section (7) and then remove rubber seal (4) from outer groove at end of master cylinder.
3. Remove push-rod (5) from power section. **DO NOT DISTURB ADJUSTMENT SCREW.**
4. Remove push rod boot (3) from rear shell (2) and valve operating rod (7, fig. 33).

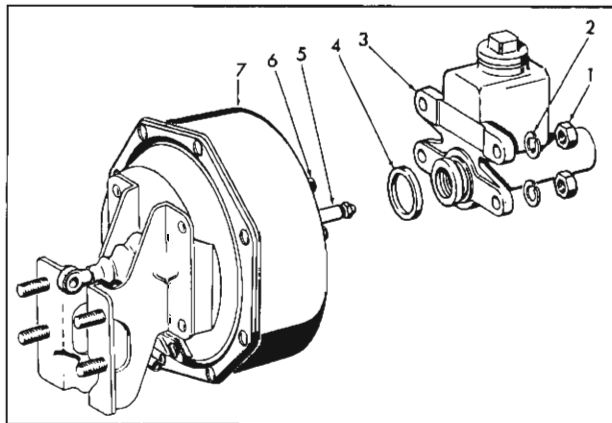


Fig. 32—Removal of Master Cylinder and Power Section

- |                    |                    |
|--------------------|--------------------|
| 1. Nut             | 5. Push Rod        |
| 2. Lockwasher      | 6. Mounting Stud   |
| 3. Master Cylinder | 7. Vacuum Cylinder |
| 4. Seal            |                    |

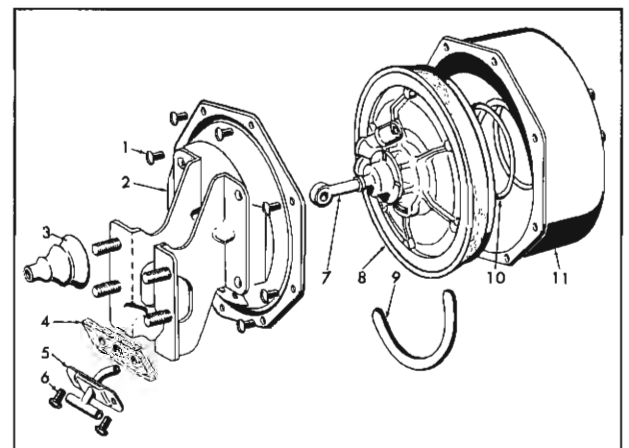


Fig. 33—Removal of End Plate, Air Cleaner, Vacuum Piston and Spring from Vacuum Cylinder

- |                                |                          |
|--------------------------------|--------------------------|
| 1. End Plate Screw             | 7. Valve Operating Rod   |
| 2. End Plate                   | 8. Piston                |
| 3. Dust Guard                  | 9. Vacuum Hose           |
| 4. Air Filter                  | 10. Piston Return Spring |
| 5. Vacuum Tube and Air Cleaner | 11. Vacuum Cylinder      |
| 6. Air Cleaner Screws          |                          |

5. Scribe alignment marks across rear shell and vacuum cylinder (front shell) (11). Remove six of the eight end plate attaching screws (1) leaving two opposite screws. Press down on rear shell (2) while removing remaining two screws to prevent piston return spring (10) from expanding.
6. Scribe across face of piston (8) to register with mark on rear shell and remove rear shell with vacuum piston and piston return spring.
7. Pull vacuum hose (9) from vacuum piston and from vacuum tube on inside of rear shell. Separate rear shell from vacuum piston assembly.
8. Remove air cleaner attaching crews (6), vacuum tube and air cleaner assembly (5) and air filter (4) from rear shell.
9. Spring the felt retaining ring (1) sufficiently to disengage ring from grooves in bosses on rear piston plate (fig. 34).

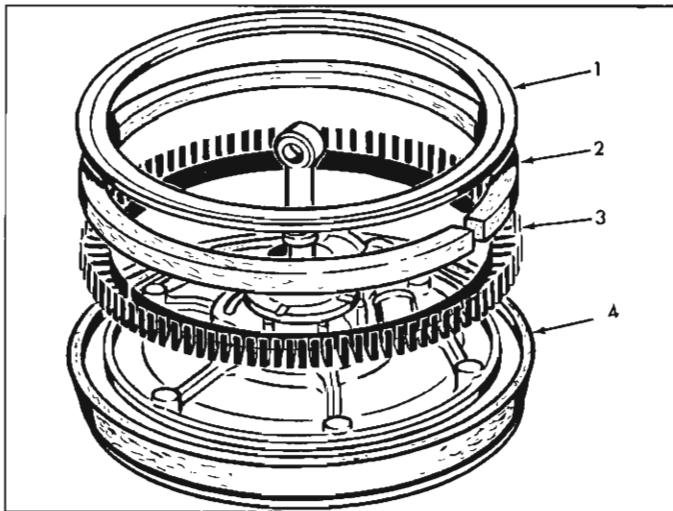


Fig. 34—Removal of Felt Retainer, Felt and Expanding Ring from Piston Assembly

- |                   |                    |
|-------------------|--------------------|
| 1. Retaining Ring | 3. Expanding Ring  |
| 2. Piston Felt    | 4. Piston Assembly |

10. Remove piston felt (2) and expander ring (3) from piston assembly (4).
11. Remove six piston plate attaching screws (15) and separate front piston plate (14) and piston packing (6) from piston plate (4, fig. 35).
12. Remove valve return spring (7), floating control valve and diaphragm assembly (8), floating control valve spring (12) and diaphragm plate (13). Separate floating control valve spring retainer (11) and floating control valve diaphragm (10) from floating control valve (9).
13. Remove rubber reaction disc (17) and shim (16), if present, from front piston plate. If necessary, use a piece of rod having a smooth flat end to push reaction disc and shim out of piston plate.

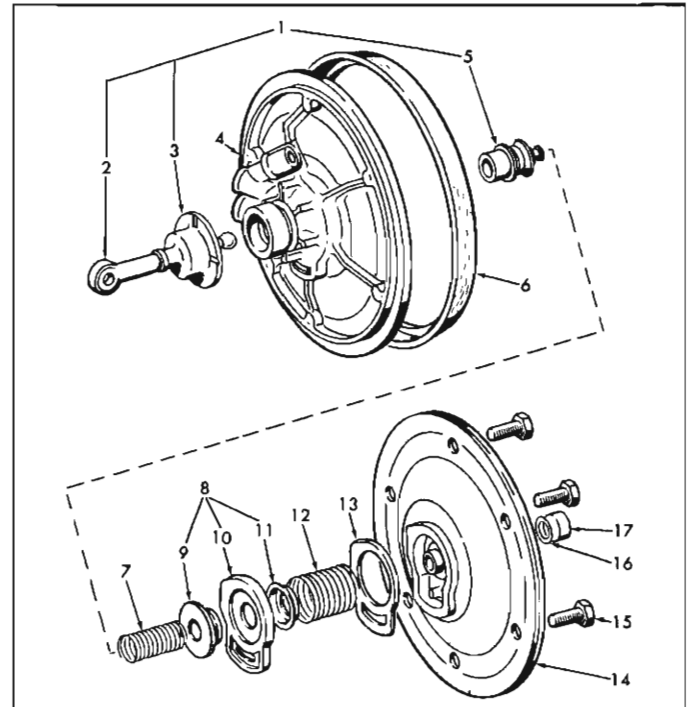


Fig. 35—Details of Vacuum Power Piston and Valve

- |   |  |
|---|--|
| 1. Piston Assembly                      | 10. Floating Control Valve Diaphragm       |
| 2. Valve Operating Rod                  | 11. Floating Control Valve Spring Retainer |
| 3. Valve Rod Seal                       | 12. Floating Control Valve Spring          |
| 4. Piston Plate                         | 13. Diaphragm Plate                        |
| 5. Valve Plunger                        | 14. Piston Plate                           |
| 6. Piston Packing                       | 15. Attaching Screws Assembly              |
| 7. Valve Return Spring                  | 16. Shim                                   |
| 8. Control Valve and Diaphragm Assembly | 17. Rubber Reaction Disc                   |
| 9. Floating Control Valve               |  |

**NOTE: DO NOT** remove valve operating rod (2) and valve plunger from rear piston plate unless it is necessary to replace faulty or damaged parts. Normally steps 14 and 15 are omitted.

14. When it is found necessary to replace either valve operating rod (2) or valve plunger (5), remove valve rod seal (3) from groove in piston plate and pull seal over end of rod.
  15. Hold piston with valve plunger side down and inject alcohol in valve plunger through opening around valve rod to wet the rubber lock in the plunger, then drive or pry valve plunger off valve rod.
- NOTE: If master cylinder is not to be overhauled omit steps 16-19.**
16. Remove snap ring (1) from groove in base at end of master cylinder (fig. 36).
  17. Remove piston assembly (2), primary cup (5), retainer spring assembly (6), and check valve (7) from master cylinder (8).
  18. Remove filler cap (10) and gasket (9) from master cylinder body.

