

SECTION 9-D POWER BRAKES

CONTENTS OF SECTION 9-D

Paragraph	Subject	Page	Paragraph	Subject	Page
9-14	Description of Power Brake System . .	9-23	9-16	Disassembly, Inspection, As-	
9-15	Removal, Installation, Adjusting, Testing of Power Brake Unit . . .	9-29		sembly of Power Brake Unit . . .	9-30

9-14 DESCRIPTION OF POWER BRAKE SYSTEM

a. General Description

The power brake system combines a hydraulic master cylinder with a vacuum suspended power cylinder which utilizes intake-manifold vacuum and atmospheric pressure to provide power-assisted application of brakes. The combined unit takes the place of a master cylinder in a conventional brake system. From the master cylinder unit outward to the wheel units, the power brake system is the same as a conventional brake system.

The power brake requires a mechanical connection to a brake pedal which is suspended from a bracket mounted between the dash panel and the cowl. The push rod from the power unit connects to the brake pedal pin by a special washer and retainer. The pedal pivots on nylon bushings which are lubricated at assembly and do not require periodic lubrication. Because there is no pedal stop, the pedal position when released is determined by a stop built into the power cylinder. There is no linkage adjustment, and therefore no pedal height adjustment. See Figures 9-15 and 9-16.

The power brake unit provides lighter pedal pressures obtained in combination with reduced pedal travel which makes it possible to bring the brake pedal down to the

approximate height of the accelerator pedal when at closed throttle position. Therefore, after closing the throttle, the driver can shift his toe from one pedal to the other without lifting his heel from the floor.

In addition to the master cylinder and brake pedal connections, the power unit requires a vacuum connection to the engine intake-manifold (through a vacuum check valve). See Figures 9-15 and 9-16. The check valve permits several power applications of the brakes after the engine has stopped or after vacuum supply has been interrupted some other way. After vacuum reserve has become exhausted, brakes can be applied in the conventional manner, but additional pedal pressure is required.

b. Construction of Power Brake Unit

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

The power cylinder is vacuum suspended, meaning that vacuum is present in the chambers on both sides of the power piston when the brake is in the unapplied position. As shown in Figure 9-17, a front and rear housing interlock to form a large chamber in which the power piston and related parts operate. The vacuum chamber at the front of the power piston is partitioned off from the vacuum

chamber at the rear by a rubber diaphragm. The inner edge of the diaphragm is held between the two parts of the power piston assembly; the outer edge is clamped between the front and rear housing. When in unapplied position, passages in the power piston allow vacuum to enter the rear chamber from the front. During brake application, vacuum is shut off to the rear chamber, and atmospheric pressure enters through an air filter element. This element is assembled around the pedal push rod and fills the cavity inside the hub of the power piston.

The power piston assembly houses the control valve and reaction mechanism, and the power piston return spring. The control valve is composed of an air valve and floating control valve assembly. The reaction mechanism consists of a hydraulic piston reaction plate and three reaction levers. The push rod, which operates the air valve, projects out of the rear of the power piston through a boot. A vacuum check valve assembly is mounted in the front housing for connection to a vacuum source. See Figure 9-20.

The master cylinder push rod is a steel plunger which extends from the heart of the power cylinder section into the master cylinder section. The master cylinder contains a fluid reservoir which supplies fluid to fill the space between the primary cup and the secondary seals through a

