

## GROUP 9-E

### BENDIX POWER BRAKES

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### 9-22 DESCRIPTION OF POWER BRAKE MECHANISM

The Bendix Power Brake Unit is a self-contained vacuum hydraulic power braking unit. It is of the vacuum suspended type which utilizes engine intake manifold vacuum and atmospheric pressure for its power. It consists of three basic elements combined into a single unit. See Figures 9-34 and 9-35.

The three basic elements are as follows:

1. A vacuum power chamber consisting of a front and rear housing, a diaphragm, a power piston, a hydraulic push rod and a power piston return spring.
2. A mechanically actuated control valve, integral with the vacuum power piston, controls the degree of power brake application or release in accordance with the foot pressure applied to the valve operating rod through the brake pedal linkage. The control valve consists of a single poppet and an atmospheric port and a vacuum port. The vacuum port seat is a part of the valve body attached to the power piston assembly. The atmospheric port seat is a part of the valve plunger which moves within the valve housing and power piston assembly.
3. A single piston hydraulic master cylinder of the sealed type is used with the power brake and contains all of the elements of

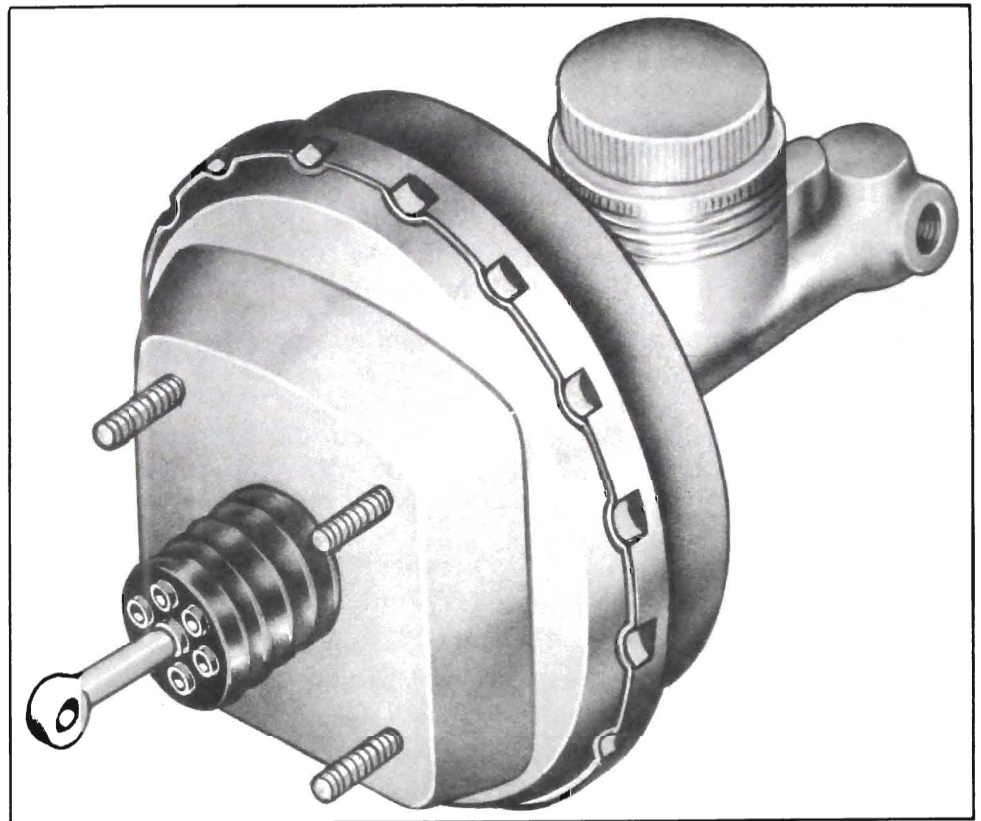


Figure 9-34—External View of Power Brake

the conventional brake master cylinder except for the hydraulic push rod which is of special design. In the sealed type of master cylinder, a flexible diaphragm, located between the fluid reservoir and the vented filler cover, seals the fluid in the systems from outside air and dust while maintaining normal atmospheric pressure on the fluid in the fluid reservoir.

The power piston assembly and the components which make up the valve assembly are connected to the brake pedal through the

valve operating rod and pedal linkage. The valve operating rod is connected to the air valve plunger which moves within the power piston assembly. A valve return spring returns the air valve plunger and valve rod to the released position when pressure is released from the brake pedal. The floating control valve is of the flexible rubber type and is supported by the valve body. In the released position the floating control valve return spring holds the poppet against the atmospheric port seat. A special bearing and seal is used