**NOTE: DO NOT disassemble piston assembly (2) unless secondary cup is damaged or faulty.**

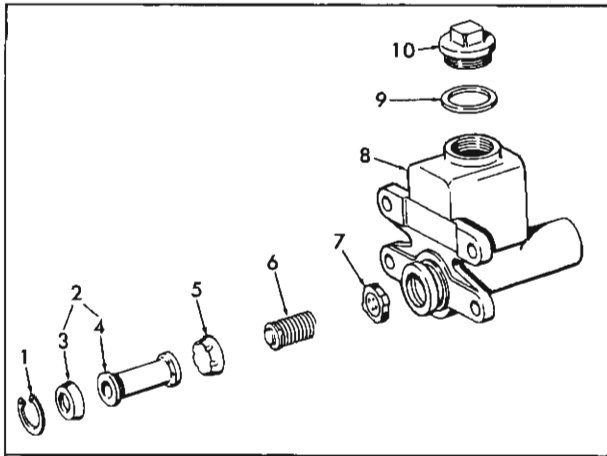


Fig. 36—Details of Master Cylinder

- |                    |                         |
|--------------------|-------------------------|
| 1. Snap Ring       | 6. Spring               |
| 2. Piston Assembly | 7. Check Valve          |
| 3. Secondary Cup   | 8. Master Cylinder Body |
| 4. Piston          | 9. Gasket               |
| 5. Primary Cup     | 10. Filler Cap          |

19. If necessary, to remove secondary cup (3) from piston (4), use thin blade screw driver or scribe to stretch cup out of groove and over end of piston.

### Cleaning

After disassembly, immersion of all metal parts in "Bendix Metalclene" or commercial cleaner solvent is recommended. Use only alcohol or "Declene" on rubber parts or parts containing rubber. After parts have been thoroughly cleaned and rinsed in cleaning solvent, metal parts which come in contact with hydraulic brake fluid should be rewashed in clean alcohol or "Declene" before assembly. Use air hose to blow dirt and cleaner fluid from recesses and internal passages. When overhauling a Master-Vac, use all parts furnished in the repair kit. **DISCARD ALL OLD RUBBER PARTS.**

### Inspection

Inspect all other parts for damage or excessive wear. Replace damaged or excessively worn parts. If inside of vacuum cylinder (front shell) is rusted or corroded, polish with steel wool or fine emery cloth. Replace cylinder shell when scored.

Inspect master cylinder bore for signs of scoring, rust, pitting or etching. Any of these will require replacement of master cylinder.

### Assembly

The following operation (steps 1-5) applies to a completely disassembled master cylinder. If the master cylinder is not included in the overhaul, omit steps 1-5.

1. Coat bore of master cylinder (10) with brake fluid.

2. If secondary cup (3) has been removed, dip cup in brake fluid and assemble over end of piston (4) from end shown (fig. 36).
3. Dip piston assembly (2), primary cup (5), and check valve (7) in brake fluid. Stack parts in piston in order shown and assemble in master cylinder bore far enough to clear snap ring groove.
4. Install snap ring (1) in groove of cylinder. Make certain snap ring is firmly seated in groove.
5. Assemble new gasket (9) on filler cap and replace filler cap (10).
6. If valve operating rod (2) and valve plunger (5) were separated, assemble these parts as follows (fig. 35). assemble valve rod seal (3) on rod as shown, insert valve rod through piston (4), dip valve plunger (5) in alcohol and assemble to ball end of valve rod. Make certain ball end of rod is locked in place in valve plunger.

**NOTE: It may be necessary to tap end of valve operating rod to seat ball end of rod in valve plunger.**

7. Assemble floating control valve diaphragm (10) over end of floating control valve (9). Make certain diaphragm is in recess of floating control valve. Press floating control valve spring retainer (11) over end of floating control valve and diaphragm.
8. Clamp valve operating rod in a vise with rear piston plate (4) up. Lay leather piston packing (6) on rear piston plate with lip of leather over edge of piston plate.
9. Install floating control valve return spring (7) over end of valve plunger (5).
10. Assemble diaphragm plate (13) in relief of diaphragm and assemble floating control valve with diaphragm (8) in recess of rear piston plate.
11. Install floating control valve spring (12) over retainer (11). Align and assemble front piston plate (14) with rear piston plate. Center floating control valve spring on front piston plate and center valve plunger stem in hole of piston.
12. Hold front and rear piston plates together and install six piston plate cap screws (15). Leave screws loose.
13. Insert shim (16) and rubber reaction disc (17) in recess at center of front piston plate.

**CAUTION: Use care not to lose shim and disc out of piston before push-rod is installed**

14. Place (Tool J-7780) (5, fig. 37) over piston packing, turn piston assembly (4) upside down and assemble expander ring (3) against inside lip of leather packing as shown. Saturate felt (2) in "Bendix Vacuum Cylinder Oil" or "Delco Shock Absorber Fluid—Type A" and assemble in expander ring. Assemble retainer ring (1) over

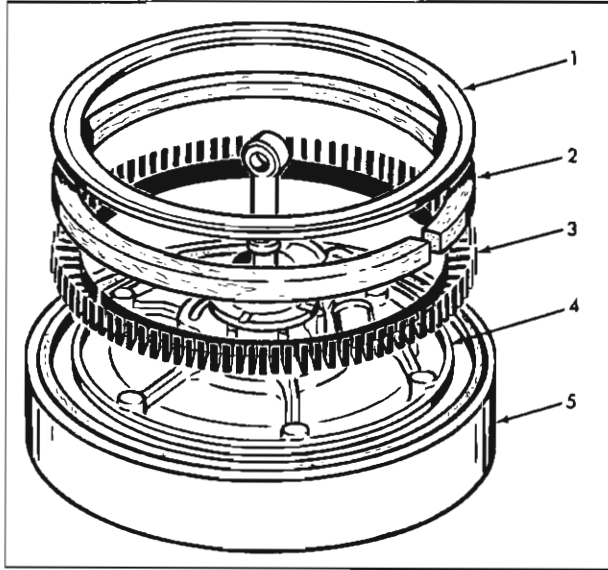


Fig. 37—Assembly of Piston Packing, Expander Ring and Felt

- |                   |                         |
|-------------------|-------------------------|
| 1. Retaining Ring | 4. Piston Assembly      |
| 2. Piston Felt    | 5. Assembly Ring J-7780 |
| 3. Expanding Ring |                         |

bosses on rear piston plate making certain retainer is anchored in grooves of piston plate. Securely tighten six cap screws in front piston plate.

15. Assemble air cleaner filter (4) over vacuum tube of air cleaner and tube assembly (5) and attach air cleaner to shell in position shown (fig. 33) with screws (6).
16. Slide vacuum hose (9) onto vacuum inlet tube of power piston and align hose to lay flat against piston.
17. Apply thin coat of vacuum cylinder oil to bore of vacuum cylinder (front shell). Remove assembly ring (Tool J-7780) from vacuum piston and coat leather piston packing with vacuum cylinder oil.
18. Install rear shell (2) over end of valve operating rod (7) and attach vacuum hose to tube end on each side of end plate.

**NOTE: Before proceeding further, make certain shim (if previously removed—used only on early production 1959 brake units) and rubber reaction disc are in place in front piston plate.**

19. Center small diameter end of piston return spring (10) in vacuum cylinder (11) (front shell). Center large diameter of spring on piston. Check alignment mark on piston with marks on vacuum cylinder (front shell) and rear shell, compress spring and install two attaching screws (1) at opposite sides to hold rear shell and cylinder (front shell) together. Replace balance of screws and tighten all screws uniformly.
20. Dip small diameter end of push rod boot (3) in alcohol and assemble guard over end of valve operating rod and over flange on shell.
21. Insert large diameter end of push-rod (5, fig. 32)

through hole in end of vacuum cylinder (front shell) and guide into hole of front piston plate.

**NOTE: Before proceeding with assembly, check the distance from the outer end of the push-rod to the master cylinder mounting surface on the vacuum cylinder. This dimension should be 1.195"–1.200".**

22. After push-rod adjustment is correct, replace rubber seal (4) in groove of master cylinder body.
23. Assemble master cylinder assembly to the vacuum cylinder (front shell) at four studs. Replace lockwashers (2) and nut (1) and securely tighten.

**Push Rod Adjustment**

The push-rod is designed with a self-locking adjustment screw to provide the correct relationship between the vacuum power piston and master cylinder piston. The adjustment screw is set to the correct height at the time of original assembly of the power unit. **Under normal service condition the adjustment screws do not require any further attention providing the push-rod assembly remains in the original unit.**

When a new push-rod is used or the push-rod assembly is transferred to a unit other than the original one, the distance from the end of the adjustment screw to the mounting face of the power cylinder should be rechecked either with a micrometer depth gauge to a dimension of 1.195"–1.200" or with a height gauge as shown in Figure 38. The dimensions for making this height gauge in the shop are given in Figure 39. Tool J-7723-01, if available, may be used to make this measurement.

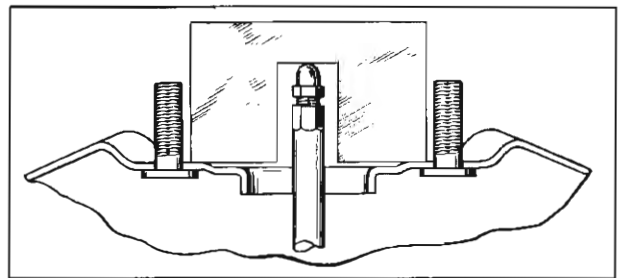


Fig. 38—Adjustment of Push Rod

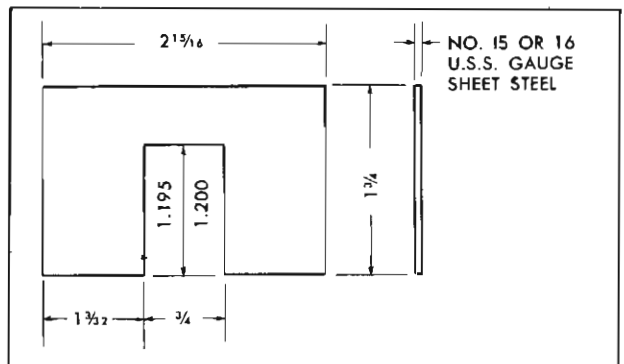


Fig. 39—Push Rod Gauge

If either a micrometer or a height gauge is not available, the correct adjustment of the push-rod can be made as follows: using an ordinary scale accurately position the adjustment screw so that the distance from the end of the screw to the mounting flange is  $1\frac{7}{32}$ " (1.218"). From this point, turn the screw into the push-rod an additional  $\frac{1}{2}$  to  $\frac{3}{4}$  turn. This will give an approximate setting to avoid excessive clearance between the adjustment screw and the hydraulic piston. After assembly of the master cylinder to the power unit, the piston cup of the hydraulic cylinder should just clear the compensating hole when the unit is in the released position. This can be checked by placing a few drops of brake fluid over the compensating hole and then applying light air pressure at the output port of the master cylinder. If air bubbles appear, the compensating port is open. If the primary cup overlaps the compensating port, there will be no flow of air through the compensating port. If this condition exists, the adjustment screw should be turned into the push-rod a slight amount or until the compensating port is open.