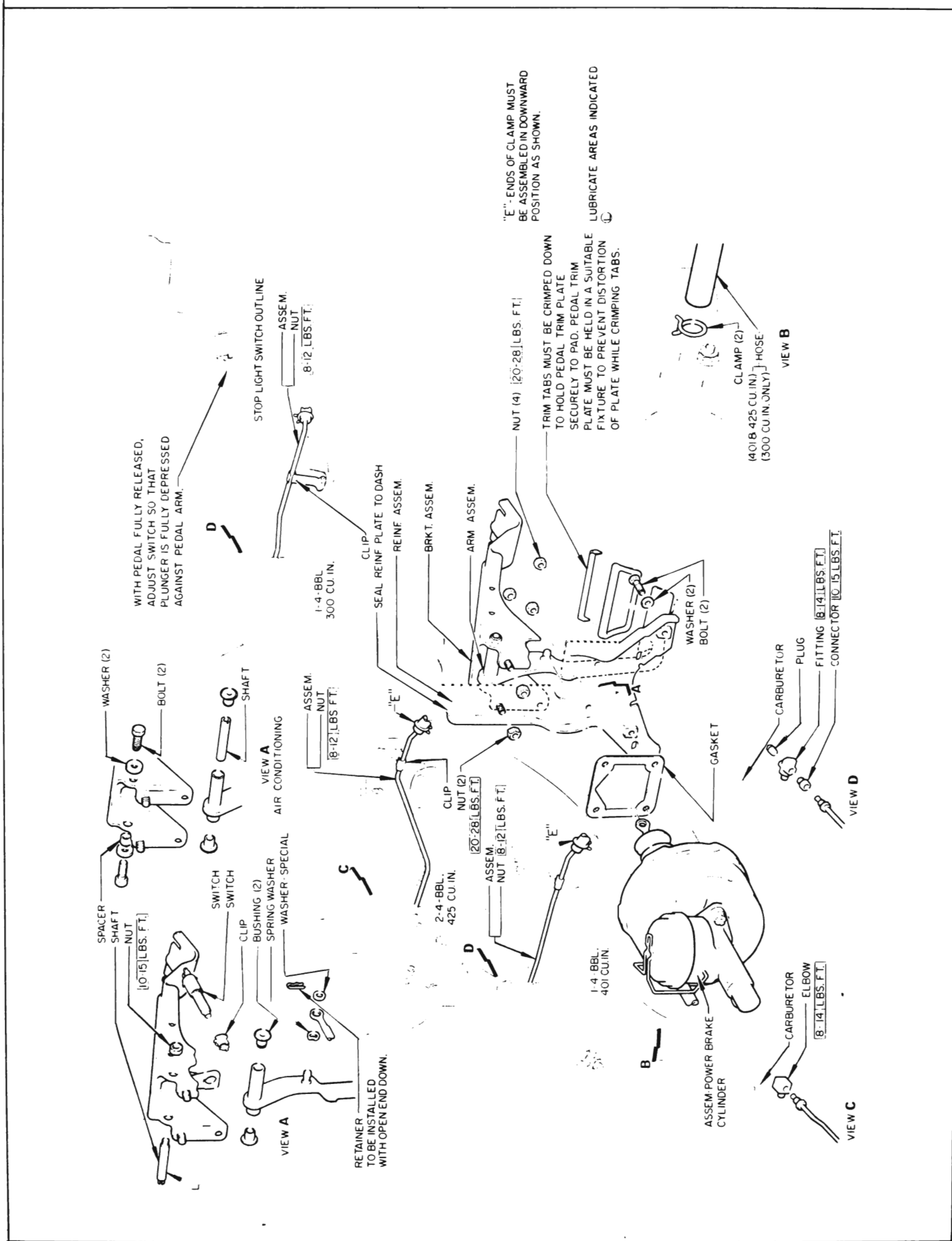


Figure 9-15—Power Brake Installation (4400-4600 & 4800 Series)