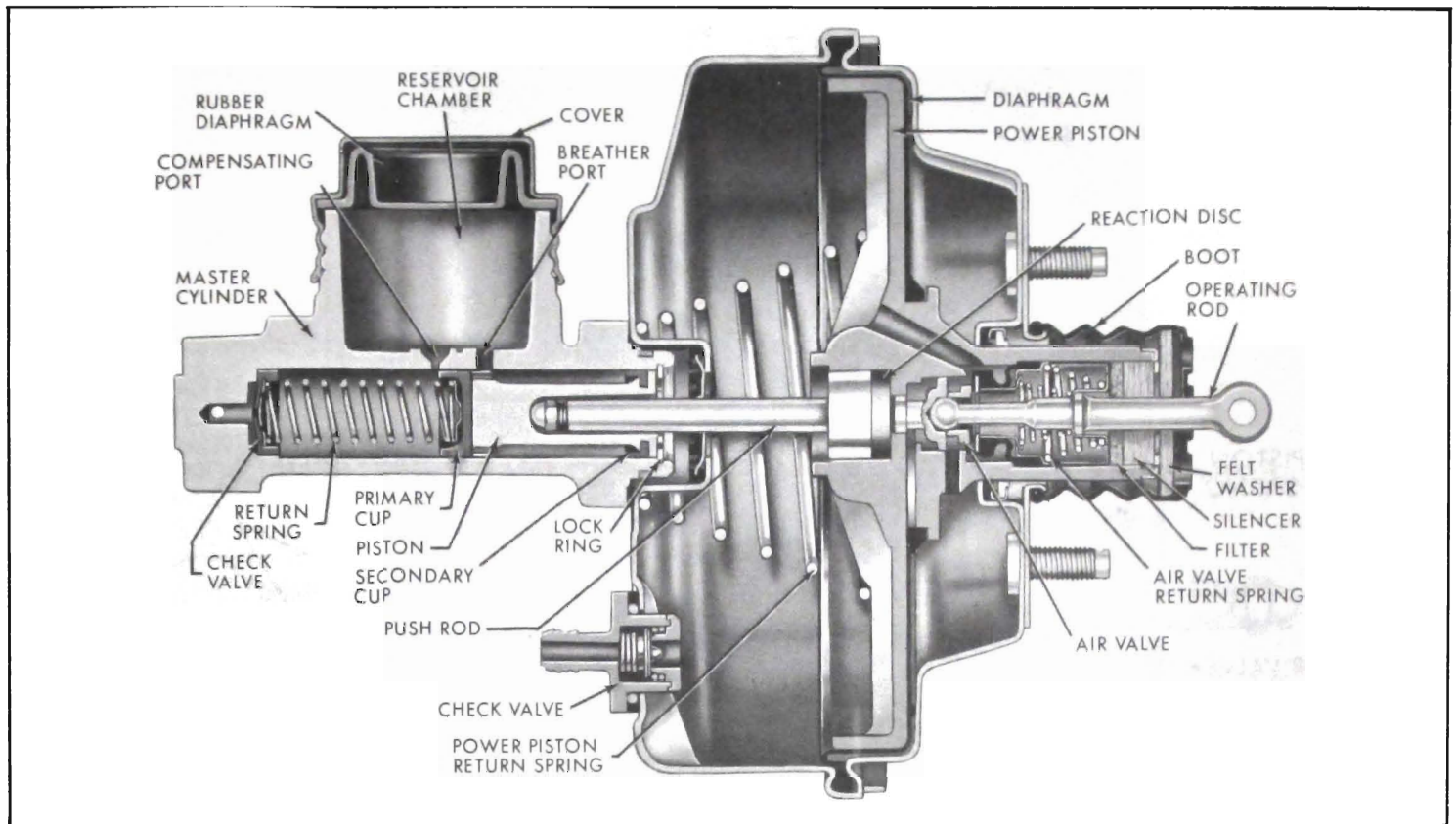


Figure 9-35—Power Brake and Master Cylinder Assembly - Cross Section

to seal the opening between valve body sleeve and the rear end plate. Vacuum is supplied to the power unit through a vacuum check valve located in the front shell. Air for operating is admitted through six holes in the end of the rubber valve rod boot and passes through three filters which protect all internal operating parts from dust and dirt. A seal located in the front vacuum chamber seals the opening between the vacuum chamber and the hydraulic push rod. The hydraulic push rod is the link between the vacuum power diaphragm assembly and the piston of the hydraulic master cylinder.

## 9-23 OPERATION OF POWER BRAKE

### a. 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 (left) vacuum chamber. In the released position (no pressure applied to the brake pedal), the valve operating rod and air valve plunger are held to the right in the valve housing 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 power piston return spring is free to return the power piston 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 ex-

pansion of/or loss of fluid from the brake system.

### b. Applied Position

As the brakes are applied by the driver, the valve operating rod and air valve plunger move to the left in the power piston assembly 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 operating rod 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 right of the power piston. With the left side of the power piston exposed to vacuum, and atmospheric pressure on the right side, a force is developed to move



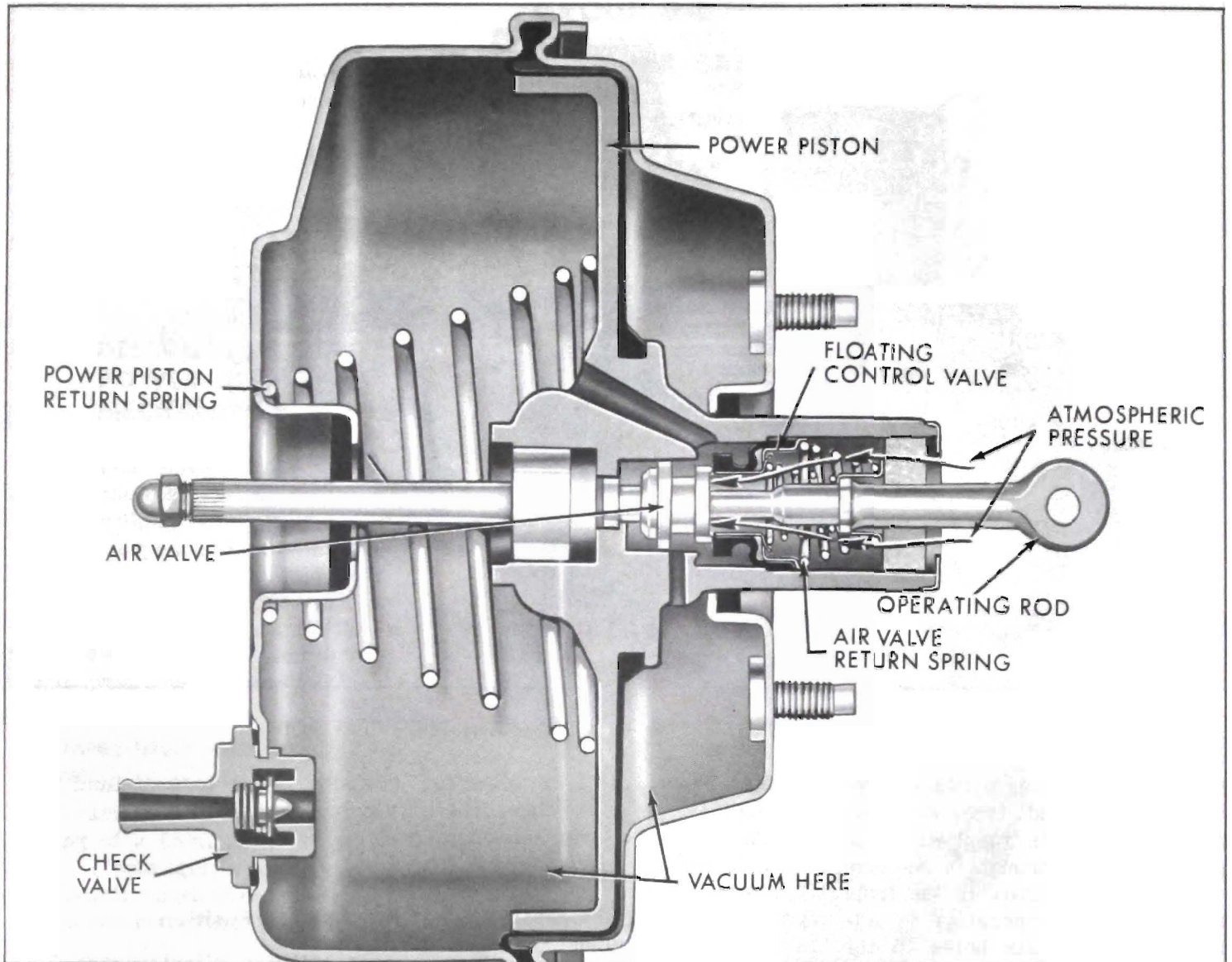


Figure 9-36—Power Brake - Released Position

the power piston assembly, hydraulic push rod and hydraulic piston to the left to close the compensating port and force hydraulic fluid under pressure through the residual check valve and brake tubes into the brake wheel cylinders.