**Installation**

If the linkage was removed, proceed as follows:

1. Place one operating lever on the collar. Tap in place until it seats against shoulder. Install second operating lever.
2. Place the lever and collar in position and install the pivot pin and cotter key.

**NOTE: The large diameter of the collar must be on the inboard side of the mounting bracket. The pivot pin can only be installed from the outer side of the mounting bracket.**

3. Place one of the wave washers on the inner side of the outer operating lever (over upper hole) and

install the clevis pin, flat washer and cotter pin to the power brake assembly operating rod.

4. Place the remaining wave washer on the inner side of the outer operating lever (over the middle hole) and install the clevis pin, flat washer and cotter pin to the brake pedal push rod.

If the linkage was not removed, omit steps 1-4 and proceed with step 5.

5. Mount the power brake assembly in place and install the four attaching nuts and lock washers. Be certain to place the push rod through hole in fire wall.
6. Attach hydraulic line to master cylinder.
7. Attach vacuum lines to power brake unit.
8. Attach the push rod clevis to the brake pedal assembly. Adjust pedal height by means of clevis on brake pedal push rod at pedal. Correct heights are:

Biscayne and Bel Air .....	4 $\frac{7}{8}$ "
Impala .....	4 $\frac{5}{8}$ "

**NOTE: Check stop light switch after adjusting pedal height.**

9. Bleed brakes as follows:
  - a. Fill reservoir of master cylinder.
  - b. Depress brake pedal slowly to the floor and hold for 6-10 seconds.
  - c. Release slowly and wait 6-10 seconds. Repeat above two operations 4-6 times.
  - d. Replenish fluid supply in master cylinder.
  - e. Check operation of brakes.

**NOTE: The above procedure is to be used when the master cylinder line only has been disconnected.**

# MORaine POWER BRAKES

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## GENERAL DESCRIPTION

The Moraine power brake unit (fig. 44) is composed of two main sections, the vacuum power cylinder and the hydraulic master cylinder.

The vacuum power cylinder contains the power piston assembly, which houses the control valve and reaction mechanism, and the power piston return spring. The control valve is made up of the air valve and the floating control valve assembly. The reaction

mechanism consists of a hydraulic piston reaction plate, a series of levers, and a valve reaction plate. On the outside of the power cylinder housing is an air filter and a tube for connection to the vacuum source. The push rod, which operates the air valve, projects out the end of the power cylinder housing through a felt silencer and a boot.

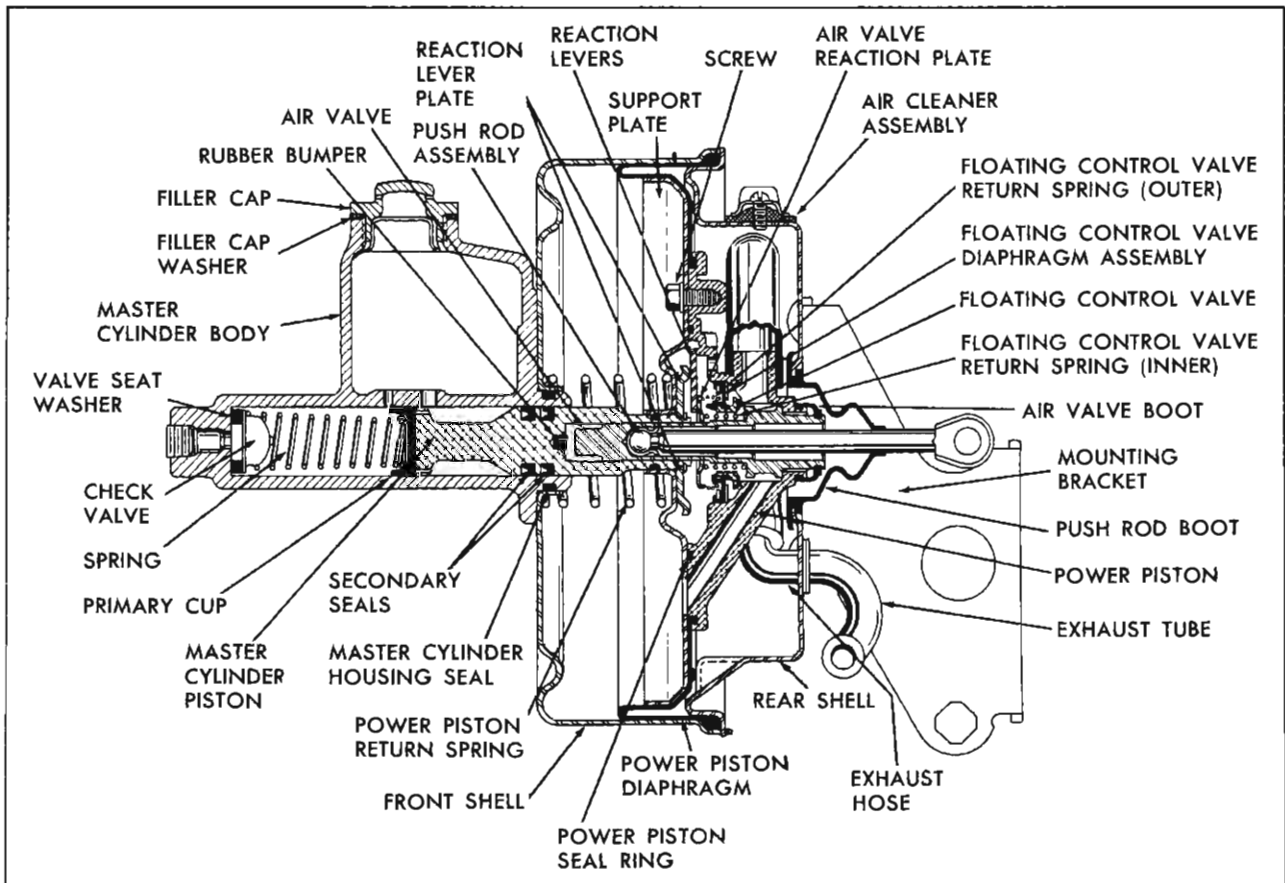


Fig. 40—Moraine Power Brake

## MAINTENANCE AND ADJUSTMENTS

### INSPECTIONS

1. Check vacuum lines and vacuum line connections as well as vacuum check valve in the vacuum intake lines for possible vacuum loss.
2. Inspect all hydraulic lines and connections at the wheel cylinders and master cylinder for possible hydraulic leaks.
3. Check brakes for scored drums, grease or brake fluid on linings, worn or glazed linings and make necessary brake adjustments.
4. Check the brake fluid level in the hydraulic reservoir. The reservoir should be filled to within  $\frac{1}{2}$ " of the top of the filler cap opening. Inspect the reservoir cover for leaks at gasket.
5. Check air cleaner filter on power cylinder and replace air filter if necessary.
6. Inspect the air cleaner and vacuum inlet tube assembly for loose screws.
7. Check for loose unit mounting bolts.
8. Check brake pedal for binding and misalignment between pedal and push rod.

### LUBRICATION

The Moraine Power Brake Unit is lubricated at the time of assembly and needs no further lubrication, other than maintaining normal reservoir fluid level. The reservoir should be filled as described herein using only G.M. Super 11 brake fluid.

### BLEEDING INSTRUCTIONS

The power brake system may be bled manually or with a pressure bleeder as outlined elsewhere in this section. Use only G.M. Super 11 brake fluid. Do not use the vacuum assist while bleeding. The engine should not be running and the vacuum reserve should be reduced to zero by applying the brake several times before starting the bleeding procedure.

### AIR CLEANER SERVICE

The air cleaner filter used with the power brake unit should be cleaned at least twice a year. To clean, remove air cleaner screw and gasket and remove cover and filter. Wash thoroughly in cleaning solvent and allow to dry before reinstalling.

## SERVICE OPERATIONS

### Removal

1. Disconnect clevis at brake pedal assembly.
- NOTE:** If clearance hole through fire wall is not

large enough it may be necessary to remove clevis yoke from push rod. Note approximate location of yoke on rod.