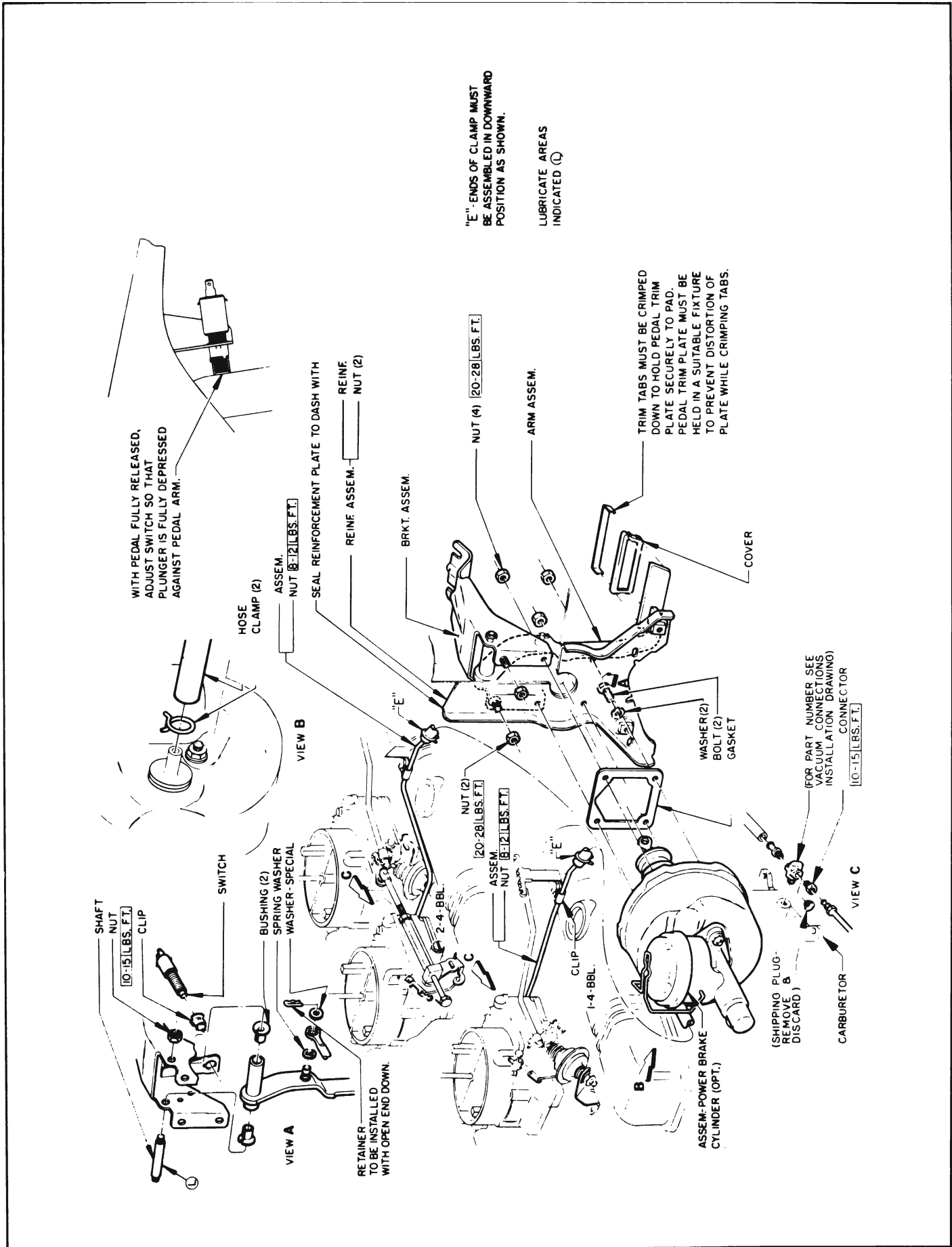


Figure 9-16—Power Brake Installation (4700 Series)

hole in the casting. When the brake pedal is released quickly, the master cylinder piston returns immediately (to the released position). Since fluid from the lines cannot return as quickly as the piston, compensation is provided by a flow of fluid through holes in the piston, past the lip of the primary cup. As fluid from the lines returns, the excess fluid in the master cylinder bore flows into the reservoir through a small compensation port.

Connection is made to the wheel cylinders through brake pipes and a conventional check valve. This check valve and a return spring

maintain a static residual pressure in the hydraulic brake system.

c. Operation of Power Brake Unit

Description of power brake cylinder operation will cover (1) Released Position, (2) Applying, (3) Holding, (4) Releasing, (5) Manual Applying.

(1) Released Position

A line from the engine intake-manifold is connected to the vacuum check valve in the front housing of the power brake. This

check valve is to prevent loss of vacuum when manifold vacuum falls below that in the power brake system.

At the released position the air valve is seated on the floating control valve. See Figure 9-17. The air under atmospheric pressure, which enters through the filter element in the tube extension of the power piston, is shut off at the air valve. The floating control valve is held away from the valve seat in the power piston insert. The vacuum, which is present at all times in the space to the left of the power piston, is free to evacuate any existing air

