SECTION E

45-46-48-49000 BENDIX HYDRAULIC MASTER CYLINDER AND POWER BRAKES

CONTENTS

DIVISION I SPECIFICATIONS AND ADJUSTMENTS

50-17 BRAKE SPECIFICATIONS

Since specifications for the Bendix hydraulic master cylinder and the power brake unit are the same as listed for the Delco-Moraine units, see Section C for hydraulic master cylinder or Section D for power brake unit.

DIVISION II DESCRIPTION AND OPERATION

50-18 DESCRIPTION OF POWER BRAKE MECHANISM

NOTE: See Section C for hydraulic master cylinder.

a. General Description of Power Brake Unit

The Bendix Power Brake Unit is a combined vacuum and hydraulic unit which utilizes engine intake manifold vacuum and atmospheric pressure to provide power-assisted application of vehicle brakes. The unit takes the place of the master cylinder in a conventional brake system. From the master cylinder connection outward to the wheel units, there is no other change in the brake system. In addition to the master cylinder connections, the unit requires a vacuum connection to the engine intake manifold (through a vacuum check valve) and a mechanical connection to the brake pedal. As shown in Figures 50-76 and 50-77, the unit is self-contained with no external rods or levers exposed to dirt or moisture.

The power brake unit provides lighter pedal pressures. These lighter pedal pressures are obtained in combination with reduced pedal travel making it possible to bring the brake pedal down to the approximate height of the accelerator pedal when at closed throttle position. Thus, the driver after closing the throttle can shift his toe from one pedal to the other without lifting his heel from the floor.

The vacuum check valve mounted on the power brake front shell

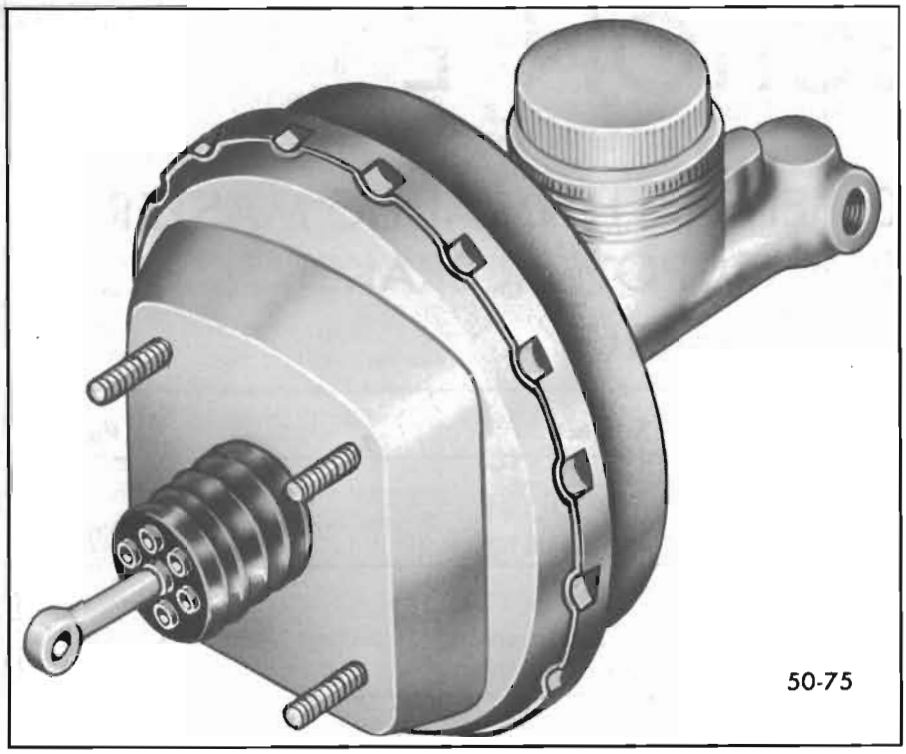


Figure 50-75—External View of Bendix Power Brake

permits several applications of the power brake unit with vacuum-assist after the engine has stopped or after any other loss of vacuum. When the vacuum stored in the unit has been lost or in case of vacuum failure at the unit or its vacuum connections, the brakes can be applied in the conventional manner. Since the vacuum assist is not available, the pedal pressure will be greater.

b. Construction of Power Brake Unit

The unit is composed of two main sections: the vacuum power cylinder and the hydraulic master cylinder.

The vacuum power cylinder contains the diaphragm, plate and valve body assembly which houses the valve rod and plunger mechanism and the return spring. The valve rod and plunger is composed of the air valve and the floating control valve assembly. The remaining mechanism consists of a hydraulic piston push rod and reaction disc. An air filter element and a silencer are assembled around the push rod and fill the cavity inside the hub of the plate and valve body. The plunger which operates the air valve projects out of the end of the power cylinder housing through a boot. A vacuum check valve assembly is mounted in the front shell for connection to the vacuum source.

A fluid reservoir is integrally cast with the master cylinder and supplies fluid to the space between the primary and secondary cups through a hole in the casting.

Connection is made to the wheel cylinder through the hydraulic outlet and a conventional check valve.

50-19 OPERATION OF POWER BRAKE

1. Released Position

With the engine running and the brakes released, vacuum from the intake manifold is admitted through the vacuum check valve to the front vacuum chamber. In the released position (no pressure applied to the brake pedal), the valve rod and plunger are held to the rear in the valve body by the valve return spring to close the atmospheric port and open the vacuum port. With the valve in this position, the chamber to the rear of the power piston is also open to vacuum through the porting in the valve housing. Since vacuum is present on both sides of the diaphragm, the return spring is free to return the plate and valve body, valve rod and plunger assembly and the hydraulic push rod to the fully released position. With the hydraulic push rod in the released position, the compensating port in the master cylinder is open to permit brake fluid to either return from the brake system to the fluid reservoir or enter the brake system from the fluid reservoir to compensate for expansion or loss of fluid from the brake system. See Figure 50-79.

2. Applied Position

As the brakes are applied, the valve rod and plunger move to the front in the plate and valve body to compress the valve return spring and bring the floating control valve into contact with the vacuum port seat in the valve housing to close the vacuum port. Any additional movement of the valve rod and plunger in the applied direction moves the air valve plunger away from the floating control valve to open the atmospheric port and admit atmosphere through the air filter and passages to the chamber at the rear of the diaphragm. With the front side of the diaphragm exposed to vacuum and atmospheric pressure on the rear side, a force is developed to move the plate and valve body, hydraulic push rod and hydraulic piston to