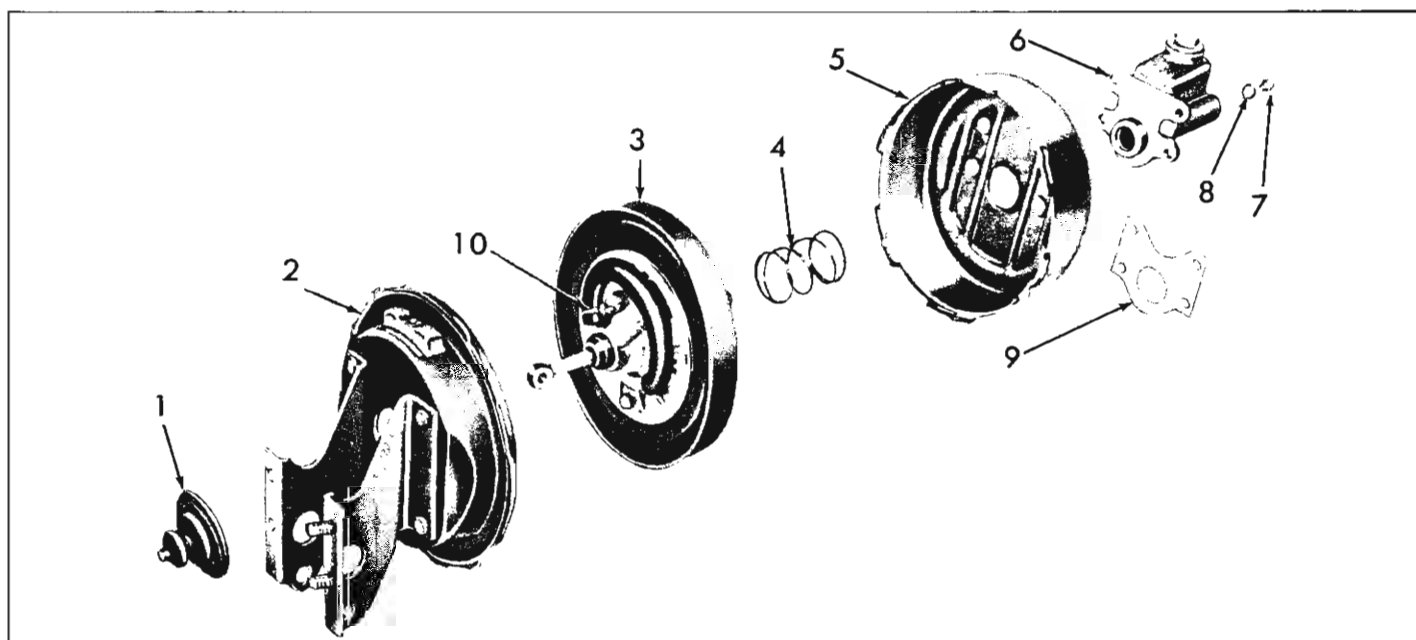


Fig. 41—Component Exploded View

1. Boot
2. Rear Shell
3. Power Piston Assembly
4. Piston Return Spring

5. Front Shell
6. Master Cylinder Assembly
7. Nut
8. Lock Washer

9. Shim
10. Clamp

## BRAKES—MORAINE 6-24

2. Remove vacuum hoses from power brake unit.
3. Disconnect hydraulic line from master cylinder.
4. Remove the four nut and lock washers securing the unit to the firewall. Withdraw power brake unit.

If the linkage is to be removed from the power brake unit, proceed as follows:

5. Remove the cotter pin, clevis pin and flat washer from the end of the brake pedal push rod. Carefully remove the push rod as a wave washer is used between the rod and the bracket.
6. Remove the cotter pin, clevis pin and flat washer from the end of the power brake operating rod. Remove the wave washer.
7. Remove the cotter pin then tap out the pivot pin. Remove the two operating levers and the pivot collar. Tap the one operating lever to remove it from the collar.

### Disassembly

The following procedure applies when the complete power brake assembly (vacuum power section plus master cylinder) is removed as a unit from the vehicle.

1. Place the power brake unit in a vise or fixture with the push rod up. With the unit firmly clamped on the reservoir, place a bar in position on the rear

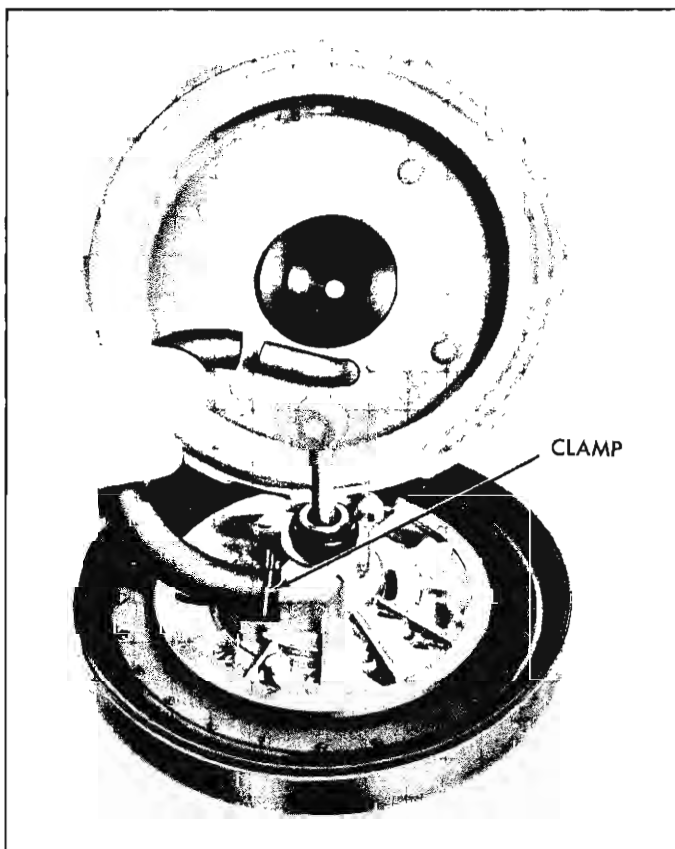


Fig. 42—Power Piston and Rear Shell Disassembly

shell (2, fig. 41) so that the rear shell can be rotated counterclockwise, to separate the rear shell from the front shell (5).

2. Now the power piston assembly (3) and the rear shell can be lifted from the unit.
3. Remove the power piston return spring (4) from the front shell.
4. Pull the push rod through the boot and remove the exhaust hose from the exhaust tube on the rear shell. Figure 42.
5. Re-position the master cylinder assembly in the vise to facilitate the removal of the front shell from the master cylinder.
6. Remove the four nuts (7, fig. 41) and lockwashers (8) from the studs.

**NOTE: Count and remove shims (9) located between the housing and the master cylinder.**

7. From the rear shell assembly, remove air filter screw (5, fig. 47), cover (6), and filter element (7).
8. Remove two screws (2) from the exhaust tube bracket (1) and free the exhaust tube assembly and gasket (3).

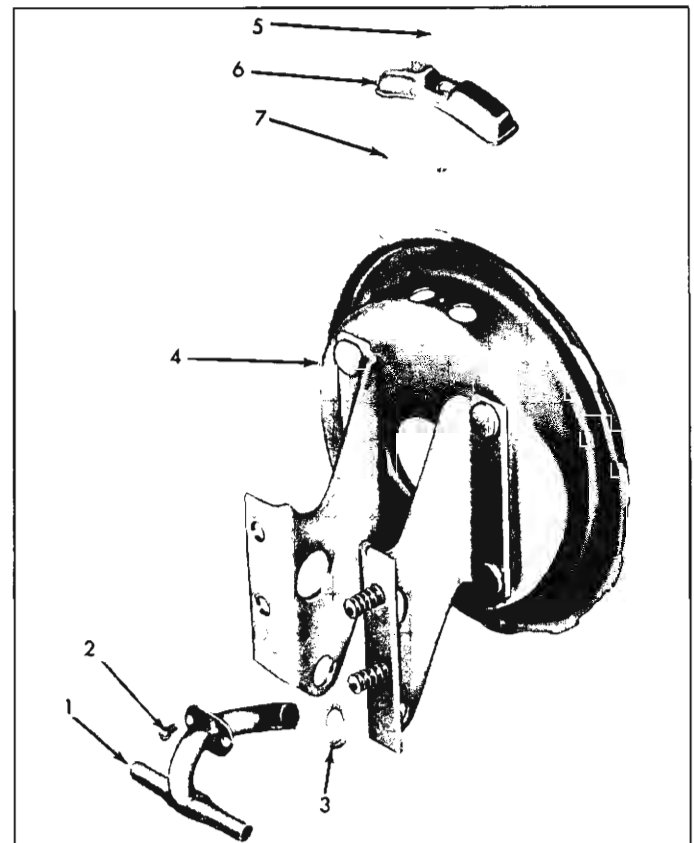


Fig. 43—Rear Shell Assembly—Exploded View

- |                 |                     |
|-----------------|---------------------|
| 1. Exhaust Tube | 5. Screw            |
| 2. Screw        | 6. Air Filter Cover |
| 3. Gasket       | 7. Air Filter Unit  |
| 4. Rear Housing |                     |