As hydraulic pressure is developed within the master cylinder, a counter force (to the right), acting through the hydraulic push rod and rubber reaction disc, sets up a reaction force against the power piston and air valve

plunger. The rubber reaction disc distributes the pressure between the power piston assembly and the valve plunger in proportion to their respective contact areas. The pressures acting against the air valve plunger and valve operating rod tend to move the air valve plunger slightly to the right in relation to the power piston and valve housing assembly 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.

### c. 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 said to be in the "lap" or holding position. When both valves are closed or "lapped off", 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

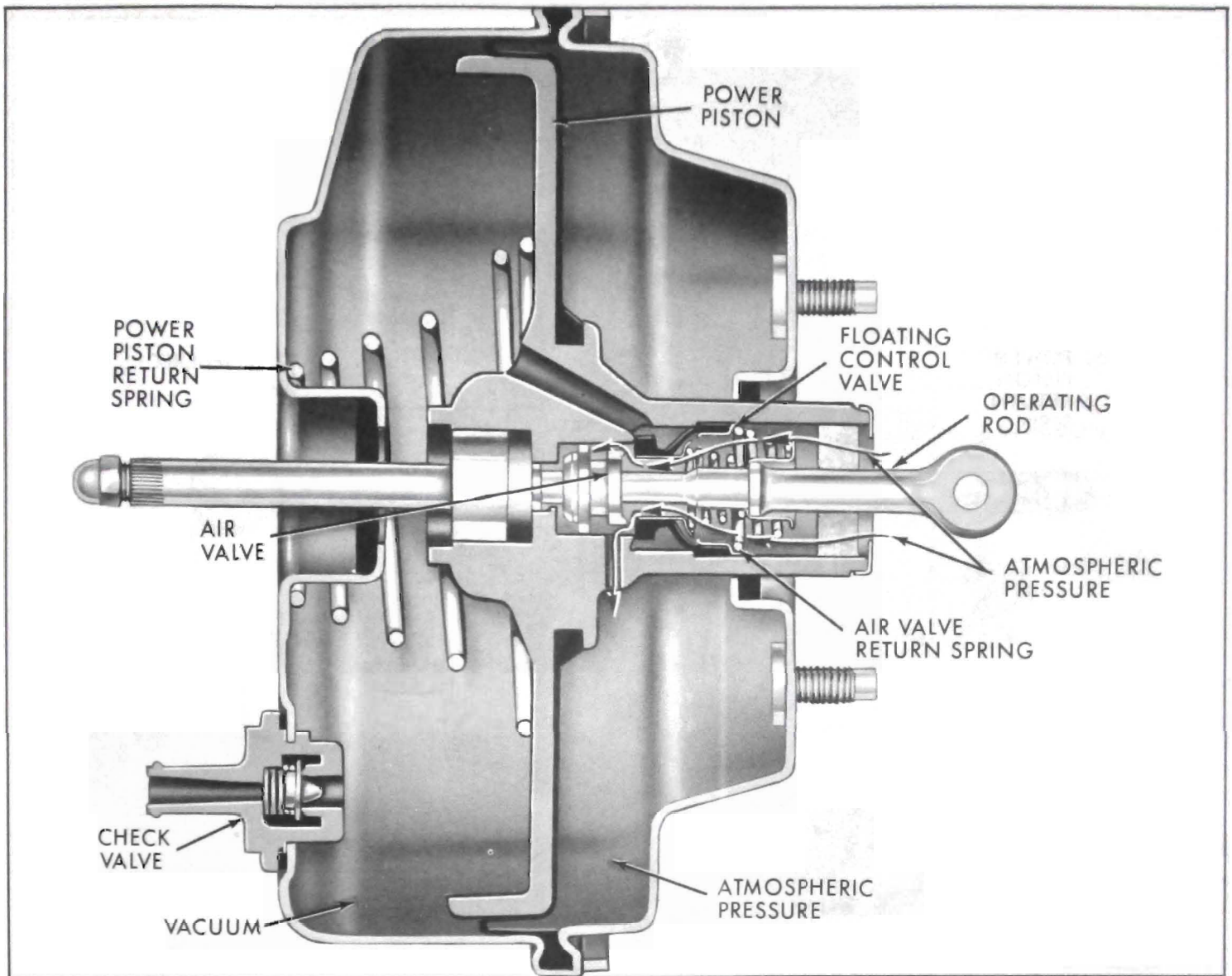


Figure 9-37—Power Brake - Applied Position

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 'lap' or 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 right of the power piston. With vacuum in the chamber at the left of the power piston, full power application is attained which is referred to as the "run out" point of the power unit. Any increase in hydraulic pressure

beyond this point must be supplied by physical effort of the driver.

## 9-24 REMOVAL, INSTALLATION, ADJUSTING, TESTING OF POWER BRAKE UNIT

### a. Removal of Power Brake Unit

1. Disconnect brake pipe from hydraulic master cylinder and tape end of pipe to prevent entrance of dirt.
2. Remove retainer and special washer from brake pedal pin and disengage push rod eye.
3. Remove four right hand nuts holding power brake unit to dash panel.
4. Disconnect vacuum hose from cylinder.
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