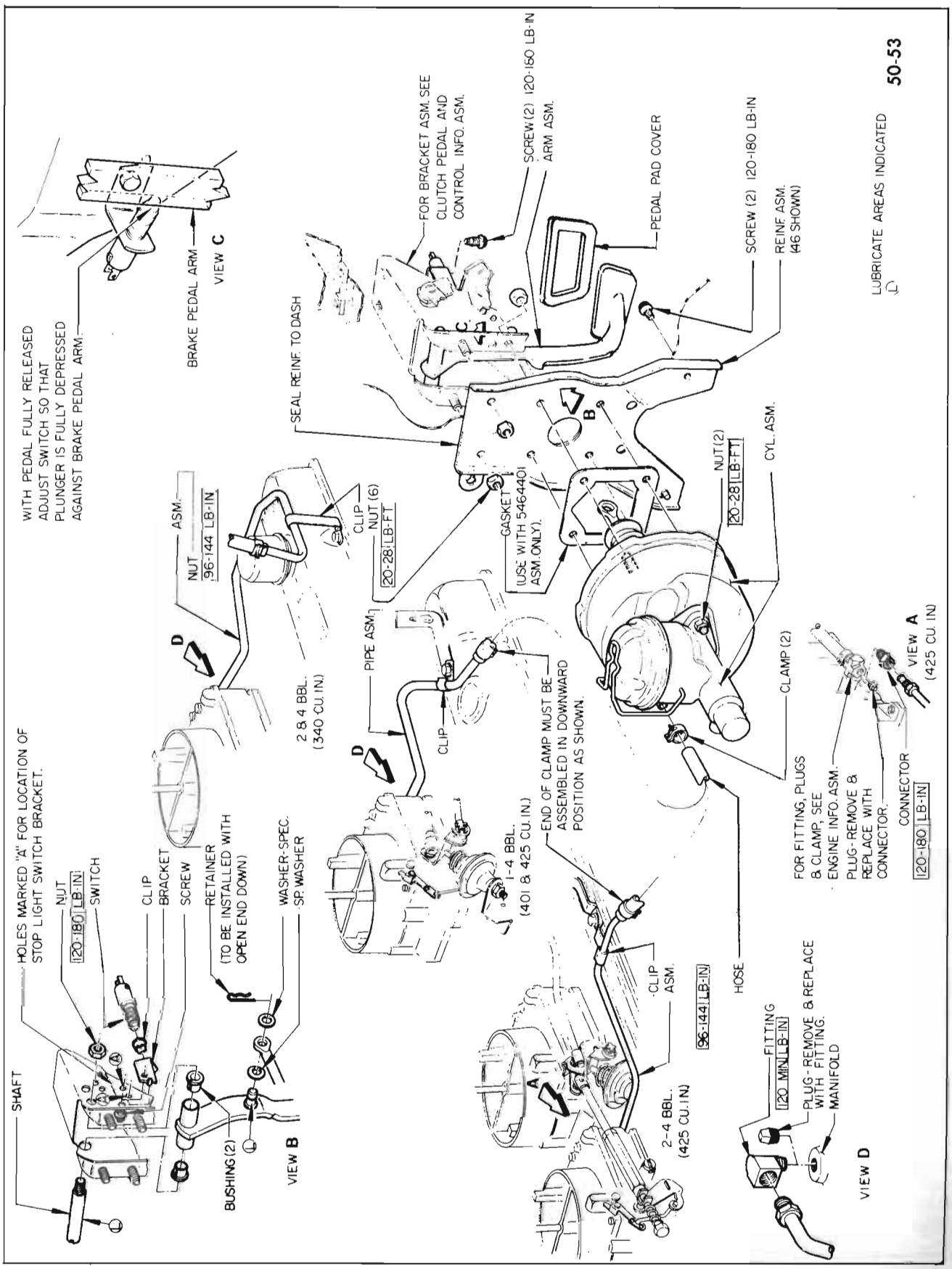


Figure 50-76 45-46-48000 Power Brake Installation

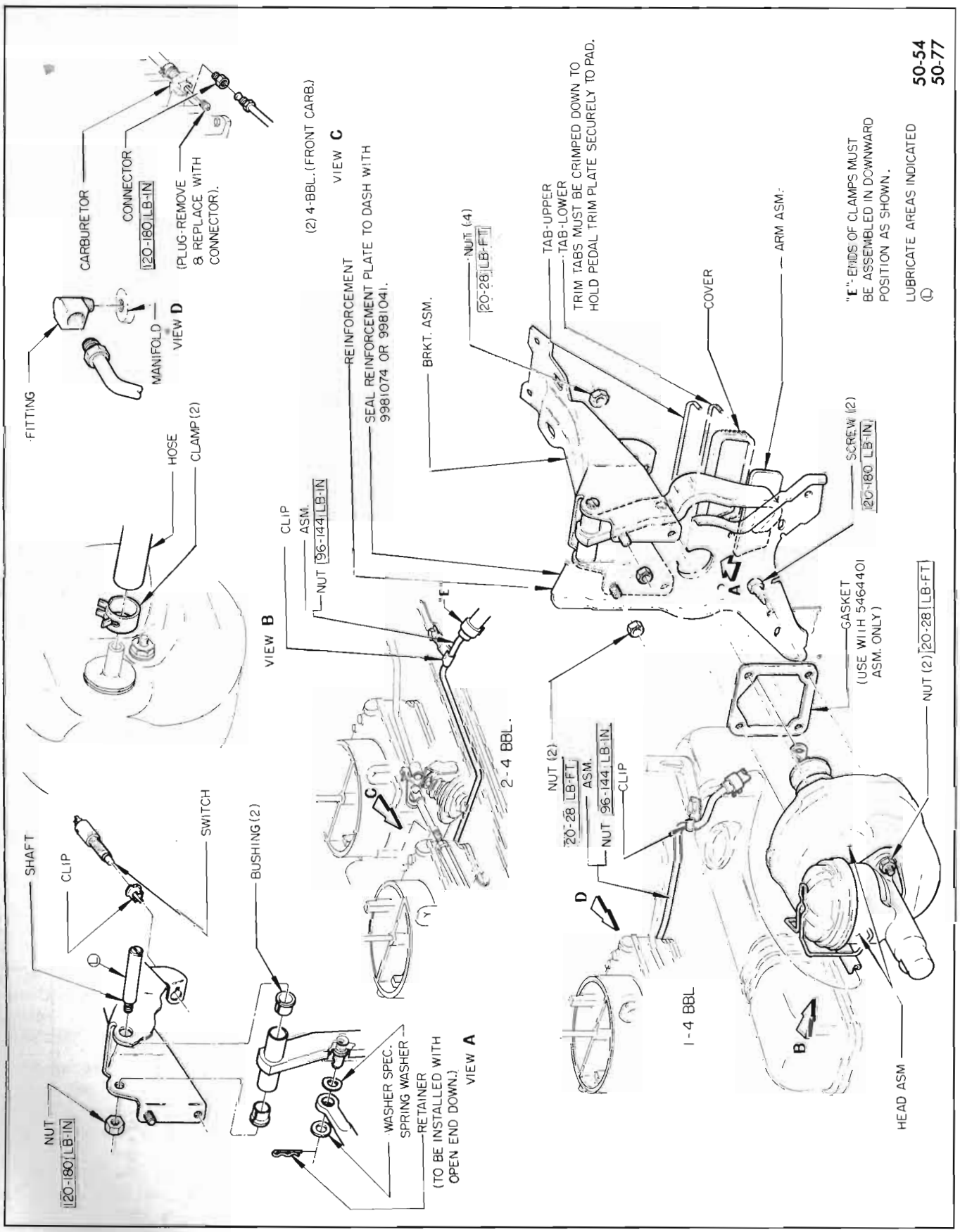


Figure 50-77 49000 Power Brake Installation

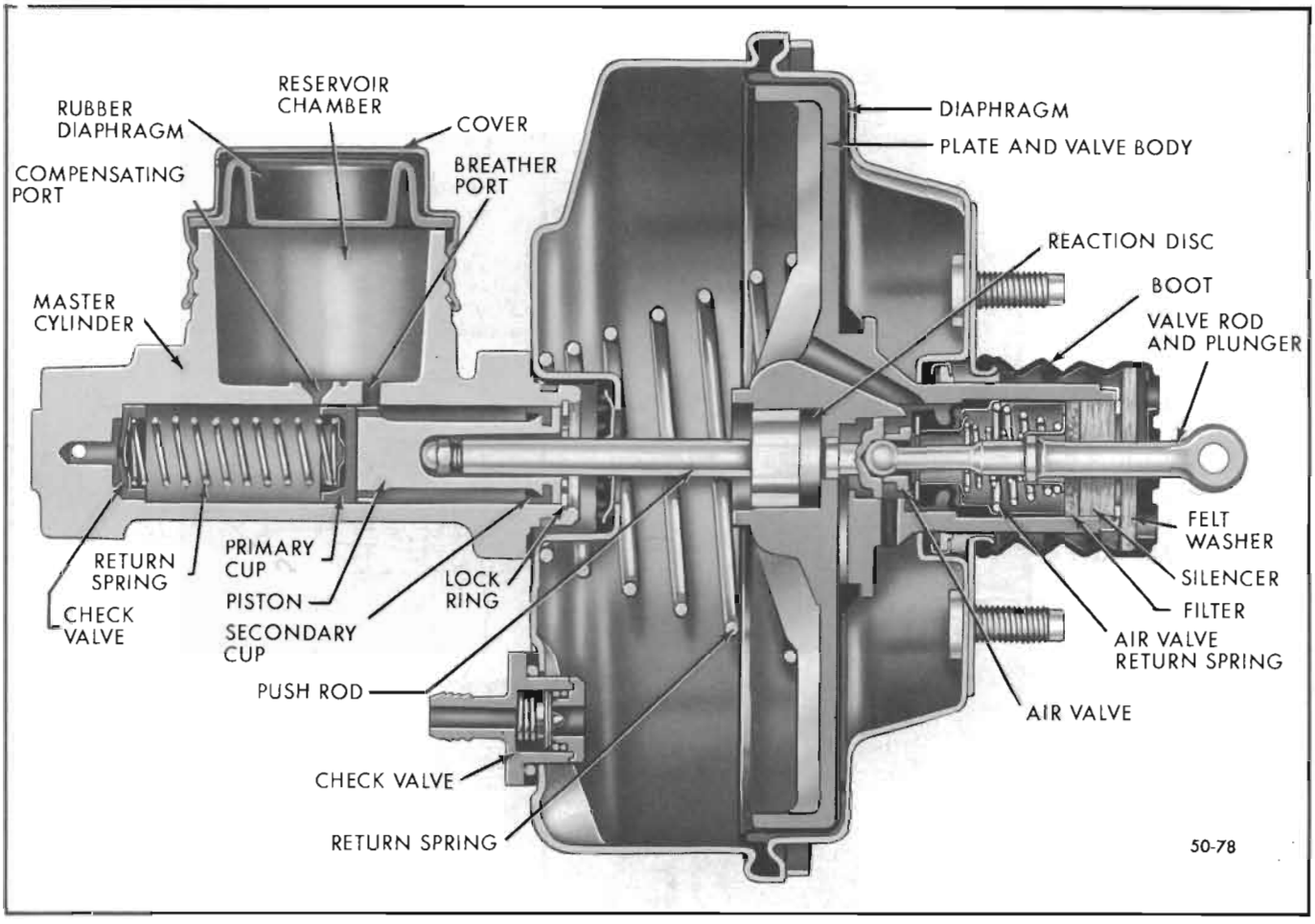


Figure 50-78—Bendix Master Cylinder and Power Unit

the front to close the compensating port and force hydraulic fluid under pressure through the check valve and brake tubes into the brake wheel cylinders.