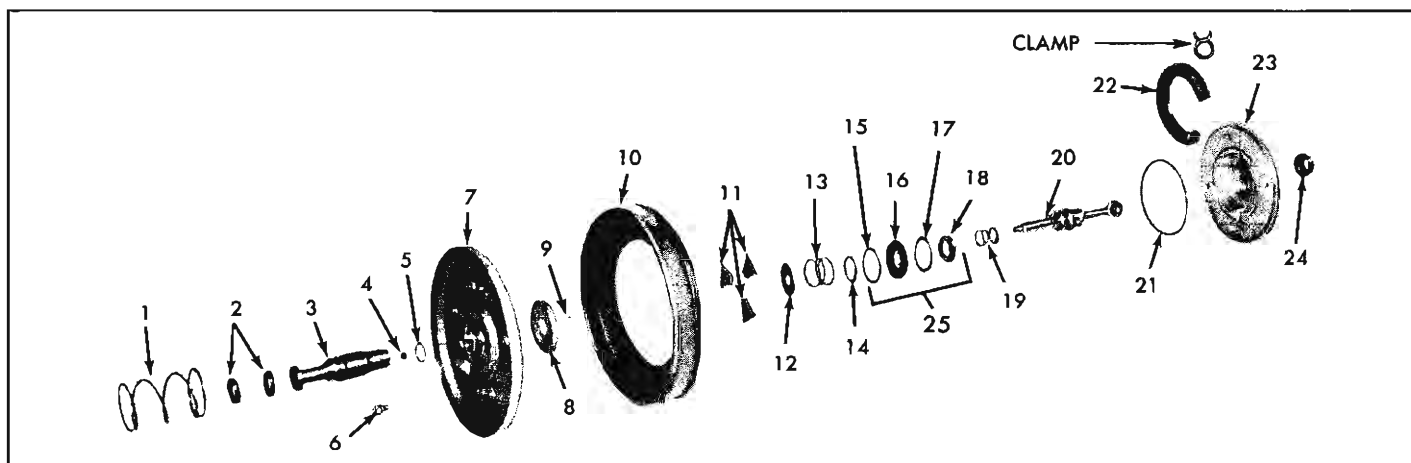


Fig. 44—Power Piston—Exploded View

- |                           |  |   |
|---------------------------|--|---|
| 1. Piston Return Spring   | 10. Power Piston Diaphragm                 | 19. Air Valve Return Spring                       |
| 2. Secondary Seals        | 11. Reaction Levers                        | 20. Push Rod and Air Valve Assembly               |
| 3. Master Cylinder Piston | 12. Air Valve Reaction Plate               | 21. Seal Ring                                     |
| 4. Rubber Bumper          | 13. Floating Control Valve Return Spring   | 22. Exhaust Hose                                  |
| 5. "O" Ring               | 14. Floating Control Valve Spring Retainer | 23. Power Piston                                  |
| 6. Screws                 | 15. Reaction Diaphragm Retainer            | 24. Air Valve Boot                                |
| 7. Piston Diaphragm Plate | 16. Valve Reaction Diaphragm               | 25. Floating Control Valve and Diaphragm Assembly |
| 8. Reaction Plate         | 17. Reaction Diaphragm Support Plate       |   |
| 9. Truarc Ring            | 18. Floating Control Valve                 |   |

**CAUTION:** Extreme care must be taken in handling the diaphragm (10, fig. 44) of the power piston assembly. The diaphragm should be guarded against grease, oil, foreign matter and must be protected from nicks, scratches or gouges. Care must be taken that the master cylinder piston (3) is not nicked, scratched or distorted.

9. Loosen the four  $\frac{1}{4}$ " screws and lockwashers (6, fig. 44) in the power piston assembly. With the master cylinder piston (3) up, remove the four screw assemblies and lift the master cylinder piston, piston diaphragm plate and power piston diaphragm from the power piston assembly as shown in Figure 45. Lay the piston diaphragm plate and the diaphragm aside.
10. Remove the three reaction levers (11, fig. 44) and the air valve reaction plate (12). Remove the floating control valve return spring (19), and power piston seal ring (21).
11. Turn the power piston over, release the exhaust hose clamp (11) and remove the exhaust hose (24) from the piston assembly, then remove the air valve boot.
12. Push the air valve and push rod assembly (20) through the power piston (23) and remove the floating control valve and diaphragm assembly (25) as shown in Figure 46.
13. Separate the floating control valve and diaphragm assembly from the push rod.
14. From the floating control valve and diaphragm assembly remove the spring retainer (14, fig. 47).

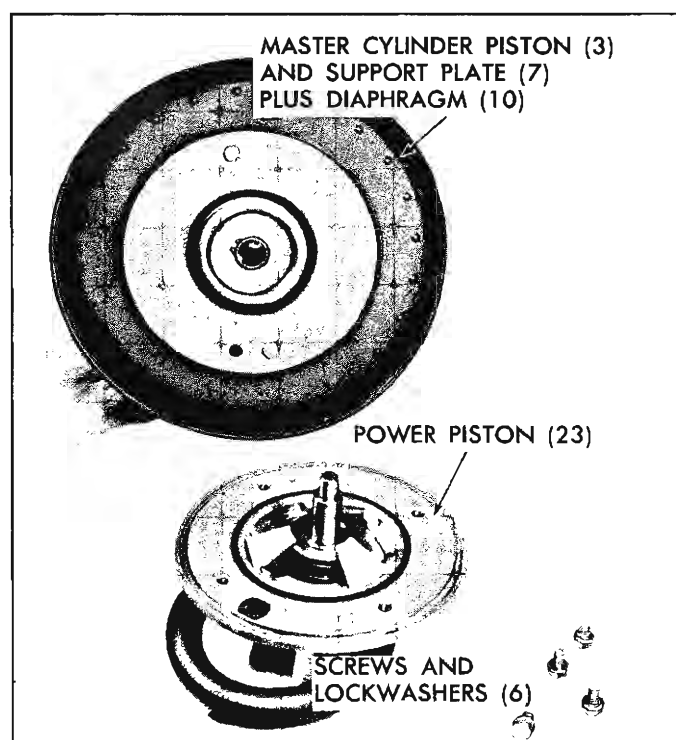


Fig. 45—Power Piston Disassembly

15. Remove the reaction diaphragm retainer (15) from under the lip of the diaphragm (16) and remove the diaphragm from the hub of the floating control valve (18). The reaction diaphragm support plate (17) can now be lifted from the control valve.

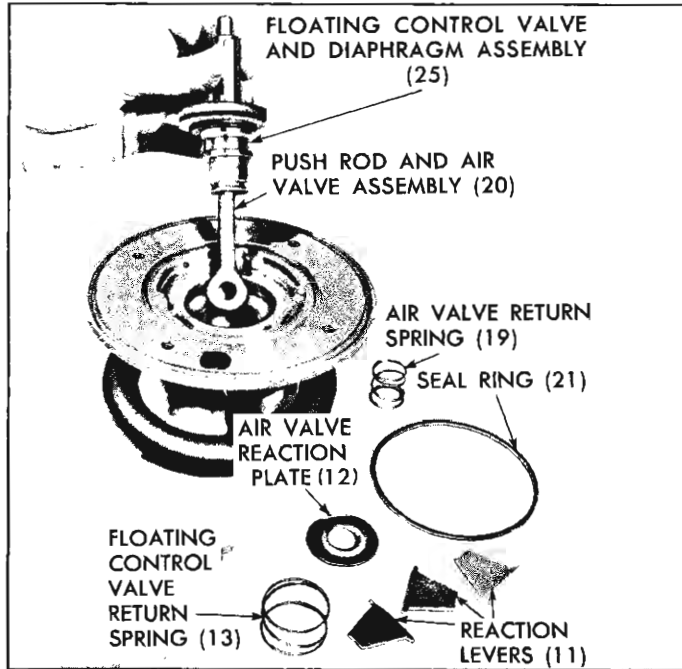


Fig. 46—Removing Control Valve from Power Piston

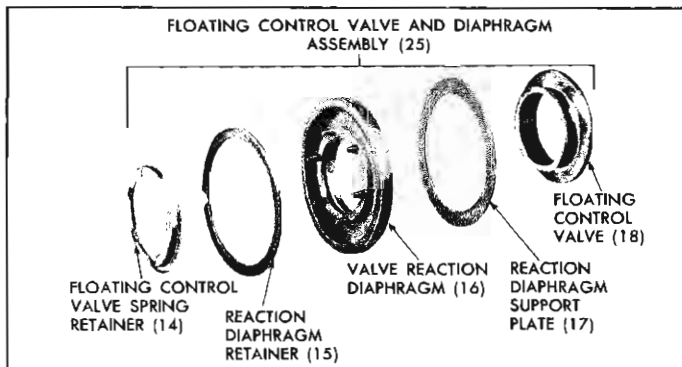


Fig. 47—Floating Control Valve and Reaction Diaphragm

from the piston diaphragm plate (7) and inspect for cuts, pin holes, distortion or cracks.

16. Remove the retaining ring (9) from the master cylinder piston (3). Remove the reaction lever plate (8) from the master cylinder piston and press the master cylinder piston assembly through the piston diaphragm plate, Figure 48.
17. From the master cylinder piston assembly, remove the "O" ring (5), two secondary seals (2) and the small rubber bumper (4, fig. 44) which is inside the piston.

**NOTE:** If master cylinder is not to be overhauled omit steps 18-19.

18. Remove the master cylinder housing seal (4, fig. 49) from the flange on the master cylinder body (3). Remove the primary cup (8), spring and retainer (7), check valve (6) and valve seat washer (5) from the bottom of the master cylinder bore.
19. Position the master cylinder body in a vise and re-

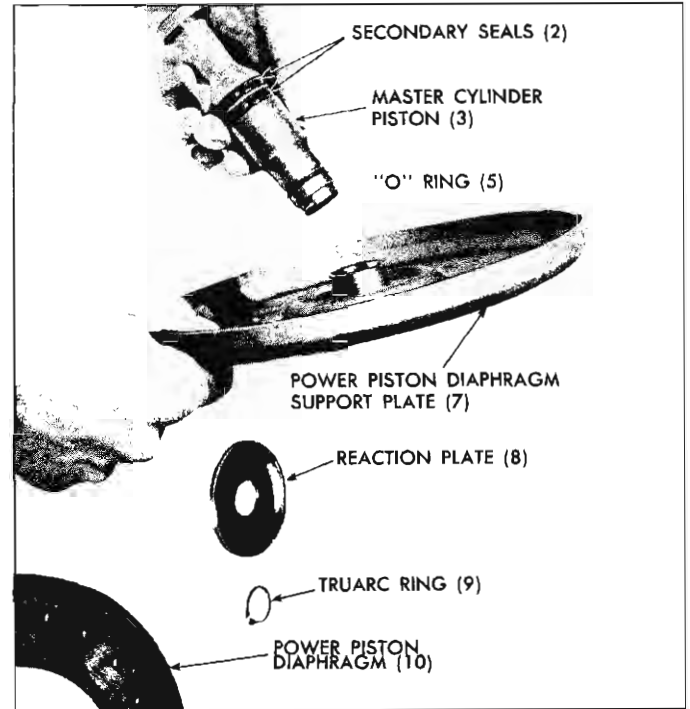


Fig. 48—Master Cylinder Piston and Power Piston Diaphragm Support Plate Disassembly

move filler cap (1) and gasket (2). Remove casting from vise and inspect the bore for corrosion, pits and foreign matter. Be certain that outlet port to hydraulic brake line is unrestricted. Inspect fluid reservoir for foreign matter, and check that the by-pass and compensating ports to the master cylinder bore are also unrestricted.