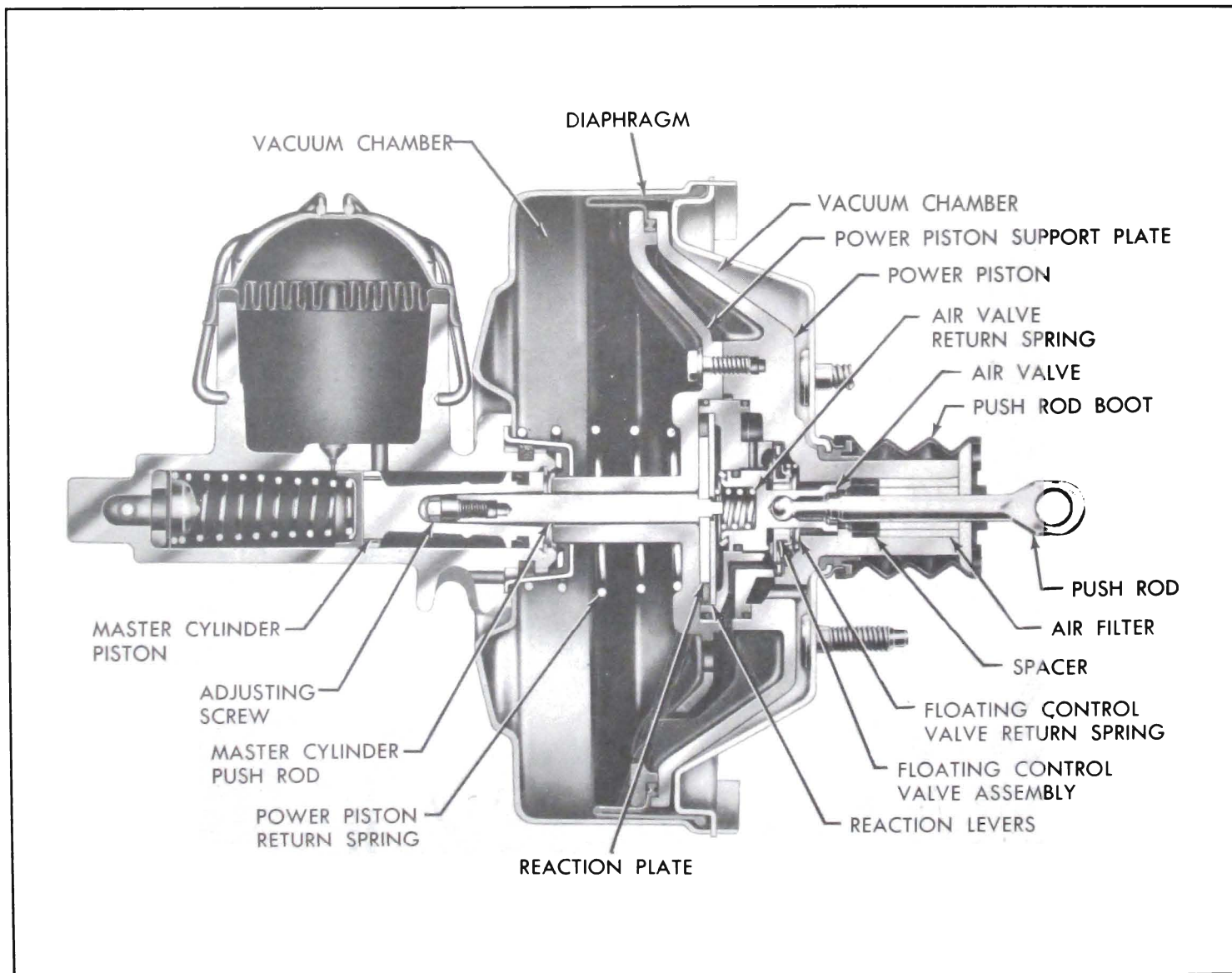


Figure 9-17—Power Brake Unit—Released Position

on the right side of the power piston. This air is drawn through a small passage in the power piston, over the valve seat in the power piston insert, and then through a passage in the power piston insert. From here it travels through a hole in the power piston support plate into the space at the left of the power piston. It is then drawn through the check valve and thence to the vacuum source.

In this position there is vacuum on both sides of the power piston, and the power piston is held against the rear housing by the power piston return spring. At rest the hydraulic reaction plate

is held against the support plate. The reaction levers are held against the hydraulic reaction plate by the air valve spring. The air valve is held against its stop in the tube of the power piston by the air valve spring.

The floating control valve assembly is held against the air valve seat by the floating control valve spring. In this position, the bypass hole in the hydraulic master cylinder is open to the reservoir and fluid can flow freely in either direction between the hydraulic cylinder and the fluid reservoir. A residual pressure is maintained in the brake lines by the check valve and its spring.

(2) Applying Position

As the pedal is depressed, the push rod carries the air valve away from the floating control valve. See Figure 9-18. The floating control valve will follow until it is in contact with the raised seat in the power piston insert. When this occurs, the vacuum is shut off to the right hand side of the power piston, and air under atmospheric pressure rushes through the air filter and travels past the seat of the air valve and through a passage way into the housing on the right of the power piston.