As hydraulic pressure is developed within the master cylinder, a counter force (to the rear), acting through the hydraulic push rod and rubber reaction disc, sets up a reaction force against the valve rod and plunger. The rubber reaction disc distributes the pressure between the plate and valve body and the valve rod and plunger in proportion to their respective contact areas. The pressure acting against the valve rod and plunger tend to move the plunger slightly to the rear in relation to the plate and valve body to close off the atmospheric port. Since this counter force or reaction force is in direct proportion to the hydraulic pressure developed within the brake system, the driver is able to maintain a "feel" of the degree of brake application attained. See Figure 50-81.

3. Holding Position

During application of the brakes, the "reaction" against the air valve plunger is working against the driver to close the atmospheric port. With both atmospheric and vacuum ports closed, the power brake is in the holding position. When both valves are closed, any degree of braking application attained will be held until either the atmospheric port is reopened by an increase in pedal pressure to further increase the brake application or by a decrease in pedal pressure to reopen the vacuum port and decrease the brake application. Whenever the pressure applied to the brake pedal is held constant for a moment, the valve returns to its holding position. However, upon reaching the fully applied position, the air valve plunger holds the floating control valve away from the atmospheric port seat to admit maximum atmospheric pressure to the chamber at the rear of the diaphragm. With vacuum in the chamber at the front of the diaphragm, full power application is attained. Any increase in hydraulic pressure beyond this point must be supplied by physical effort of the driver. See Figure 50-82.

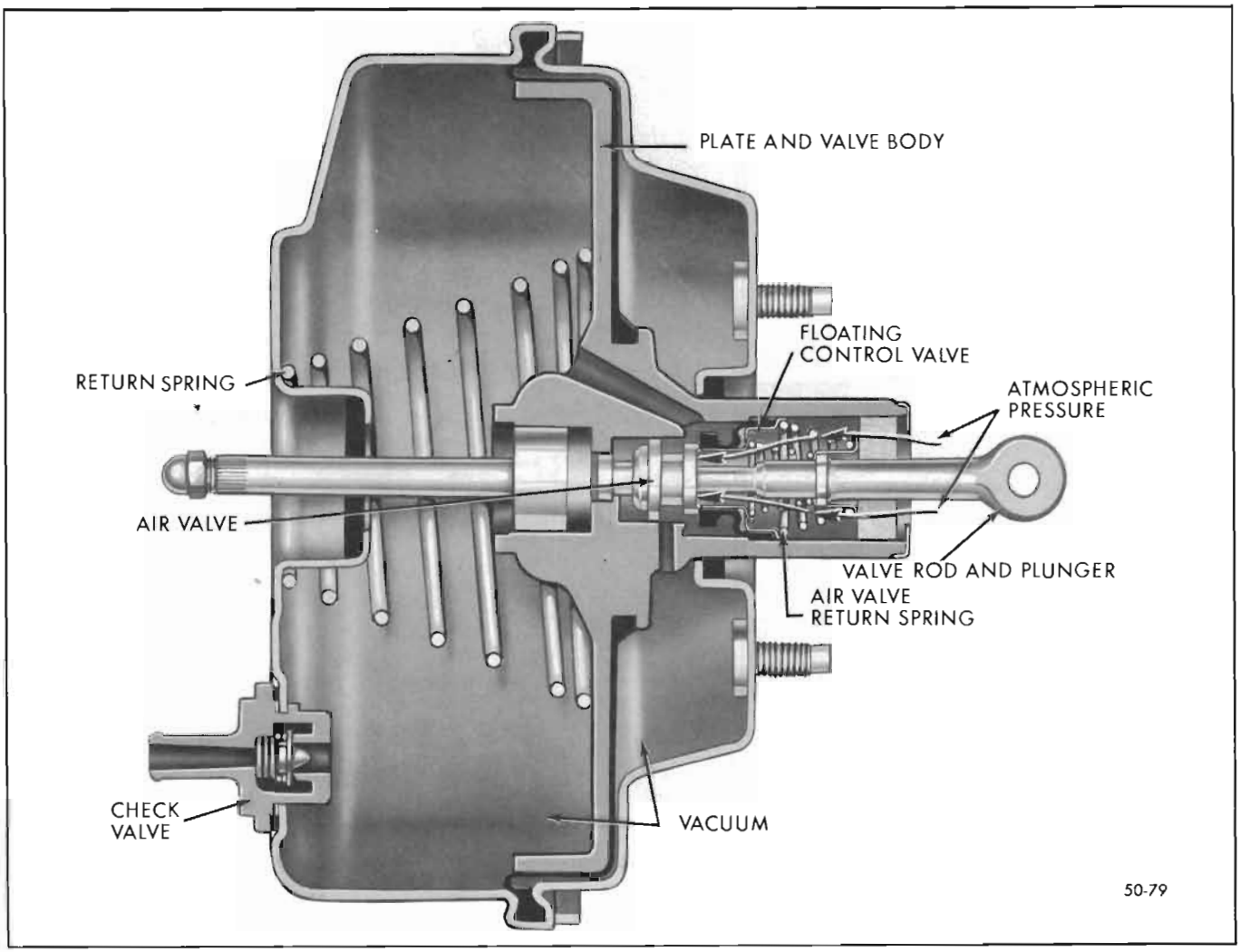


Figure 50-79—Power Brake - Released Position

DIVISION III SERVICE PROCEDURES

57-13 REMOVAL OF POWER BRAKE UNIT

1. Disconnect vacuum hose from cylinder.

2. Disconnect brake pipe from hydraulic master cylinder and tape end of pipe to prevent entrance of dirt.

3. Remove retainer and special washer from brake pedal pin and disengage push rod eye.

4. Remove four nuts holding power brake unit to dash.

5. Remove power brake unit from car, being careful not to drip brake fluid on car paint.

6. Remove filler cap and diaphragm and turn unit so that any brake fluid will drain out. Pump push rod by hand for full interior drainage. Discard old fluid. Install filler cap and diaphragm and cover hydraulic cylinder outlet with tape to exclude dirt. Clean all loose dirt from outside of unit before disassembling.