### Cleaning and Inspection

Use Declene or clean brake fluid to clean all metal brake parts thoroughly. Immerse in the cleaning fluid and brush with hair brush to remove foreign matter. Blow out all passages, orifices and valve holes. Air dry and place cleaned parts on clean paper or lint-free cloth. If slight rust is found inside power cylinder housing, polish clean with crocus cloth or fine emery paper, then follow with a thorough cleaning.

Dirt is the major cause of trouble and wear in service. Be certain to keep parts completely clean until reassembly.

If there is any suspicion of contamination or any evidence of corrosion, completely flush hydraulic brake system as described in this section. Failure to clean hydraulic brake system can result in early repetition of trouble.

Use of gasoline, kerosene, antifreeze alcohol or any other cleaner with even a trace of mineral oil will damage rubber parts. Be particularly careful during reassembly that no grease or mineral comes in contact with these rubber parts.

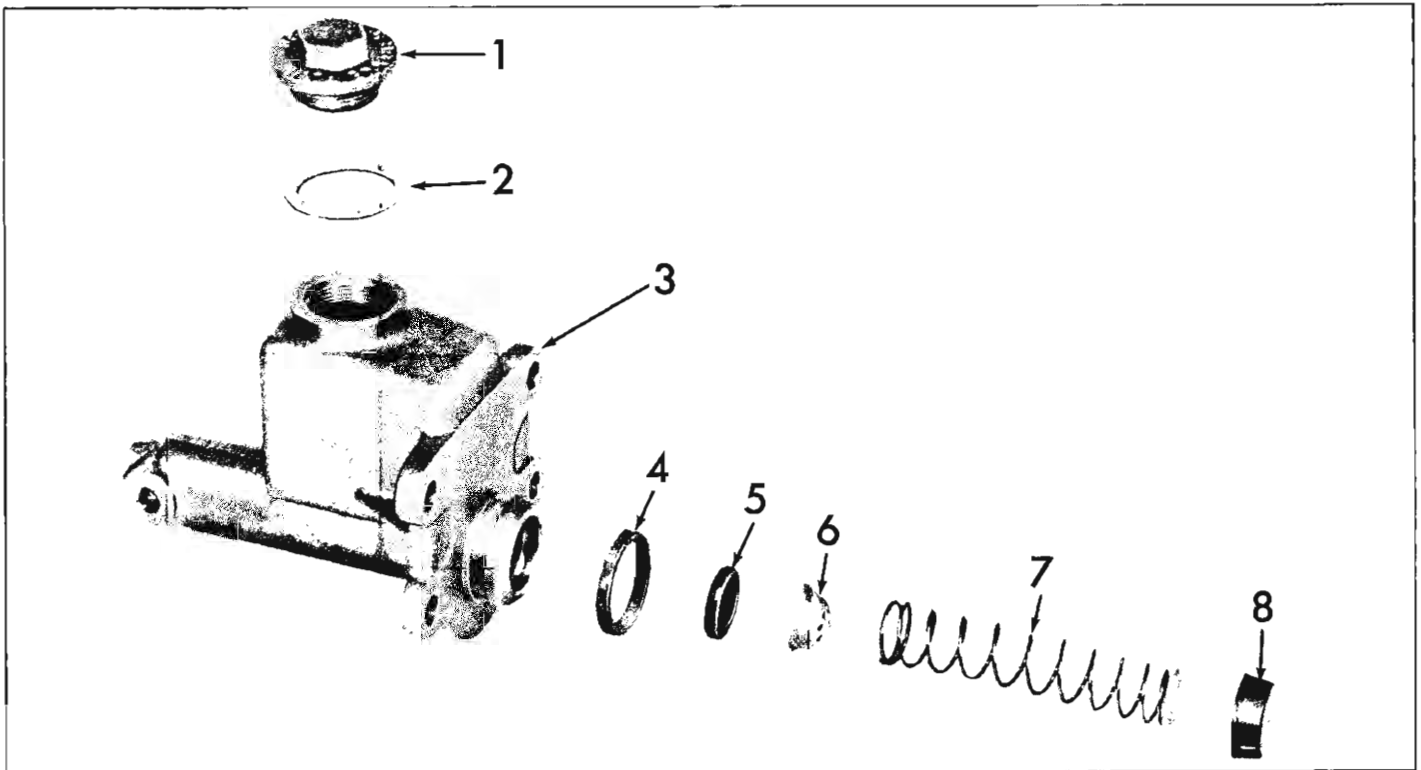


Fig. 49—Power Brake Master Cylinder

1. Filler Cap  
2. Filler Cap Gasket  
3. Cylinder Housing

4. Housing Seal  
5. Valve Seat Washer  
6. Check Valve

7. Spring and Retainer  
8. Primary Cup

### Inspection

Wipe fluid from rubber parts and very carefully inspect each leather or rubber part for cuts, nicks or other damage. These parts are the key to the control of fluid or air flow and should account for the majority of troubles traceable to leakage. If there is any question whatever as to the service-ability of a rubber or leather part, replace it. It is good practice to replace all "O" ring seals prior to reassembly. If inside of vacuum cylinder is rusted or corroded, polish with steel wool or fine emery cloth. Replace cylinder shell when scored. Inspect master cylinder bore for signs of scoring, rust, pitting, or etching. Any of these will require replacement of master cylinder. Common sense based upon a visual inspection of these parts plus a consideration of the length of service of the unit and other factors should determine the need for replacement of such parts.

### Assembly

1. The air filter element (7, fig. 43) should either be washed with solvent or replaced with a new element. Position the element (7) and the air filter cover (6) over the two holes in the rear housing (4) and install screw (5).
2. Inspect the exhaust manifold tube assembly (1) for cracks and deformations. Place a new gasket

(3) on the tube assembly, insert in the rear housing, and install two screws (2).

3. Insert the small rubber bumper (4, fig. 44) in the counter-bore of the master cylinder piston (3). Place the two secondary seals (2) in grooves of master cylinder piston with lips TOWARD the small drilled holes in the end of the piston.
4. Slip "O" ring (5) into the second groove from the counter-bored end of master cylinder piston. Lubricate "O" ring (5) on master cylinder piston with silicone grease—"A" and insert the piston into the piston diaphragm plate from the flange side, Figure 48.

**NOTE: Silicone grease—"A" is part of repair kit, part No. 5459082.**

5. Place the reaction lever plate (8), with raised rim away from piston diaphragm plate (7), over piston and install snap ring (9) in groove (3).
6. Set the assembly aside and protect it from dirt and foreign matter.
7. To assemble the floating control valve and diaphragm assembly (fig. 47), place the reaction diaphragm support plate over the hub of floating control valve. Assemble reaction diaphragm over flanged hub of control valve so the flange fits into the groove on the inside diameter of the diaphragm.

8. Insert the diaphragm retainer under the lip of diaphragm and place the floating control valve spring retainer over the reaction diaphragm hub so the six small rubber bumpers are properly positioned in the spring retainer.
  9. Place the power piston (23, fig. 44) in fixture or vise with the flat surface up. DO NOT CLAMP.
  10. Insert the push rod end of the air valve push rod assembly into the piston as shown in Figure 46 and press down into the piston to seat the air valve.
  11. Wipe thin film of silicone grease—"A" on the outside diameter of reaction diaphragm (16).
  12. Place the floating control valve and diaphragm assembly (25, Fig. 44) down over the air valve so that the rubber face of the control valve rests on the annular seat in the power piston (23) and press the outer edge of the reaction diaphragm (16) into position in power piston (23).
- NOTE: Make sure the rubber diaphragm is not distorted as the assembly is pressed into the power piston.**
13. Place the air valve return spring (19) inside the floating control valve (18) to seat on the air valve. Place the floating control valve return spring (13) to seat on the flange of the spring retainer (14). Position the air valve reaction plate (12) over the air valve so the low center portion rests on inner spring (19) (air valve return spring). The outer spring (floating control valve return spring) (13) will also be in a position to engage the reaction lever plate (12).
  14. Place the ears of the reaction levers (11) in the machined locations in the power piston and rest the small ends on the reaction lever plate (12) (also refer to fig. 45). Insert seal ring (21) into the inner groove on the flat surface of the power piston face (23).
  15. Pull the skirt of the power piston diaphragm (10) down over the piston (23) and place the bead, on the inner diameter of the diaphragm, in the outer groove of the power piston face so the bumpers (buttons) are toward the piston.
  16. The master cylinder piston (3) and piston diaphragm plate (7) are positioned over the power piston diaphragm (19) and the lugs on the plate are aligned with the depressions in the power piston.
  17. The snap ring (9) on the master cylinder piston must be rotated so the lobes are located between the reaction levers (11). The ears of the reaction levers must maintain their positions in the machined seats on the power piston (23) as the piston diaphragm plate (7) contacts the power piston face. The position of the bead and levers MUST be correct as the support plate is finally positioned and the four ¼" screws and lock washers (6) bolted through the support plate into the power piston. Torque to 65-85 in. lbs.
  18. Invert the power piston assembly to assemble the