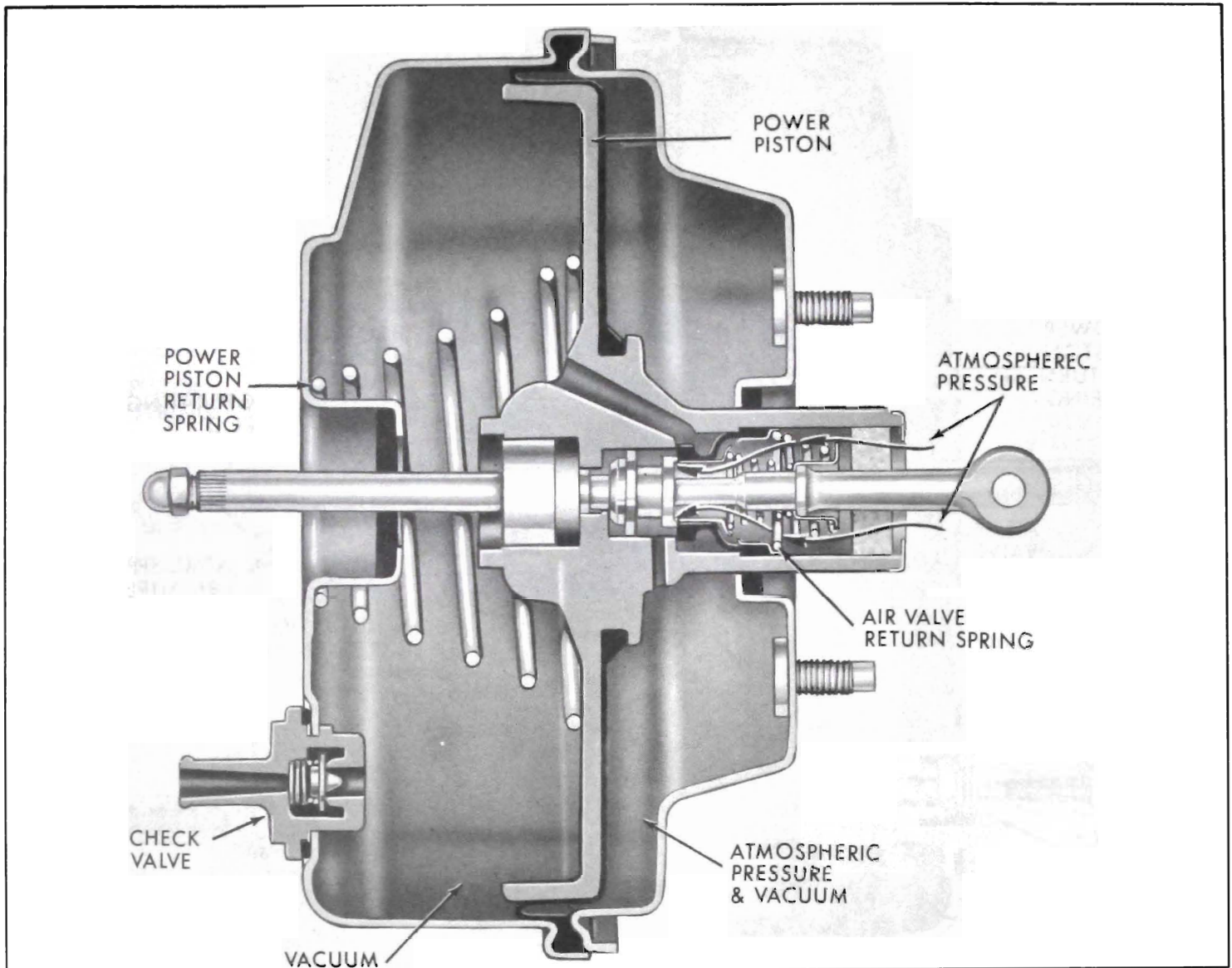


Figure 9-38—Power Brake - Holding Position

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.

#### b. Installation of Power Brake Unit

1. Place power brake unit in position. Install four nuts on studs, and torque to 20-28 ft. lbs.
2. Install push rod eye over pedal pin. Install special washer and retainer.

3. Connect brake pipe to hydraulic cylinder.

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

5. Bleed hydraulic system according to procedure in paragraph 9-6. Bleed left front wheel cylinder first and check for proper pedal feel. If system still has air in it, bleed other three wheel cylinders.

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

**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.

7. Check pedal for full return and check stop light switch adjustment as described in paragraph 9-7 (b).

#### c. Testing Power Brake Unit

1. Vacuum Assist. With engine stopped, apply brake several

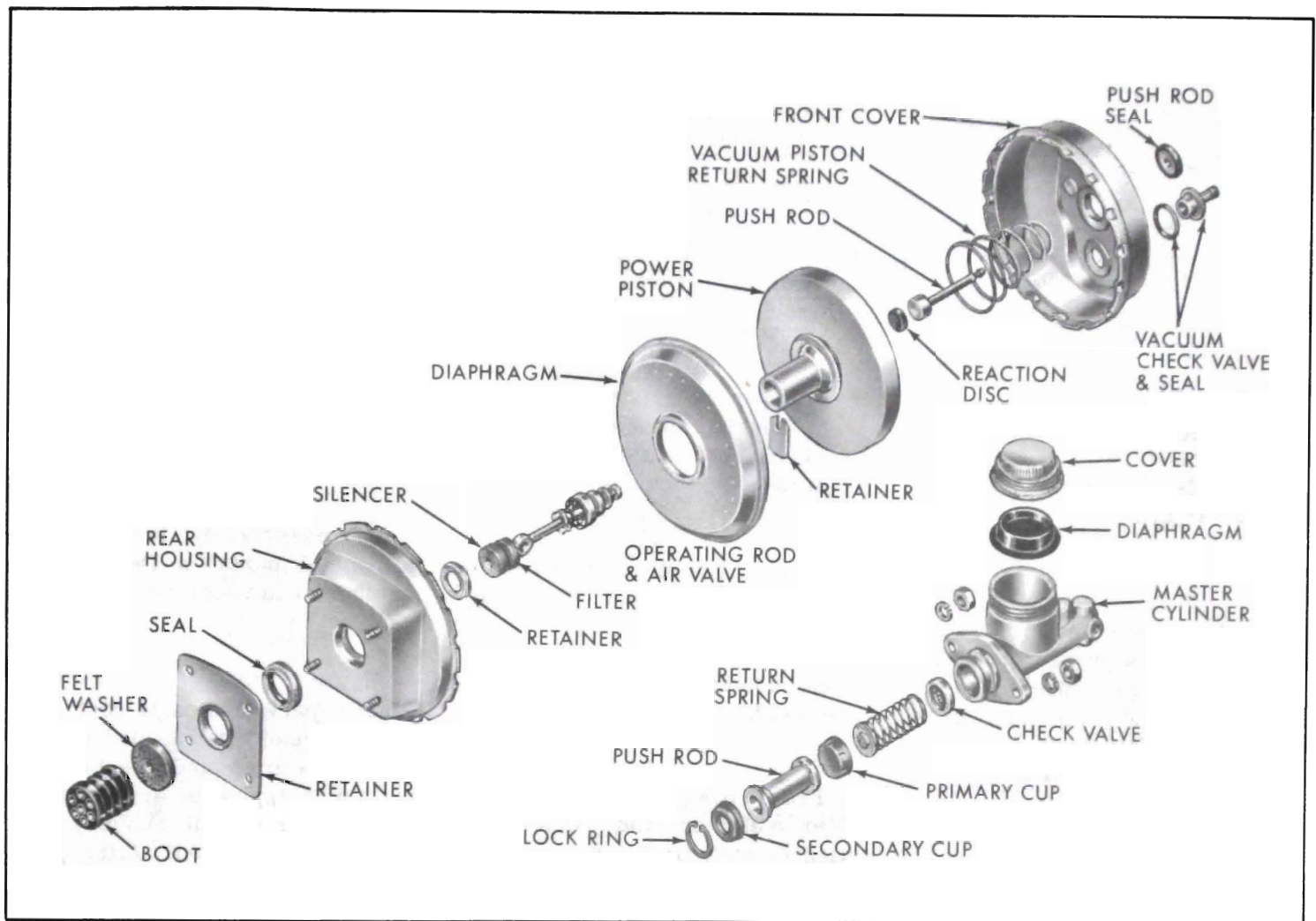


Figure 9-39—Power Brake - Exploded View

times until all vacuum reserve in system is used up. Then depress brake pedal and start engine while holding a light pedal pressure. If vacuum system is operating properly, pedal will tend to fall away from under the foot, and less foot pressure will be required to hold pedal in same position. If no action is felt, vacuum system is not functioning.