57-14 DISASSEMBLY OF POWER BRAKE UNIT AND HYDRAULIC MASTER CYLINDER

a. Disassembly of Power Brake Unit

1. Place power brake unit in a vise with push rod up. Clamp unit firmly on sides of master cylinder reservoir.

2. Remove rear retainer and boot and then reinstall nuts on rear shell studs. Scribe a line between front and rear shells. Using pry bars as shown in Figure 50-83,

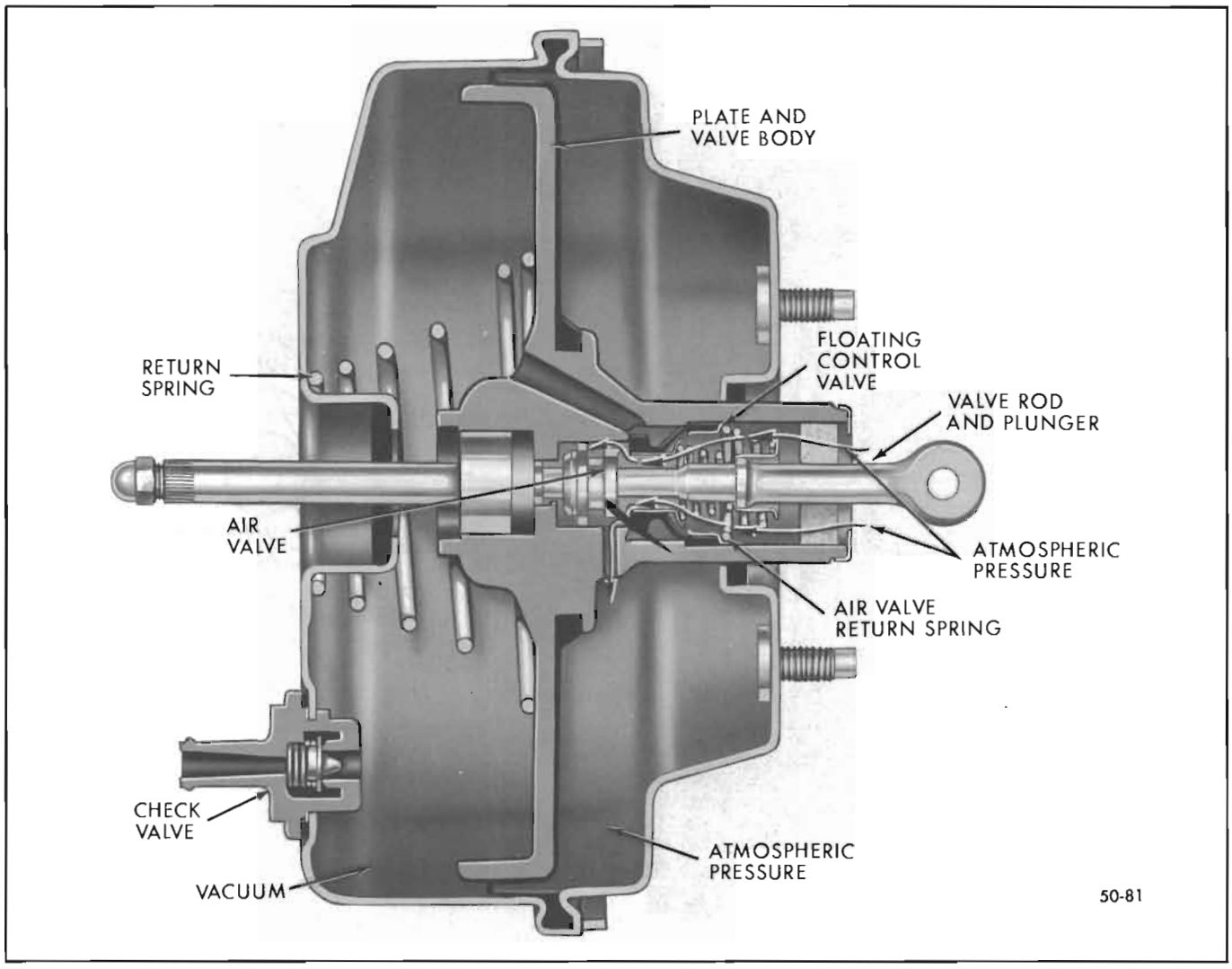


Figure 50-81—Power Brake - Applied Position

rotate rear shell so that cutouts in rear shell line up with tangs of of front shell.

CAUTION: Loosen rear shell carefully as it is spring-loaded.

3. Lift rear shell and plate and valve body, valve rod and plunger assembly from unit. Then remove return spring.

4. Remove the plate and valve body, valve rod and plunger assembly from rear shell and lay aside in a clean place.

NOTE: Do not remove bearing seal from rear shell unless seal is defective and new seal is available. To remove seal, support rear shell and drive out seal with punch or screwdriver. Discard seal. See Figure 50-85.

5. Remove the master cylinder push rod. Remove master cylinder to front shell attaching nuts and separate the master cylinder from the front shell.

6. From the front shell, remove the seal, and if defective, the vacuum check valve. See Figure 50-86.

7. Pry off filter retainer from plate and valve body and remove air silencer with air filter from valve body, beirg careful not to chip plastic. Remove diaphragm from plate and valve body, then remove valve retainer key and valve rod and plunger assembly. Press out reaction disc from diaphragm plate. See Figure 50-87.

b. Disassembly of Hydraulic Master Cylinder

1. Place master cylinder in a vise so that the lock ring can be removed from the I.D. of the bore. Remove lock ring. See Figure 50-88.

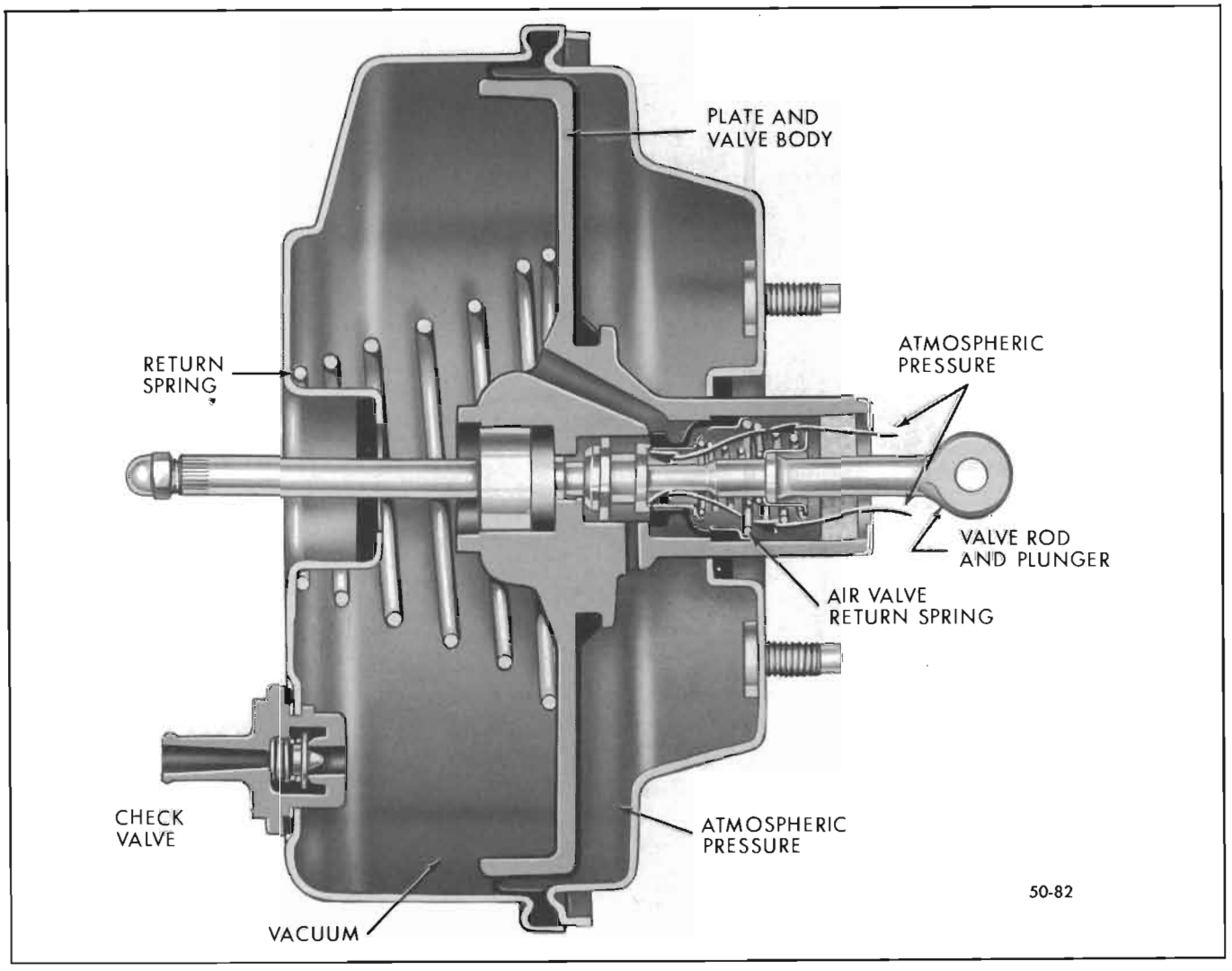


Figure 50-82—Power Brake - Holding Position

2. Remove and discard piston, primary cup, spring and check valve. Also discard lock ring. These parts are furnished in the repair kit.

3. Thoroughly clean master cylinder with brake fluid or denatured alcohol.

CAUTION: Do not use anti-freeze alcohol, gasoline, kerosene or any other cleaning fluid that might contain even a trace of mineral oil.