Since there is still vacuum on the left side of the power piston, the

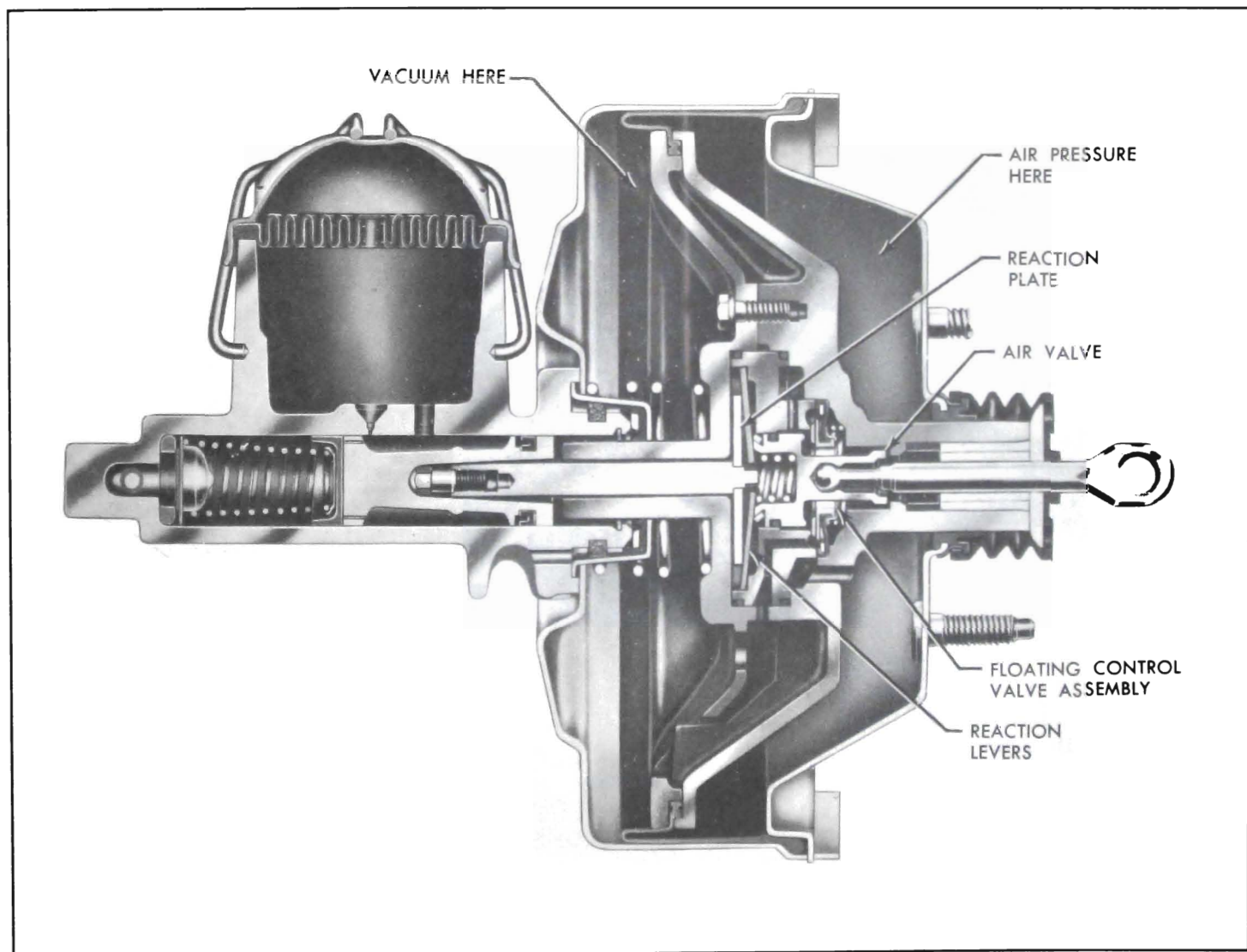


Figure 9-18—Power Brake Unit—Applying

force of the air at atmospheric pressure on the right of the piston will force the power piston to travel to the left.