**2. Hydraulic Leak.** Apply a heavy foot pressure on brake pedal with engine running. Hold this pressure at least 15 seconds and observe brake pedal. If pedal goes down gradually, check first for a leak in system outside of power brake unit. When possibility of an external leak is eliminated, leak

is in hydraulic cylinder of power brake unit.

**3. Vacuum Leak.** Allow engine to idle a minute to build-up vacuum reserve. Shut off engine and wait several minutes at least (system should hold vacuum for 12 hours) before trying brake action. If brake is not vacuum assisted for at least 2 or more slow applications, there is a leak in the vacuum system. Always check for an external leak before blaming leak on power brake unit.

**4. Road Test.** Apply brake several times at about 20 MPH to determine if a light pedal pressure stops the car evenly and quickly. Notice pedal feel as

compared to other cars of the same model.

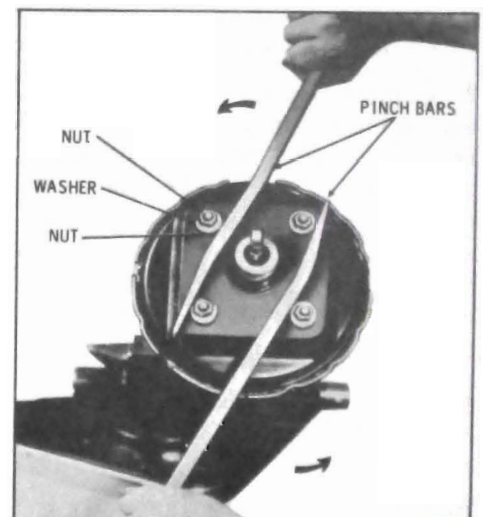


Figure 9-40—Separation of Front and Rear Housing

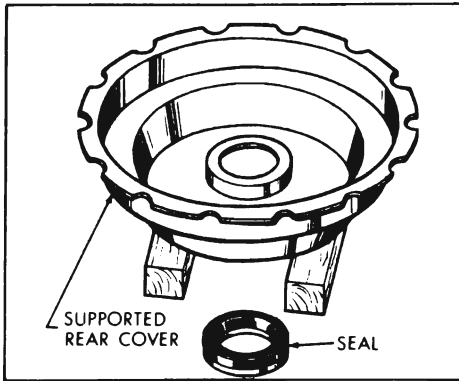


Figure 9-41—Removal of Bearing Seal from Rear Housing

#### d. Trouble-Shooting Power Brakes

Many brake troubles which are blamed on the power brake unit may actually be caused by a defect outside of this unit. Brake trouble-shooting procedure is provided in paragraph 9-5.

### 9-25 DISASSEMBLY OF POWER BRAKE

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 housing studs. Scribe a line between front and rear housings. Using pry bars as shown in Figure 9-40, rotate rear housing so that cutouts in rear housing line up with tangs of front housing. **CAUTION: Loosen rear housing carefully as it is spring-loaded.**

3. Lift rear housing assembly and power piston assembly from unit. Then remove power piston return spring.

4. Remove power piston assembly from rear housing and lay power piston aside in a clean place. **NOTE: Do not remove bearing seal from rear housing unless seal is defective and new seal is available. To remove seal, support rear housing and drive out seal with punch or screwdriver. Discard seal. See Figure 9-41.**

5. Remove the master cylinder to front housing attaching nuts and separate the master cylinder from the front housing.

6. From the front housing remove the seal, and if defective, the vacuum check valve. Also, place master cylinder push rod with front housing group. See Figure 9-42.

7. From power piston, pry off filter retainer and remove air silencer with air filter from valve housing, being careful not to chip plastic housing. Remove diaphragm from power piston, then remove valve retainer lock key, valve and rod assembly. Press out reaction disc from diaphragm plate. See Figure 9-43.

8. From the master cylinder remove snap ring, piston assembly,

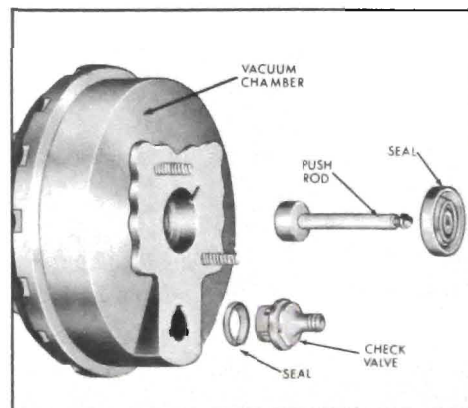


Figure 9-42—Removal of Seal, Push Rod and Check Valve

primary cup, spring and retainer, residual check valve and reservoir cover. Then remove diaphragm from reservoir cover. If secondary cup is damaged or worn, remove cup from piston.

Use suitable tool to pry cup out of groove and off piston. See Figure 9-44.

### 9-26 CLEANING AND INSPECTION OF PARTS

After disassembly, immersion of all metal parts in Del-clean or equivalent is recommended.

Plastic parts and parts containing rubber should be cleaned only in alcohol. Care should be taken to prevent chipping of or damage to plastic parts. All rubber parts should be replaced. After parts have been thoroughly cleaned, those parts which come in contact with brake fluid should be rewashed in clean alcohol before assembly. Use air hose to blow out dirt and cleaning solvent from recesses and internal passages. When overhauling the master cylinder, use all parts furnished in the master cylinder repair kit. **DISCARD ALL OLD RUBBER PARTS.**

Inspect all other parts for damage or excessive wear. Replace any damaged, worn or chipped parts. Inspect master cylinder bore for scoring, rust, pitting or etching. Any of these will require replacement or reconditioning of the master cylinder. If master cylinder is replaced or reconditioned, thoroughly clean master cylinder bore with alcohol and blow out all passages with compressed air.