57-15 CLEANING, INSPECTION AND REPLACEMENT OF PARTS

a. Cleaning of Parts

1. Use denatured alcohol, Declene or equivalent to clean thoroughly all metal brake parts. 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 clean cloth.

2. If slight rust is found inside either the front or rear shell, polish clean with crocus cloth or fine emery paper, washing clean afterwards.

CAUTION: If there is any suspicion of contamination or any evidence of corrosion, completely flush the hydraulic brake system in accordance with Section C, paragraph 56-4. Failure to clean the hydraulic brake system can result in early repetition of trouble. Use

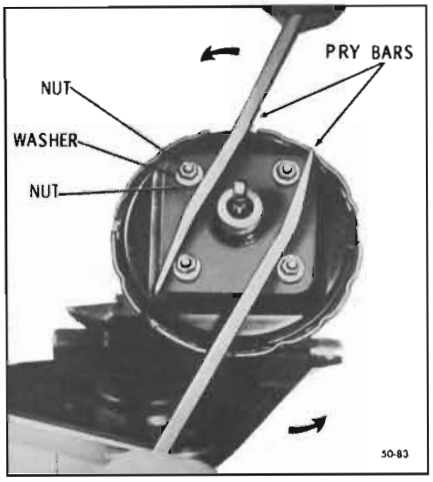


Figure 50-83—Separation of Front and Rear Shell

of gasoline, kerosene, anti-freeze alcohol or any other cleaner with even a trace of mineral oil will damage rubber parts.

NOTE: Dirt is the major cause of trouble and wear in service. Be sure to keep parts clean. Rewash at reassembly if there is any occasion to doubt cleanliness -- such as parts dropped or left exposed for eight hours or longer.

b. Inspection and Replacement of Parts

1. Inspect all rubber parts. Wipe free of fluid and carefully inspect each 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. Re-use rubber parts only if a fairly new unit is dismantled for some particular trouble, and only then if there is no doubt that the parts are in

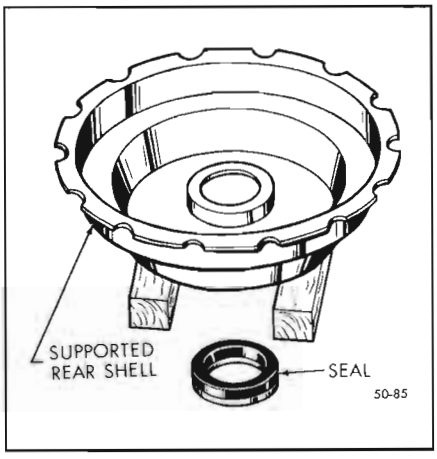


Figure 50-85—Removal of Bearing Seal From Rear Shell

equal-to-new condition. Badly damaged items or those which would take extensive work or time to repair should be replaced. In case of doubt, install new parts

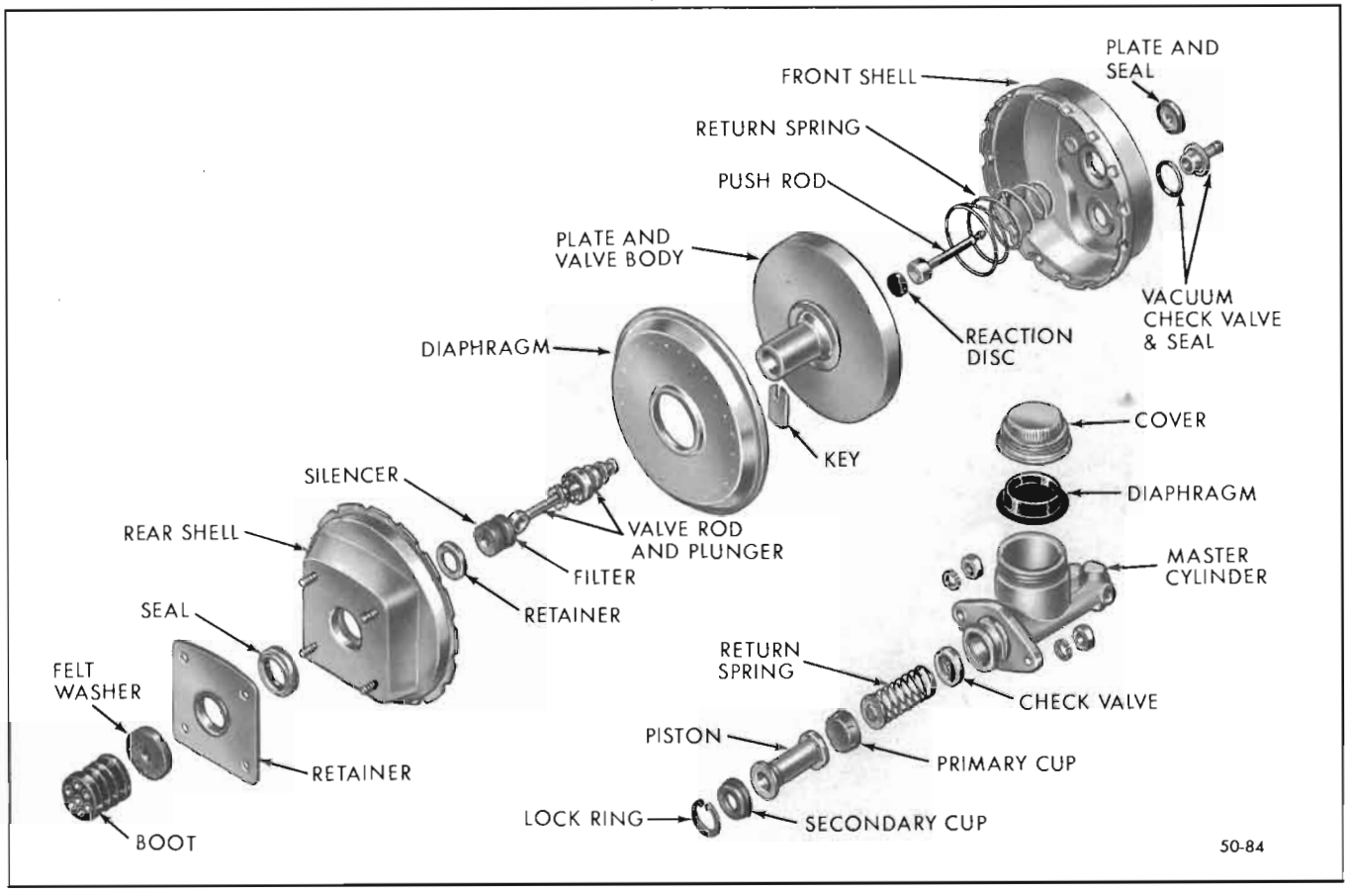


Figure 50-84—Power Brake - Exploded View

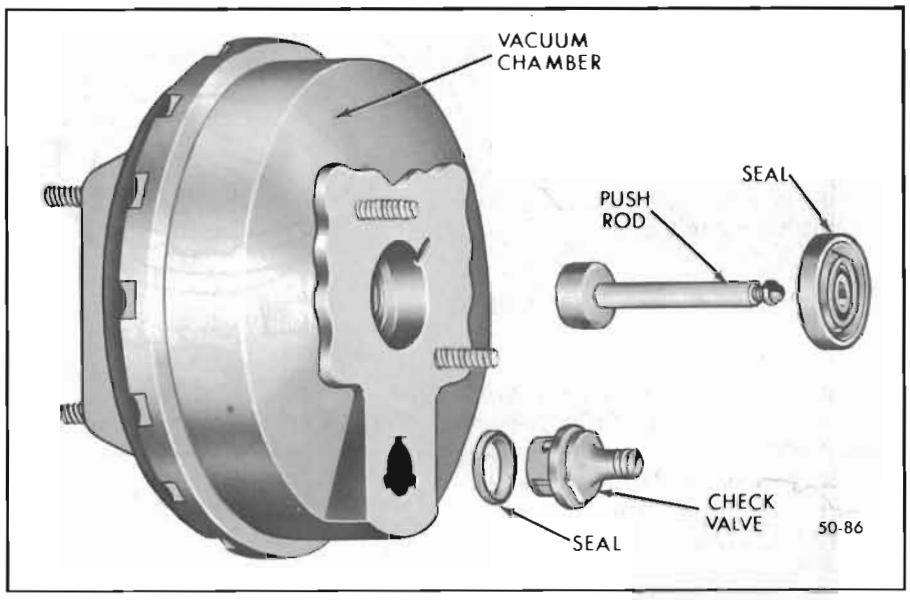


Figure 50-86—Removal of Seal, Push Rod and Check Valve

for safety and for ultimate lower cost.