As the power piston travels to the left, the master cylinder push rod carries the master cylinder piston into the bore of the master cylinder. As the master cylinder piston cup passes the by-pass hole, hydraulic pressure starts to build up in the hydraulic system. As the pressure builds up on the end of the master cylinder piston, the hydraulic reaction plate is moved off its seat on the support plate and presses against the reaction levers.

The levers, in turn, swing about their pivots and bear against the end of the air valve-push rod assembly.

In this manner, approximately 30% of the load on the hydraulic master cylinder piston is transferred back through the reaction system to the brake pedal. This gives the operator a feel, which is proportional to the degree of brake application.

(3) Holding Position

When the desired pedal pressure is reached, the power piston

moved to the left until the floating control valve, which is still seated on the power piston insert, again seats on the air valve. The power brake will now remain stationary, until either pressure is applied or released at the brake pedal. See Figure 9-19.

(4) Releasing Position

As the pressure at the pedal is released, the air valve spring forces the air valve back to its stops on the power piston. As it returns, the air valve pushes the floating control valve off its seat on the power piston insert.

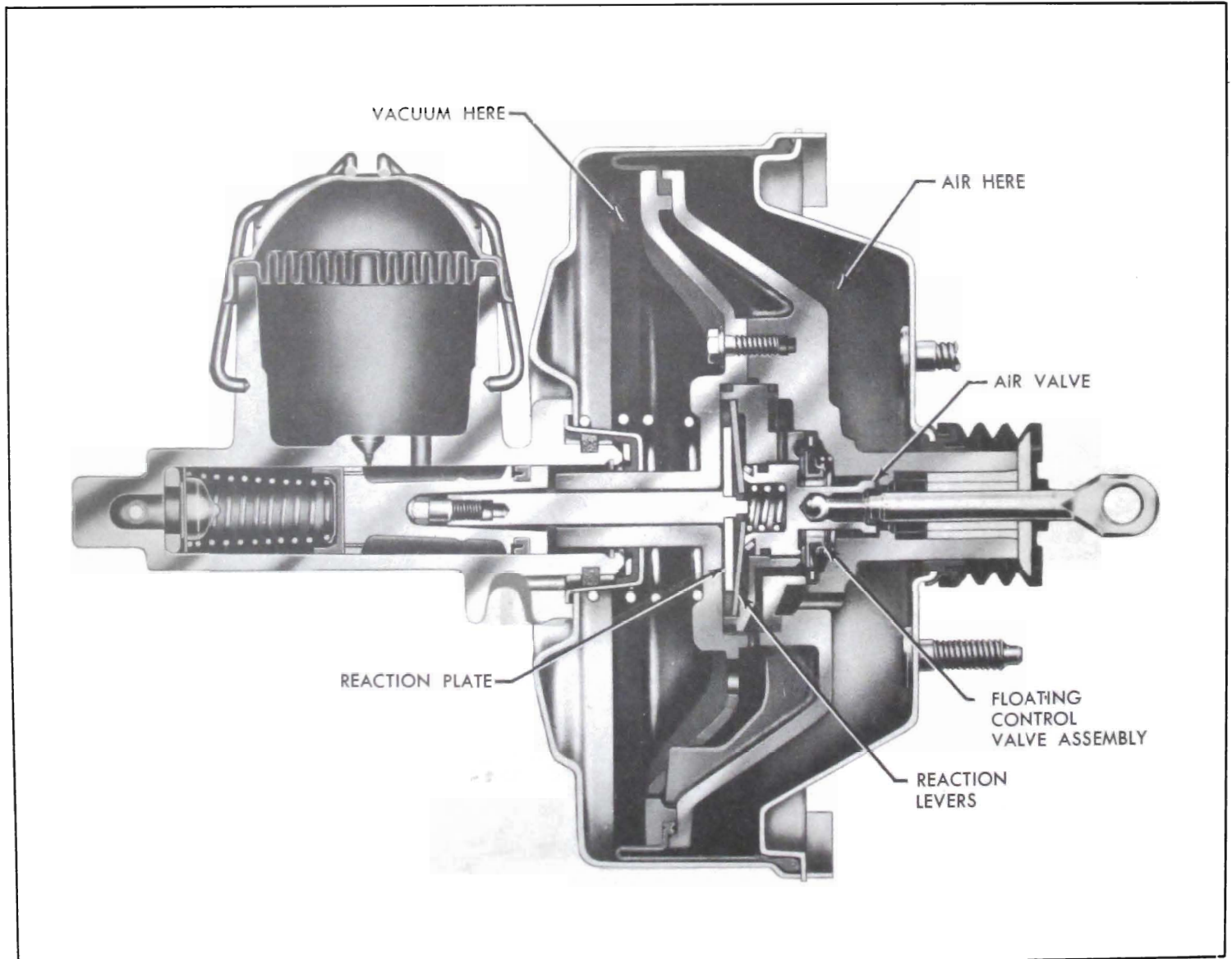


Figure 9-19—Power Brake Unit—Holding

The air valve seating on the floating control valve has shut off the outside air source. When it lifts the floating control valve from its seat on the power piston insert, it opens the space to the right of the power piston to the vacuum source.

Since both sides of the power piston are now under vacuum, the power piston return spring will return the piston to its released position against the rear housing. As the power piston is returned, the hydraulic master cylinder piston moves back, and the fluid from the wheel cylinders flows back into the master cylinder through the check valves.