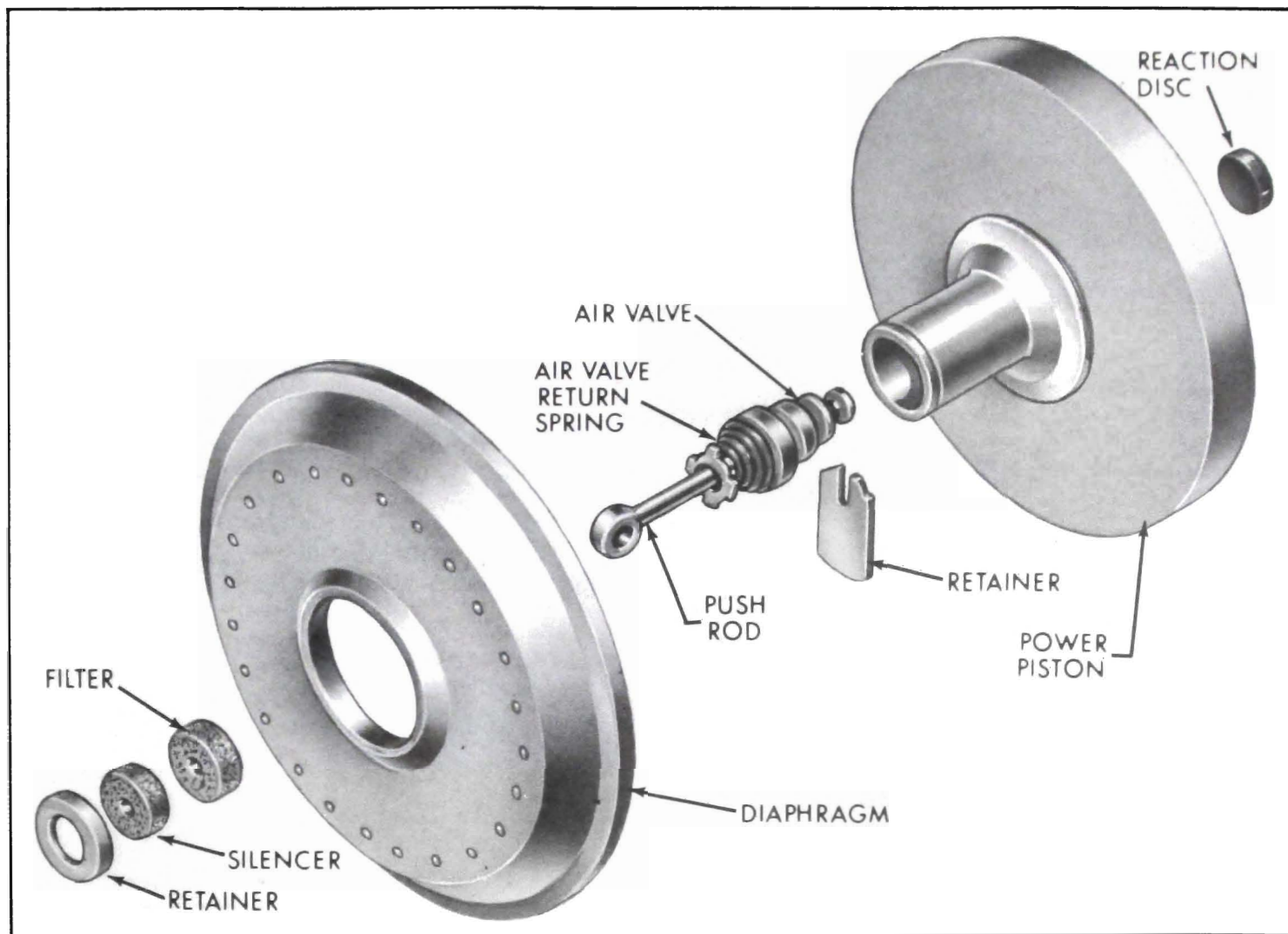


Figure 9-43—Removal of Air Filter, Diaphragm, Lock Key, Valve and Rod Assembly and Reaction Disc

## 9-27 ASSEMBLY OF POWER BRAKE

1. Before assembly of master cylinder, thoroughly clean all parts in clean alcohol and place parts in a clean pan or on a clean paper. Coat bore of master cylinder with brake fluid. If secondary cup was removed from piston, dip cup in brake fluid and assemble cup over end of piston from end shown, lip side first.

Dip hydraulic cylinder parts in brake fluid and assemble in cylinder bore in order shown. Lock parts in place with snap ring, making certain snap ring is seated in ring groove. Place dia-

phragm in master cylinder reservoir cover with raised side in dome of cover and assemble cover hand tight. See Figure 9-44.

2. 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 9-45.

3. Apply power brake lubricant to O.D. of valve housing section of power piston and to bearing surfaces of air valve plunger and to outer edge of floating control valve. Insert air valve plunger and rod assembly in valve hous-

ing of power piston. Press down on valve rod to position air valve plunger in housing and align groove in valve plunger with slot in power piston.

Insert air valve plunger lock key and assemble diaphragm on power piston making certain diaphragm is seated in the groove of piston. Assemble air filter and air silencer over valve rod and position in valve housing. Press retainer on end of valve housing using care not to chip plastic housing. See Figure 9-46.