2. Inspect in accordance with the following table: (The table is organized by power brake unit groups).

a. Master Cylinder Group

See Section C, paragraph 55-2, subparagraph c.

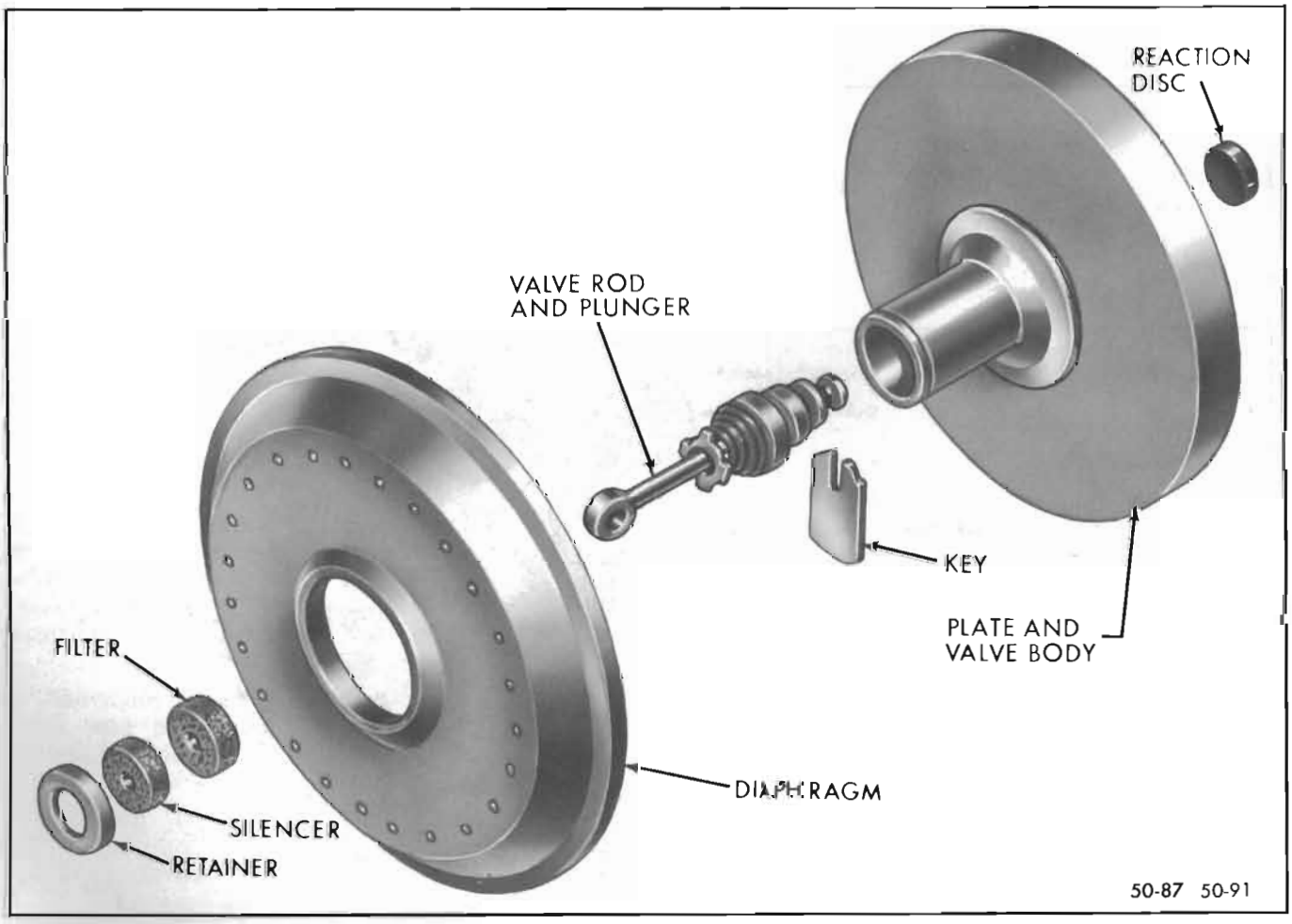


Figure 50-87—Removal of Air Filter, Diaphragm, Key, Valve Rod and Plunger, Plate and Valve Body

b. Power Piston Group

PART	INSPECT FOR	CORRECTIVE ACTION
Plate and Valve Body	Cracks, distortion, chipping, damaged seats, pitted or rough holes. Worn seal surfaces (tubes).	Cleanup or replace.
	Rough or uneven floating valve seat.	Replace.
	Open passages and flow holes.	Clean.
Reaction Disc	Deterioration of rubber or wear.	Replace.
Valve Rod and Plunger	Air valve: scratches, dents, distortion, or corrosion of I.D. or O.D. All seats to be smooth and free of nicks and dents.	Do not repair; replace.
	Push rod must move freely in air valve, but must not pull out.	If worn, replace valve rod and plunger.

c. Over-All Unit

PART	INSPECT FOR	CORRECTIVE ACTION
Front and Rear Shell	Scratches, scores, pits, dents or other damage affecting rolling or sealing of diaphragm or other seals.	Replace unless easily repaired.
	Cracks, damage at ears, damaged threads on studs.	Replace unless easily repaired.
	Bent or nicked locking lugs.	Replace unless easily repaired.
	Loose studs.	Repair or replace.
Air Filters and Silencer	Dirty	Replace.

57-16 ASSEMBLY OF POWER BRAKE UNIT AND HYDRAULIC MASTER CYLINDER

a. Assembly of Hydraulic Master Cylinder

1. Dip all internal parts in clean brake fluid just before installation. Also wet master cylinder bore with brake fluid.

2. Install check valve, spring, primary cup and piston with secondary cup. Hold piston in and install lock ring. Check for proper seating of lock ring. See Figure 50-88.

3. Install rubber diaphragm and reservoir cover.

b. Assembly of Power Brake Unit

1. If rear bearing seal is to be replaced, use Installer J-9540 to press bearing seal in rear shell with plastic side up. See Figure 50-89.

2. Apply power brake lubricant to O.D. of tube section of plate and valve body and to bearing surfaces of valve rod and plunger. Insert air valve plunger and rod assembly in valve body of plate. Press down on valve rod to position air valve plunger in housing and align groove in valve plunger with slot in power piston.