If the brake pedal is released quickly, the master cylinder piston immediately returns to the released position. If the fluid in the lines cannot return as quickly as the piston, compensation is provided for by the flow of fluid from the space between the primary cup and the secondary seal through the holes in the piston. The excess fluid in the system can flow back to the fluid reservoir through the small by-pass holes in the master cylinder bore after the brake is released.

(5) Manual Application

In case of vacuum source interruption, as the pedal is pushed down the end of the air valve contacts the reaction levers and forces them, in turn, against the hydraulic reaction plate. Since the hydraulic reaction plate is fastened to the master cylinder push rod, it forces the push rod against the master cylinder piston, which builds up the hydraulic line pressure.

The pedal pressure required for a manual application, such as described, is considerably greater than with vacuum assist.

9-15 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 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 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 brakes 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.

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. Since the brake system beyond the master cylinder is the same in either a standard or a power brake car,

one brake trouble-shooting procedure is provided for all cars. See paragraph 9-5.

9-16 DISASSEMBLY, INSPECTION, ASSEMBLY OF POWER BRAKE UNIT

NOTE: Refer to Figures 9-17 through 9-21 for identification of parts not shown in figures next to overhaul steps.

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. Place a long wooden hammer handle in position to bear against two studs. Rotate rear housing counterclockwise to separate rear housing from front housing. Do not put pressure against plastic power piston tube.

3. Lift rear housing assembly and power piston assembly from unit.

4. Remove power piston assembly from rear housing and lay power piston aside in a clean place. Lay rear housing assembly aside.