4. Coat outer bead of diaphragm with talcum powder where it



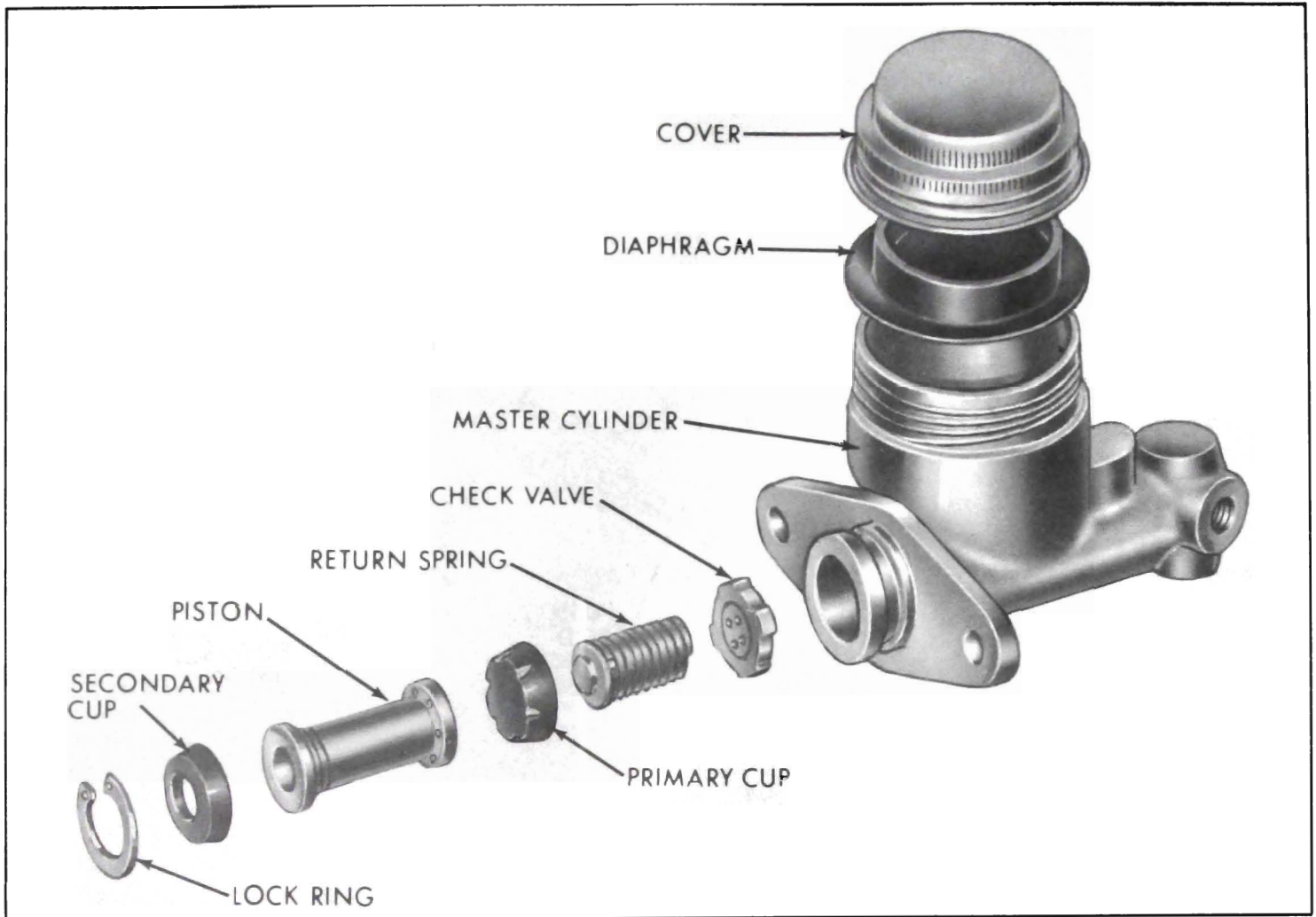


Figure 9-44—Disassembly of Master Cylinder

bears against the outer rim of the front and rear housings to aid in assembly. Apply power brake lubricant liberally to seal in rear

housing and carefully guide sleeve end of diaphragm and valve assembly through seal in rear housing.

order to prevent damage to threads.

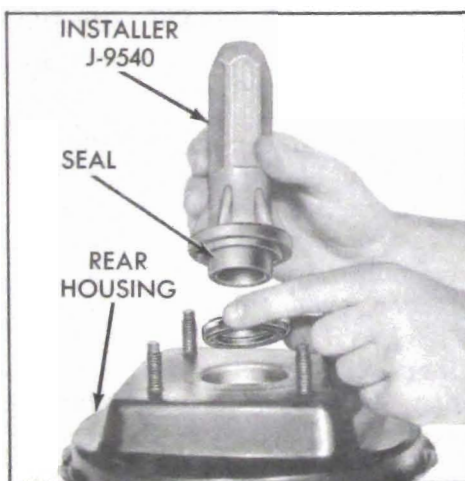


Figure 9-45—Installation of Rear Bearing Seal

5. Install master cylinder on front housing and firmly clamp assembly by master cylinder in a vise.

6. Install power piston return spring and then install rear housing assembly by using pry bars to rotate rear cover clockwise until scribe lines align.

NOTE: When using pry bars, make certain that nuts are installed on rear housing studs in

7. Remove master cylinder from housing.

8. Apply power brake lubricant sparingly to hydraulic push rod keeping lubricant away from adjusting screw end of rod. Apply lubricant liberally to piston end of push rod and to entire surface of reaction disc and plate disc on end of push rod. Guide reaction disc and push rod into center bore of diaphragm plate. Assemble plate and seal over end of push rod (plate side first). Press seal into front housing until bottomed in recess of housing.