3. Insert retainer key and assemble diaphragm on plate and

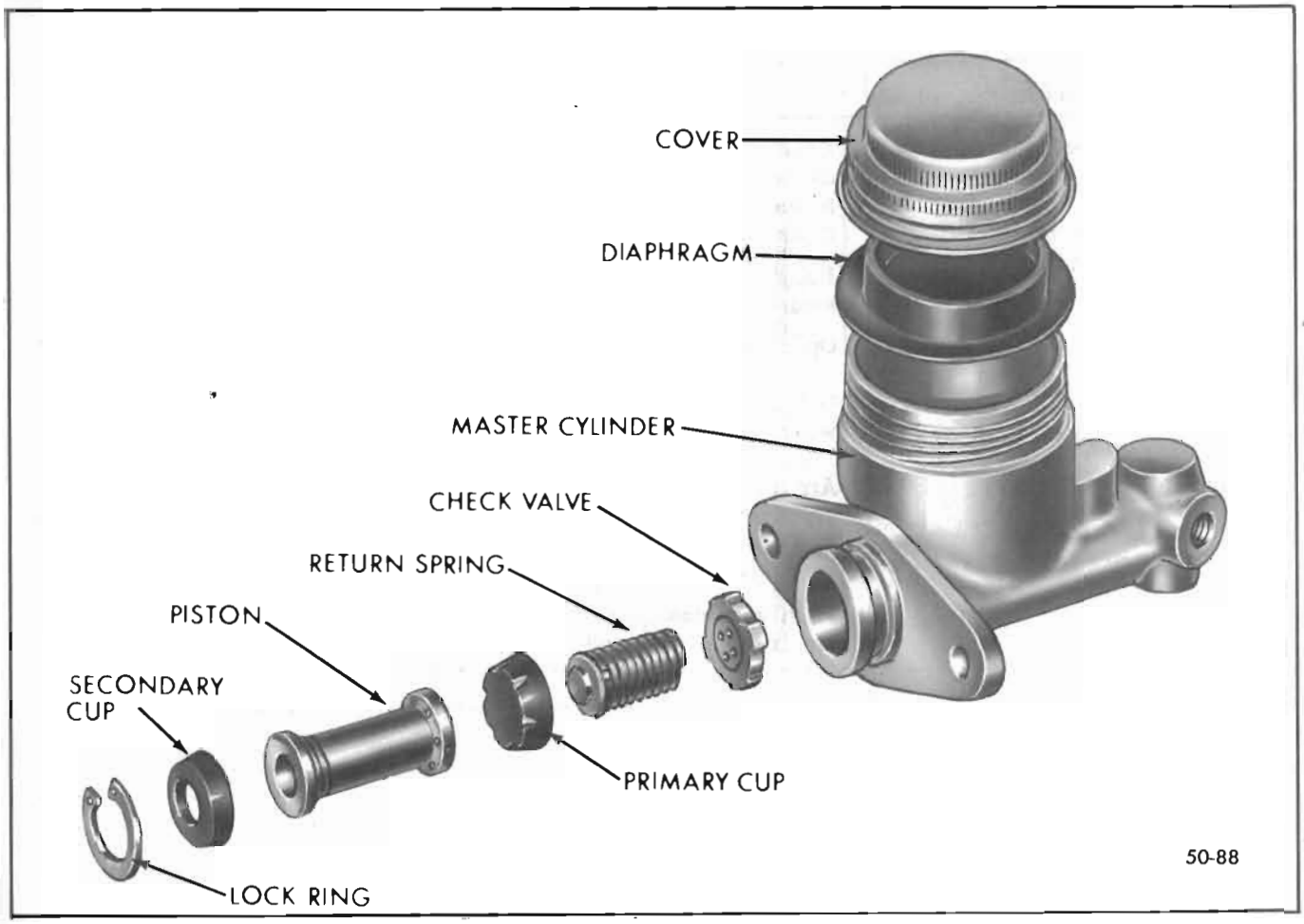


Figure 50-88—Disassembly of Hydraulic Master Cylinder

valve body making certain diaphragm is seated in the groove. Assemble air filter and air silencer over rod and position in valve body. Press retainer on end of valve body using care not to chip plastic. See Figure 50-91.

4. Apply lubricant liberally to entire surface of reaction disc and install disc in plate and valve body. See Figure 50-92.

5. Coat outer bead of diaphragm with power brake lube or silicone where it bears against the outer rim of the front and rear shell to aid in assembly. Apply power brake lubricant liberally to seal in rear shell and carefully guide tube end of plate and valve body, valve rod and plunger assembly through seal in rear shell.

6. Apply power brake lubricant sparingly to hydraulic push rod keeping lubricant away from adjusting screw. Insert push rod through front plate and seal and install both in front shell.

7. Install master cylinder on front shell and firmly clamp assembly, by master cylinder, in a vise.

8. Install return spring and then install rear shell assembly by using pry bars to rotate rear shell clockwise until scribe lines align.

CAUTION: When using pry bars, make certain that nuts are installated on rear shell studs in order to prevent damage to threads.

Figure 50-89—Installation of Rear Bearing Seal

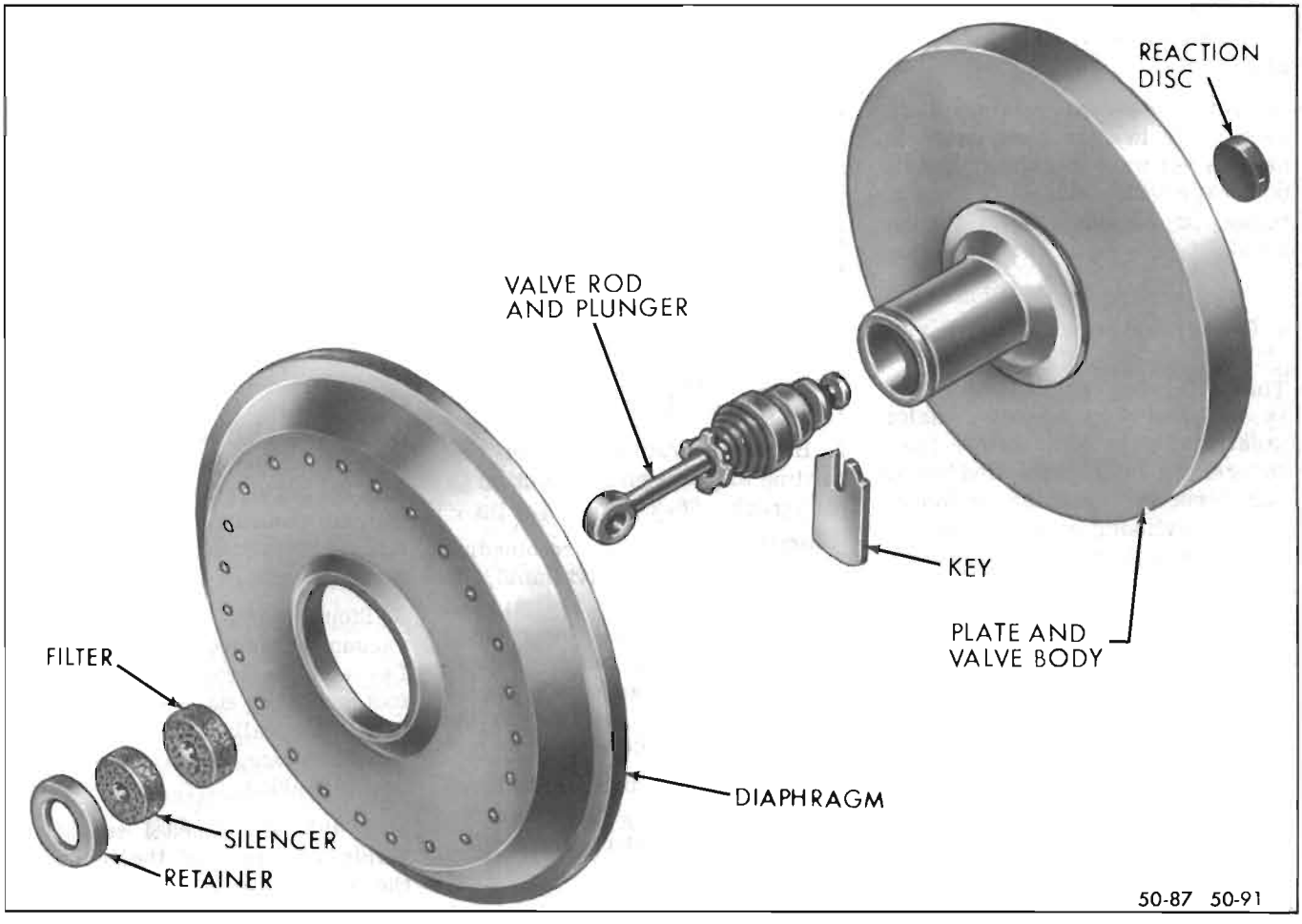


Figure 50-91—Assembly of Plate and Valve Body, Valve Rod and Plunger, Key, Diaphragm and Air Filter

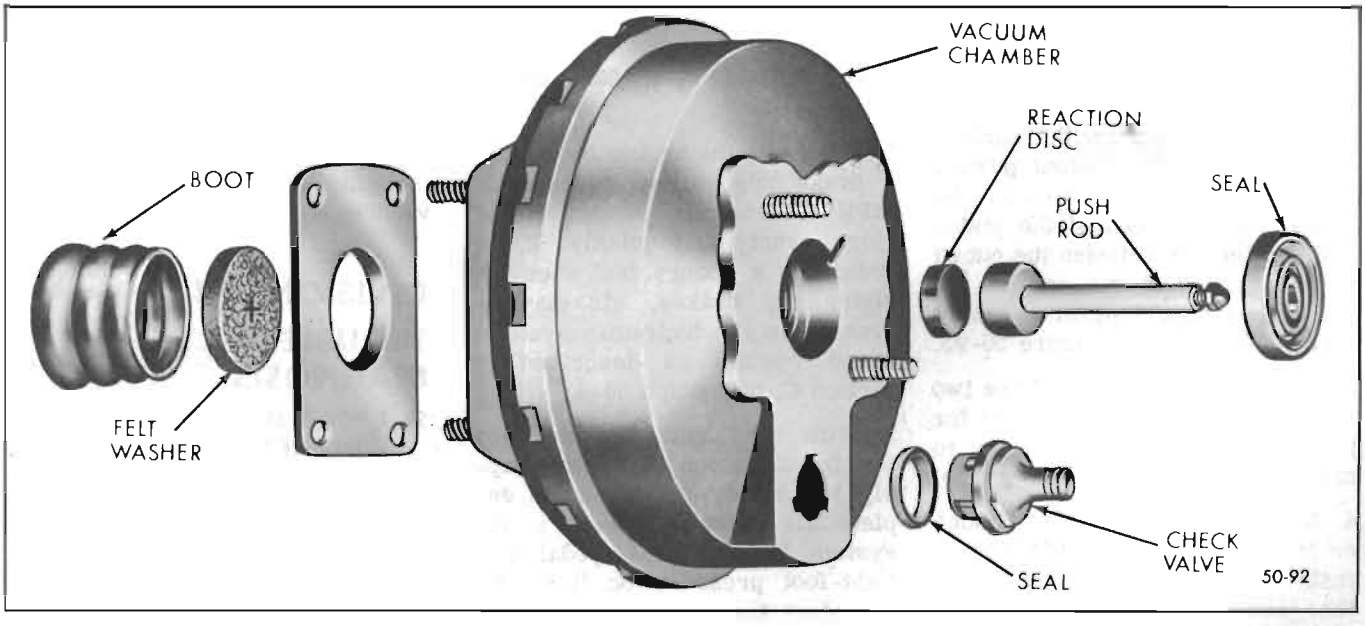


Figure 50-92—Assembly of Reaction Disc, Push Rod, Seal, Check Valve, Retainer Plate, Washer and Boot