- air valve boot (24), Position large lip of the boot in groove of power piston, and then place small diameter lip in the groove in the air valve.
19. Coat the outside diameter, in the end, of tube-like boss on power piston (23) with "3M Adhesive," or equivalent, and allow 30 - 60 seconds to air dry, then slip the exhaust hose (22) fully on the boss so hose is parallel to the power piston.
  20. To mount the master cylinder on the front shell (5, fig. 41), assemble the gasket (2, fig. 49) on the filler cap (1) and install, finger tight on the reservoir filler opening. Place the seal (4) master cylinder to housing, in the groove on the master cylinder body (3).
  21. Place the front shell (5, fig. 41) on a flat surface with studs up. Insert and position master cylinder body (6) on studs and press it into the front shell. Install four lockwashers (8) and nuts (7) on studs and torque to 15-20 ft. lbs.
  22. Invert the assembly and place it in a vise or fixture, so that the master cylinder bore is now accessible. Into this bore, place the valve seat washer (5, fig. 49). Press check valve (6) into open end of spring and retainer assembly (7) and position in the bore with the check valve (6) against the valve seat washer (5). Dip the primary cup (8) into clean brake fluid and position it in the bore with lips over the spring and retainer (7).
- NOTE: The above steps (steps 20-22) refer to a completely disassembled power brake unit. If the master cylinder was not overhauled delete all reference in these three steps to the master cylinder component parts.**
23. Work the groove of the push rod boot (1) into position in the center hole of the rear shell (2, fig. 41).
  24. Place the return spring (4) over the flange in the center of the front shell (5). Place the power piston assembly (3) over the front shell, and insert the master cylinder piston through the return spring (4) into the master cylinder bore. As the piston enters the master cylinder bore, the primary cup must be in place.
- NOTE: The power piston assembly must be rotated so that the unattached end of the exhaust hose is approximately 180° from the master cylinder filler cap.**
25. Press the power piston assembly (3) down and hold it in position while placing the bead of the power piston diaphragm into the recess in the rim of the front shell (5) (also see Figure 50 for reference).
  26. Place the exhaust hose onto the exhaust tube of the rear shell assembly (fig. 51). Force the push rod through the boot (1, fig. 41) on the rear shell (2). The air cleaner on the rear shell should be slightly left of the master cylinder filler cap as the shell is positioned on the diaphragm. Press shell down and align the locking lugs (fig. 52).

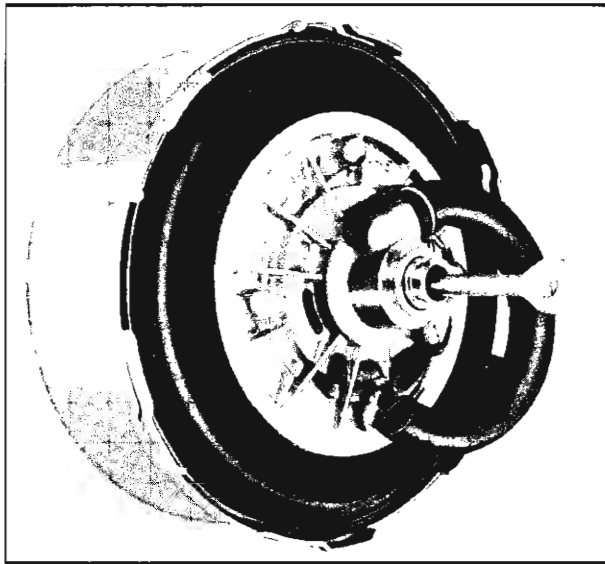


Fig. 50—Power Piston Assembly Installed in Front Shell

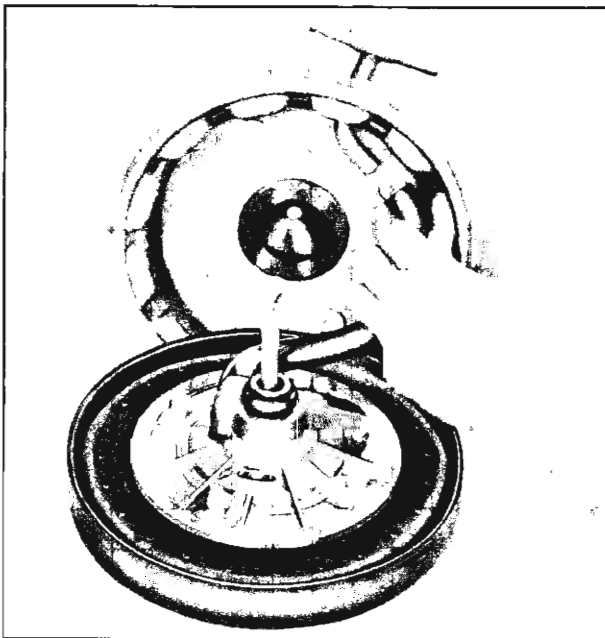


Fig. 51—Power Piston and Rear Shell Assembly

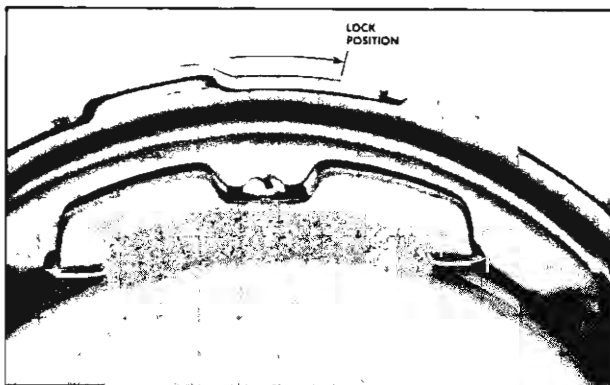


Fig. 52—Front and Rear Shell Locking Procedure

**NOTE:** After the rear shell is rotated clockwise to the locked position, the air cleaner will be in line with the master cylinder filler cap. Extreme care must be taken that the bead of the diaphragm is mounted in the recess of the front shell and the bead must not be pinched into slots as the rear shell is rotated into the locked position. The exhaust hose must now be in the cavity of the rear shell in a position that will not cause interference between the power piston and shell. The exhaust hose should not be in contact with the air filter cover screw at any time.

27. **NOTE:** The following gauging operation is necessary in the 1961 unit only after structural parts, such as the rear housing, front housing, diaphragm support plate, etc., have been replaced with new parts. It is also necessary when the exact number of shims removed at disassembly are not known.

- a. Place the assembly in a vise or fixture with the master cylinder up. Remove the four nuts and lockwashers and remove the master cylinder from the studs. Do not remove shims and do not displace any parts from the bore of the master cylinder.
- b. Place Gauge J-8531 over the master cylinder piston, as shown in Figure 53, so that it seats on the housing or shims. If the end of the gauge and end of the piston are flush, no additional shimming will be necessary.
- c. If the piston end rises higher than the gauge dimension, shims must be added until the end of the gauge and the end of the piston are as flush as possible. Never add more than five (5) shims.
- d. If the piston end is lower than the end of the gauge, disassemble the power booster and check all parts for deformation.

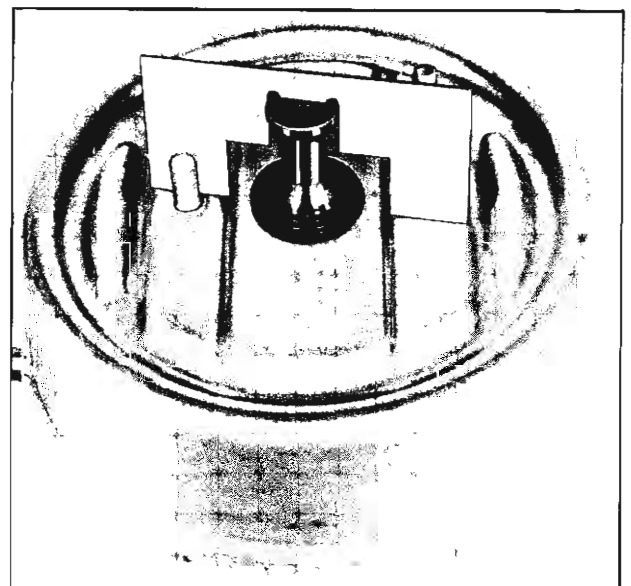


Fig. 53—Checking Shimming Using Tool J-8531

## BRAKES—MORAINE 6-30

If no gauge is available, check the correct number of shims by the following method:

- a. Torque the master cylinder nuts to 15-20 ft. lbs. and remove the filler cap.
- b. With the brake released, force air into the hydraulic outlet of the master cylinder. If air passes freely through the compensating port (the smaller of the two holes in the bottom of the master cylinder reservoir), shimming is considered satisfactory.
- c. If the air does not flow freely, remove the master cylinder and add shims until it does flow freely.

When the correct number of shims is in position, the master cylinder is assembled to the housing. When inserting the master cylinder piston into the bore, the piston cup **must** be in a position so that the piston will rest on the flat side of the piston cup. With the master cylinder in position on the studs, the four nuts and lockwashers should be torqued to 15-20 ft. lbs.

**CAUTION:** When replacing the unit on the vehicle, the engine must be started and the vacuum allowed to build up before any brake applications may be made.

### Installation

If the linkage was removed, proceed as follows:

1. Place one operating lever on the collar. Tap in place until it seats against shoulder. Install second operating lever.
2. Place the lever and collar in position and install the pivot pin and cotter key.

**NOTE:** The large diameter of the collar must be on the inboard side of the mounting bracket. The pivot pin can only be installed from the outer side of the mounting bracket.

3. Place one of the wave washers on the inner side of the outer operating lever (over upper hole) and install the clevis pin, flat washer and cotter pin to the power brake assembly operating rod.
4. Place the remaining wave washer on the inner side of the outer operating lever (over the middle hole) and install the clevis pin, flat washer and cotter pin to the brake pedal push rod.

If the linkage was not removed, omit steps 1-4 and proceed with step 5.