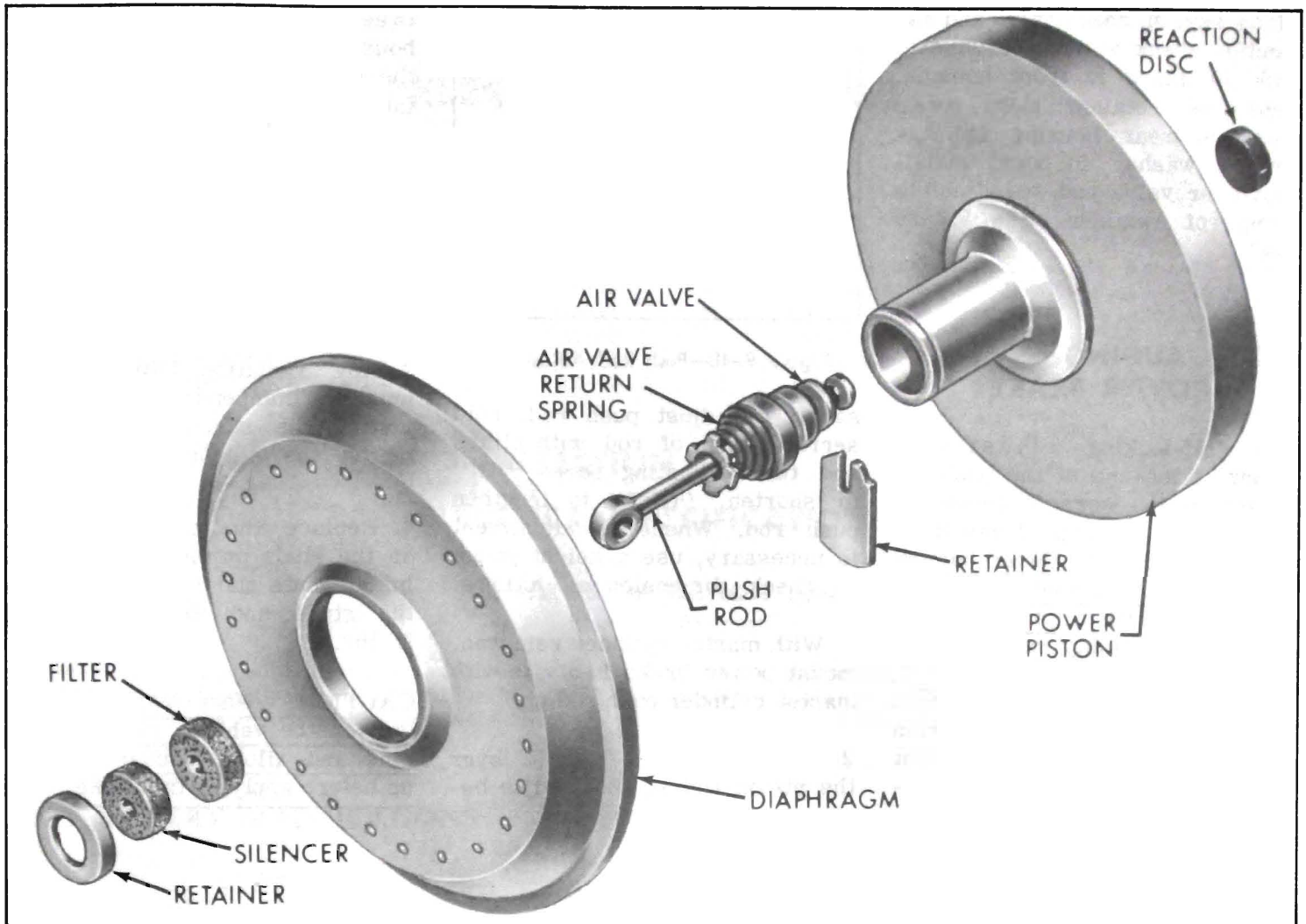


Figure 9-46—Assembly of Valve and Rod, Lock Key, Diaphragm, Filter and Retainer

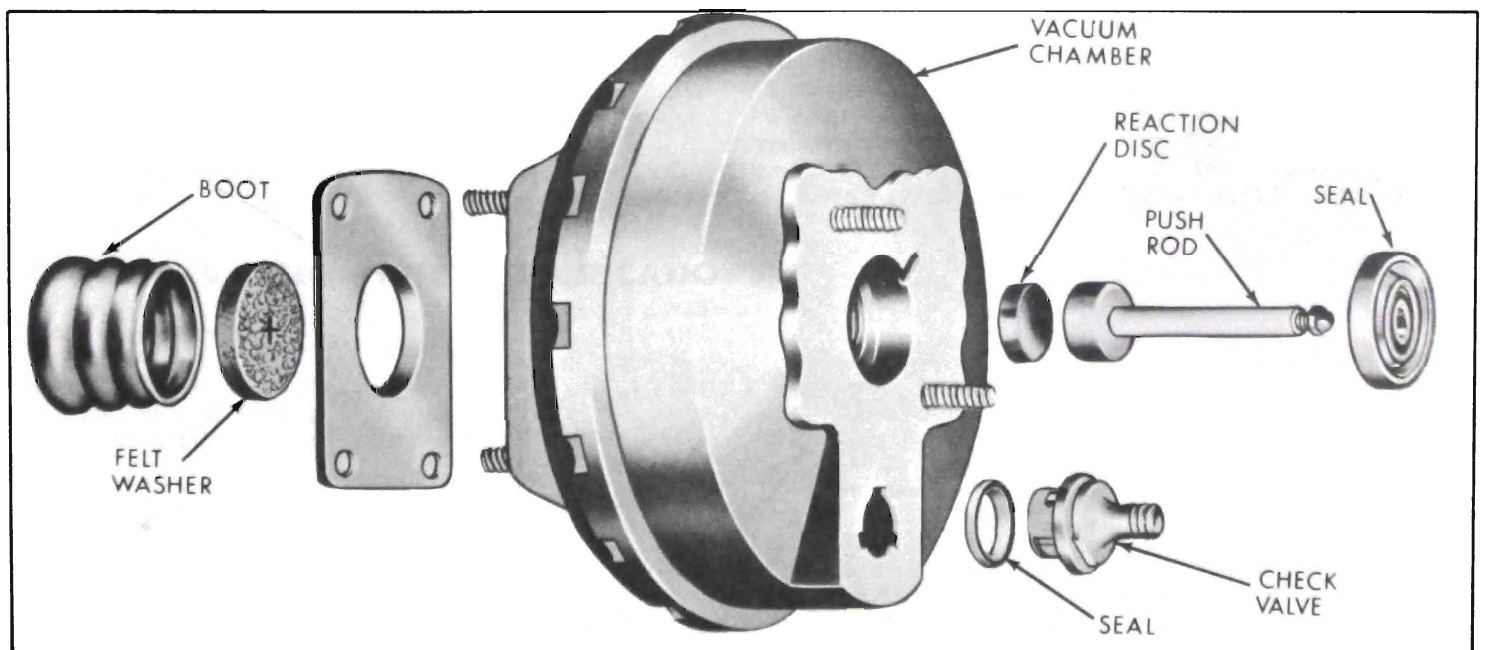


Figure 9-47—Assembly of Reaction Disc, Push Rod and Seal, Check Valve, Retainer Plate, Washer and Boot



Place seal on check valve and assemble check valve clockwise to lock in place in front housing. Assemble retainer plate over studs in rear housing and assemble washer in boot. Install boot over valve rod and attach to flange of retainer. See Figure 9-47.

## 9-28 GAUGING POWER BRAKE

The self-locking adjustment screw at the end of the push rod is set to the correct dimension at the time of original assembly of the power unit. Under normal service use no further adjustment should be needed, providing the push rod assembly remains with the original power brake unit. If, however, a new push rod is used or a push rod is transferred from another power brake, adjustment of the push rod may be neces-

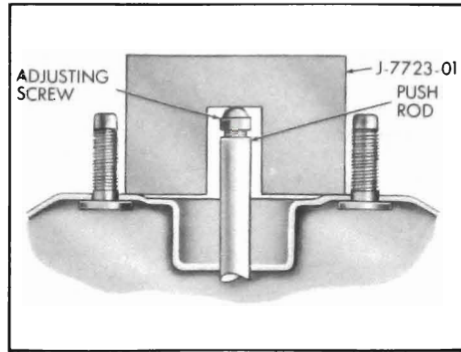


Figure 9-48—Push Rod Adjustment

sary. To adjust push rod, hold serrated end of rod with pliers and turn adjusting screw "IN" to shorten, "OUT" to lengthen push rod. Whenever adjustment is necessary, use a height gauge to check dimension as follows:

1. With master cylinder removed, mount power brake in a vise with master cylinder push rod up.
2. Place Gauge J-7723-01 over the piston rod so that it fits be-

tween the two studs on the front housing. It should be parallel to the studs and resting on the surface of the housing. The cutout portion of the gauge should never be lower than the end of the piston rod, and the gap between the cutout in the gauge and the end of the piston rod should never be more than .010 inch. See Figure 9-48.

3. Any variation beyond limits must be compensated for by adjusting the 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 15-20 ft. lbs.

**CAUTION:** When replacing the unit on the vehicle, start the engine and allow vacuum to build up before applying the brake.