9. Place seal on check valve and turn check valve clockwise in shell to lock valve in place.

10. Assemble rear retainer plate over studs in rear shell and assemble felt washer in boot. Install boot over valve rod and attach to flange of retainer. See Figure 50-92.

c. Gaging Power Brake Piston

The following gaging operation is necessary only when a major structural part such as the front or rear shell, plate and valve body, master cylinder piston or master cylinder assembly is replaced with a new part. The gage measures how far the master cylinder push rod projects from the front shell. This dimension must be correct to insure the proper clearance in the master cylinder between the primary cup and the compensating port.

Make check as follows:

1. Place the power brake assembly in a vise so that the master cylinder is up. Remove the master cylinder from the front shell. The master cylinder push rod is now exposed.

2. Place Gage J-7723-01 over the piston rod so that it fits between the two studs on the front shell. It should be parallel to the studs and resting on the surface of the shell. The cutout portion of the gage should never be lower than the end of the piston rod and the gap between the cutout in the gage and the end of the piston rod should never be more than .010 inch. See Figure 50-93.

3. Any variation beyond these two limits must be compensated for by adjusting screw in or out to match the height of the gauge.

4. Replace the master cylinder on the studs on the front housing. Install nuts and lock washers on the studs and torque to 20-28 lb. ft.

57-17 INSTALLATION OF POWER BRAKE UNIT

1. Place power brake unit in position on dash and connect push rod to brake pedal pin using retainer and special washer.

2. Install four nuts on studs. Torque to 20-28 lb. ft.

3. Connect brake pipe to hydraulic cylinder.

4. Connect vacuum hose to check valve on front shell.

5. Bleed hydraulic system according to procedure in Section C, paragraph 56-2.

NOTE: When pressure bleeding equipment is not available, do not use any vacuum assist. The engine should not be running and the vacuum reserve should be used up by repeatedly applying the brake before starting the bleeding procedure.

6. After bleeding, bring fluid level to 1/8" below top of reservoir opening and install reservoir cover.

7. Check pedal for full return and check stop light switch adjustment as described in Section C, paragraph 50-10 (b).

57-18 TESTING OF POWER BRAKE UNIT

1. Road test the brakes by making a brake application at about 20 MPH to determine if the vehicle stops evenly and quickly. If the pedal has a spongy feel when applying the brakes, air may be present in the hydraulic system. Bleed system as described in Section C, paragraph 56-4.

2. With the engine stopped and the transmission in Neutral, apply brakes several times to deplete all vacuum reserve in the system. Depress brake pedal, hold light-foot pressure on the pedal and start the engine. If the vacuum system is operating, the 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, the vacuum system is not functioning.

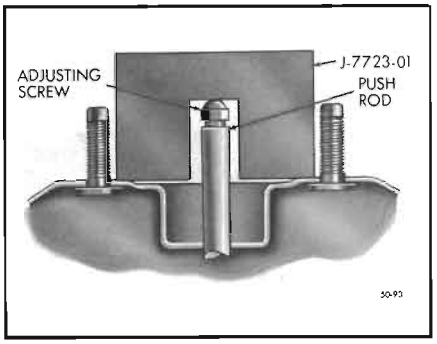


Figure 50-93—Gaging Master Cylinder Push Rod

3. Stop engine. Again deplete all vacuum reserve in the system. Depress the brake pedal and hold foot pressure on the pedal. If the pedal gradually falls away under foot pressure, the hydraulic system is leaking.

4. If the brake pedal travels to within one inch of the toeboard, the brake shoes require adjustment or relining.

5. Start engine with brakes off. Run to medium speed and turn off the ignition. Immediately close the throttle. This builds up vacuum. Wait no less than 90 seconds, then try brake action. If not vacuum-assisted for two or more applications, vacuum check valve is faulty or there is a leak in the vacuum system.

DIVISION IV
TROUBLE DIAGNOSIS

59-7 POWER BRAKE UNIT TROUBLE DIAGNOSIS

The same types of brake trouble are encountered with power brakes as with standard brakes. Before checking the power brake system for the source of trouble,

refer to the trouble diagnosis of standard brakes in Section C, Division IV. After these possible causes have been eliminated, check for the cause as outlined below:

a. Hard Pedal

1. Vacuum failure due to:

a. Faulty vacuum check valve

b. Collapsed vacuum hose to manifold

c. Plugged or loose vacuum fittings

2. Binding pedal mechanism

3. Power brake unit trouble

a. Jammed air valve

b. Vacuum leaks in unit caused by faulty air valve seal or support plate seal. Also, a damaged floating control valve, bad seal of master cylinder or power cylinder mounting studs in shells, bad seal on master cylinder push rod or a bad seal of the diaphragm bead between the shells or at power piston. It is possible to have faulty vacuum check valve grommet.

c. Defective rolling diaphragm

d. Restricted air filter elements

e. Worn or distorted reaction disc

f. Cracked or broken plate and valve body

b. Grabby Brakes (Apparent Off-and-On Condition)

1. Power brake unit valve trouble

a. Sticking air valve

b. Restricted diaphragm passage

2. Reaction system

a. Dislodged reaction disc

b. Broken air valve spring

c. Worn or distorted reaction disc

c. Pedal Goes Either to Floor or Almost to Floor

1. Fluid reservoir needs replenishing

2. Power brake hydraulic leakage

a. Defective primary or secondary cups

b. Cracked master cylinder casting

c. Leaks at wheel cylinder, in pipes or connections

3. Faulty master cylinder check valve has permitted air to enter system causing spongy pedal.

d. Brakes Fail to Release

1. Faulty hydraulic check valve

2. Blocked passage in power piston

3. Air valve sticking shut

4. Broken piston return spring

5. Broken air valve spring

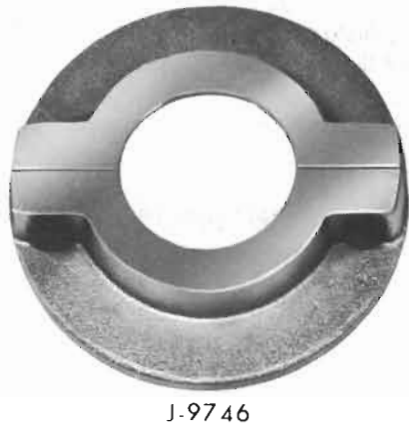
6. Tight pedal linkage

J-7723-01

J-21524

J-21601-01

J-4880



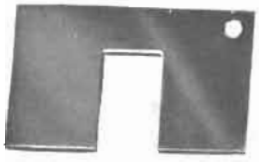
J-9746

J-21472

J 4880	-	SNAP RING PLIERS
J 7723-01	-	PUSH ROD HEIGHT GAUGE
J 9746	-	REAR PINION BEARING REMOVER
J 21472	-	BRAKE BLEEDER WRENCH
J 21524	-	POWER PISTON REMOVER AND INSTALLER
J 21601-01	-	POWER BRAKE RETAINER INSTALLER

50-94

Figure 50-94—Special Tools - Sections B and D



J-7723-01

J-9540

J-21472

J 7723-01 - PUSH ROD HEIGHT GAUGE

J 9540 - BRAKE REAR SHELL SEAL INSTALLER

J 21472 - BRAKE BLEEDER WRENCH

50-95

Figure 50-95—Special Tools - Section E