5. Mount the power brake assembly in place and install the four attaching nuts and lock washers. Be certain to place the push rod through hole in fire wall.
6. Attach the hydraulic line to the master cylinder.
7. Attach the vacuum lines to the power brake unit.
8. Attach the push rod clevis to the brake pedal assembly. Adjust pedal height by means of clevis on brake pedal push rod at pedal. Correct heights are:

Biscayne and Bel Air ..... 4 $\frac{7}{8}$ "

Impala ..... 4 $\frac{5}{8}$ "

**NOTE:** Check stop light switch after adjusting pedal height.

9. Bleed brakes as outlined in step 9 under Bendix Brakes—Installation.

## SYSTEM TESTS AND DIAGNOSIS

### SYSTEM TESTS

1. Road test brakes by making a brake application at about 20 mph to determine if vehicle stops evenly and quickly. If pedal has a spongy feel when applying the brakes, air may be present in the hydraulic system. Bleed system as described in this section.
2. With engine stopped and transmission in Neutral, apply brakes several times to deplete all vacuum reserve in the system. Depress brake pedal, hold light foot pressure on pedal and start engine. If the vacuum system is operating, pedal will tend to fall away under foot pressure, and less pressure will be required to hold pedal in applied position. If no action is felt, vacuum system is not functioning.
3. Stop engine and again deplete all vacuum reserve in system. Depress brake pedal and hold foot pressure on pedal. If pedal gradually falls away

under foot pressure, the hydraulic system is leaking.

4. If the brake pedal travels to within 1" of the toe-board, brakes require adjustment or brake shoes require relining.
5. Start engine. With brakes off, run to medium speed and turn off ignition, immediately closing throttle. This builds up vacuum. Wait no less than 90 seconds, then try brake action. If not vacuum assisted for three or more applications, vacuum check valve is faulty.

### DIAGNOSIS

The same types of brake trouble are encountered with power brakes as with standard brakes. Before check of power brake system for source of trouble, refer to "Troubles and Remedies" of standard brakes in this section. After these possible causes have been eliminated, check for cause as outlined below:

**Hard Pedal**

- a. Vacuum Failure Due To
  1. Faulty vacuum check valve.
  2. Collapsed vacuum hose.
  3. Plugged or loose vacuum fittings, hose or pipes.
  4. Leak between vacuum power cylinder and hydraulic master cylinder.
  5. Leak in vacuum reservoir tank.
- b. Bound Up Pedal Mechanism.
- c. Power Brake Unit Trouble
  1. Internal vacuum hose loose or restricted.
  2. Jammed sliding air valve.
  3. Vacuum leaks in unit caused by loose piston plate screws, loose piston packing, leaks between hydraulic master cylinder and vacuum power cylinder, or by faulty master cylinder piston, or vacuum seal.
  4. Defective diaphragm.
  5. Restricted air cleaner.

**Grabby Brakes (Apparent Off-And-On Condition)**

Power Brake unit valve trouble.

- a. Sticking air valve.
- b. Master cylinder piston binding in power piston guide.

- c. Improper number of shims on air valve.
- d. Dented or distorted power cylinder housing.

**Pedal Goes to Floor (Or Almost to Floor)**

- a. Brake Adjustment.
- b. Fluid reservoir needs replenishing.
- c. Power brake hydraulic leakage.
  1. Defective primary or secondary cup.
  2. Defective head nut or head nut gasket.
  3. Cracked master cylinder casting.
  4. Leaks at wheel cylinder in pipes, or in connections.
  5. Defective annular ring on cylinder plug.
- d. Faulty master cylinder check valve that has permitted air to enter system causing spongy pedal.

**Brakes Fail to Release**

- a. Faulty check valve at head nut.
- b. Excessive friction at seal of master cylinder piston.
- c. Excessive friction at power piston cup.
- d. Blocked air passage in power piston.
- e. Air cleaner blocked or choked.
- f. Air valve sticking shut.
- g. Broken piston return spring.
- h. Broken air valve spring.

## SPECIFICATIONS

Refer to Section 16 for Brake Specifications.

## SPECIAL TOOLS

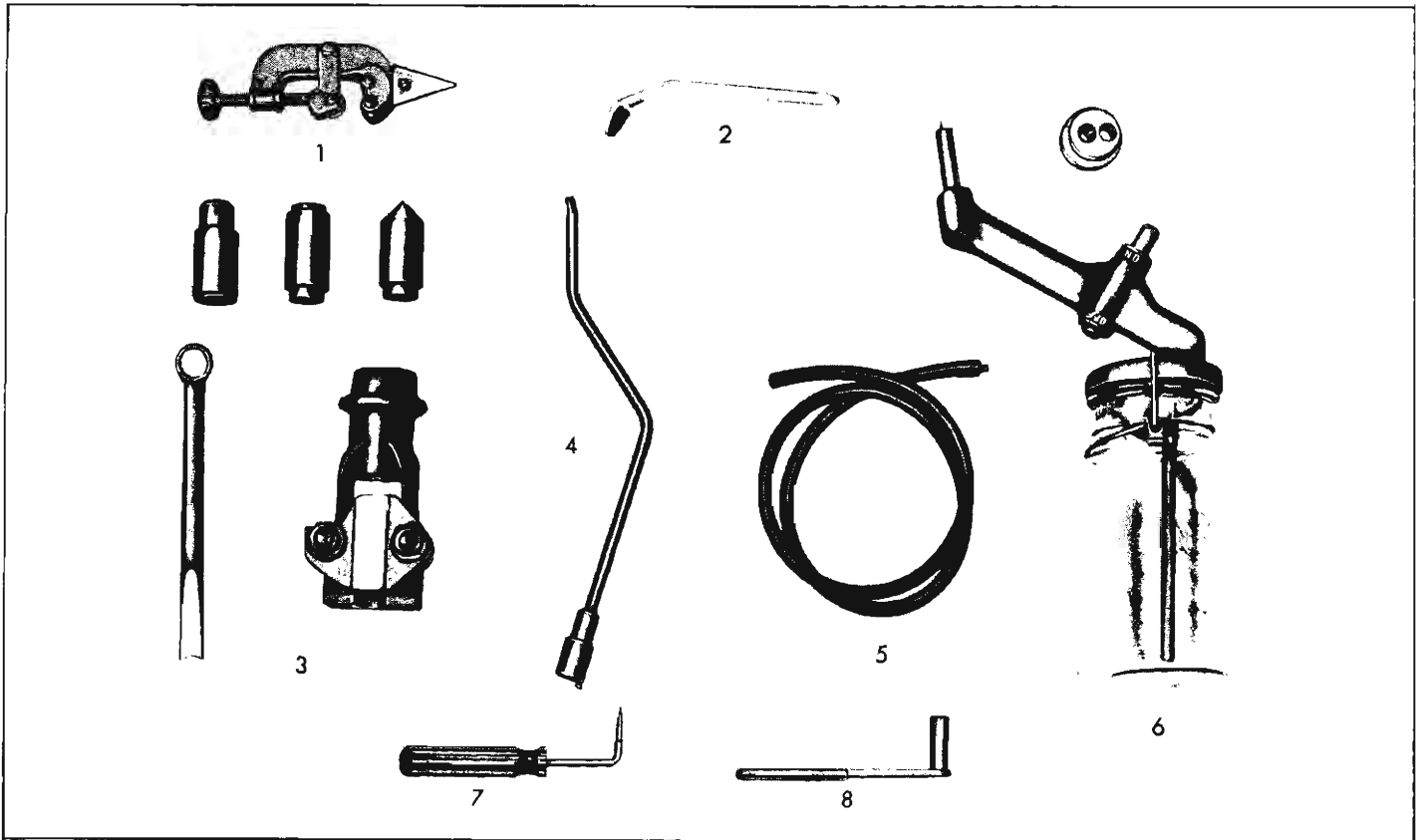


Fig. 54—Standard Brake Special Tools

- 1. J-8113 (KMO-3A) Brake Tube Cutter
- 2. J-4707 Brake Adjusting Tool
- 3. J-8051 (J-2185) Brake Tube Flaring Tool

- 4. J-8049 (KMO-526A) Brake Spring Remover and Replacer
- 5. J-628 (J-747) Brake Bleeder Tube
- 6. J-713 Brake Main Cylinder Filler

- 7. J-7777 Brake Pipe Clip Installer
- 8. J-7647 Bleeder Wrench

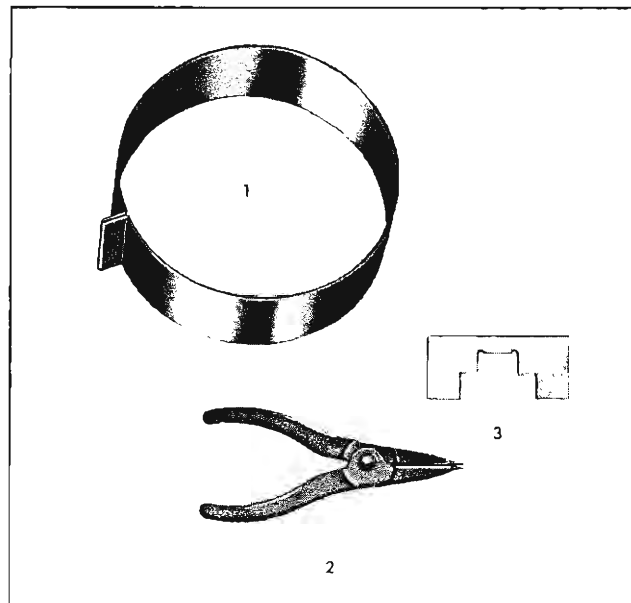


Fig. 55—Power Brake Special Tools

- 1. J-7780 Piston Assembly Ring
- 2. J-4880 Truarc Pliers (External Type)
- 3. J-8531 Master Cylinder Checking Gauge (Moraine)