5. Remove power piston return spring from front housing.

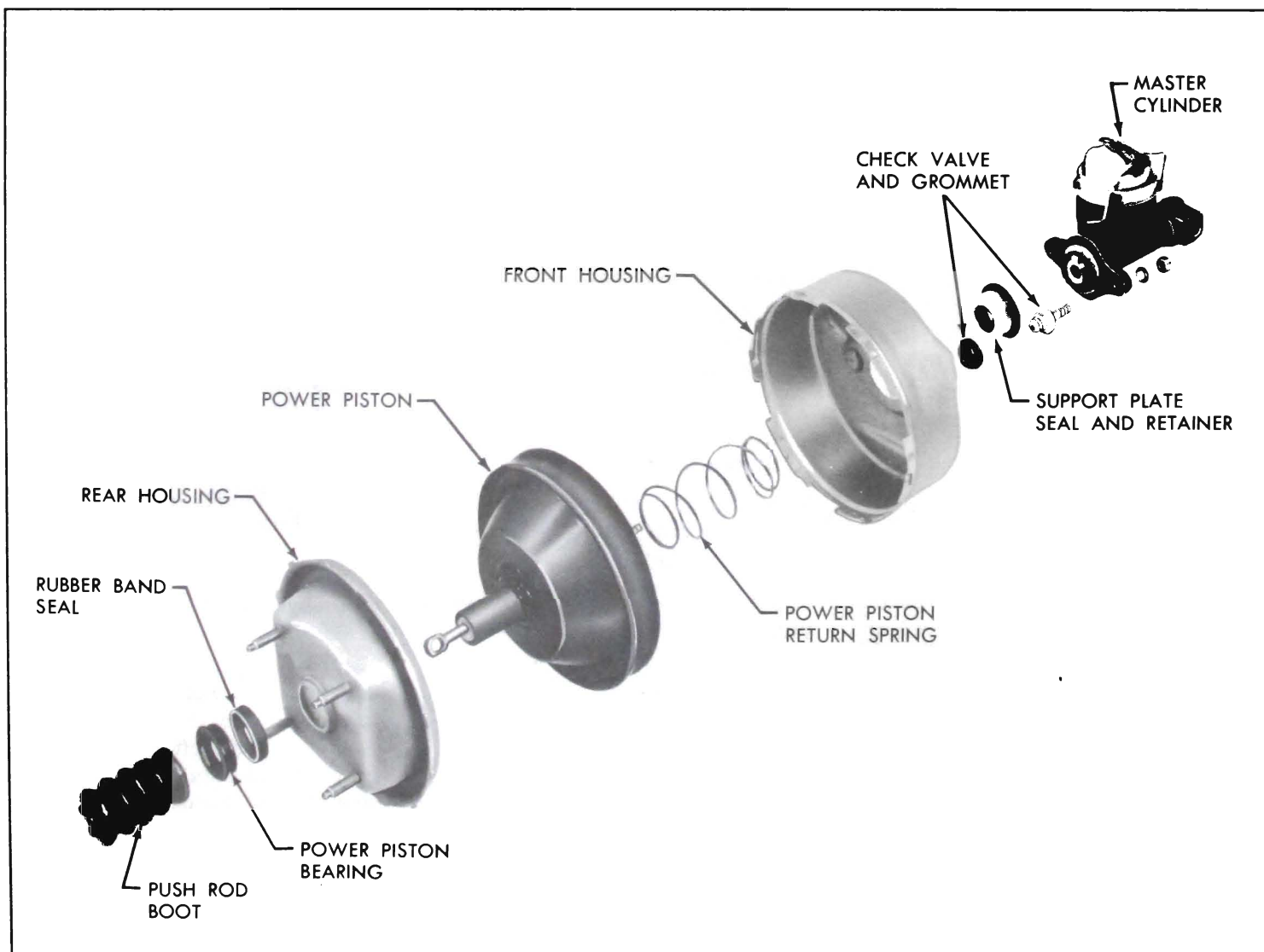


Figure 9-20—Power Brake Unit - Exploded View

NOTE: If front housing rubber parts or master cylinder need replacement or overhaul, it will be necessary to complete disassembly as follows in Steps 6, 7, and 8. Otherwise, there is no need to remove front housing from master cylinder.

6. To disassemble front housing from master cylinder, reposition master cylinder in vise to aid removal. Remove two retaining nuts and washers, and remove master cylinder from studs.

7. Remove support plate seal retainer from center of front housing. Remove seal from inside retainer. From O.D. of retainer, remove gasket. See Figure 9-21.

8. From housing, remove vacuum check valve and grommet. Lay aside in a clean place all disassembled front housing parts and master cylinder.

9. From center hole in rear housing, remove the boot, rubber band seal and power piston bearing. See Figure 9-20.

10. On the power piston assembly, loosen three special hex head retaining screws. With the master cylinder push rod up, remove the screws and lift the master cylinder push rod and rolling diaphragm support plate assembly from the power piston assembly. See Figure 9-23.

11. Remove the three (3) reaction levers from their seats in the power piston insert. Remove the air valve spring from the counterbore of the air valve. The push rod air valve assembly can be pushed through the power piston from the push rod end. The snubber and "O" ring can now be removed from the grooves in the air valve. See Figure 9-24.

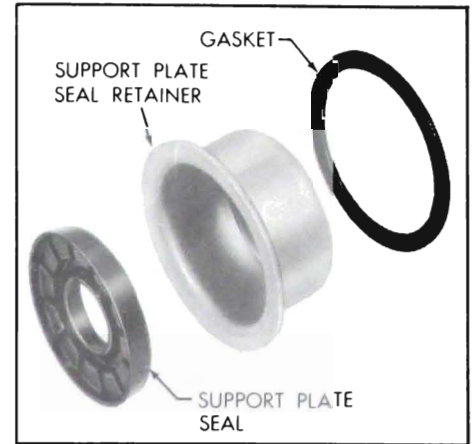


Figure 9-21—Support Plate Seal Assembly

12. Remove the power piston insert from the center of the piston. From the two (2) grooves in the O.D. of the insert, remove the two (2) "O" ring seals. See Figure 9-24.

13. Push the floating control valve assembly from its position in the

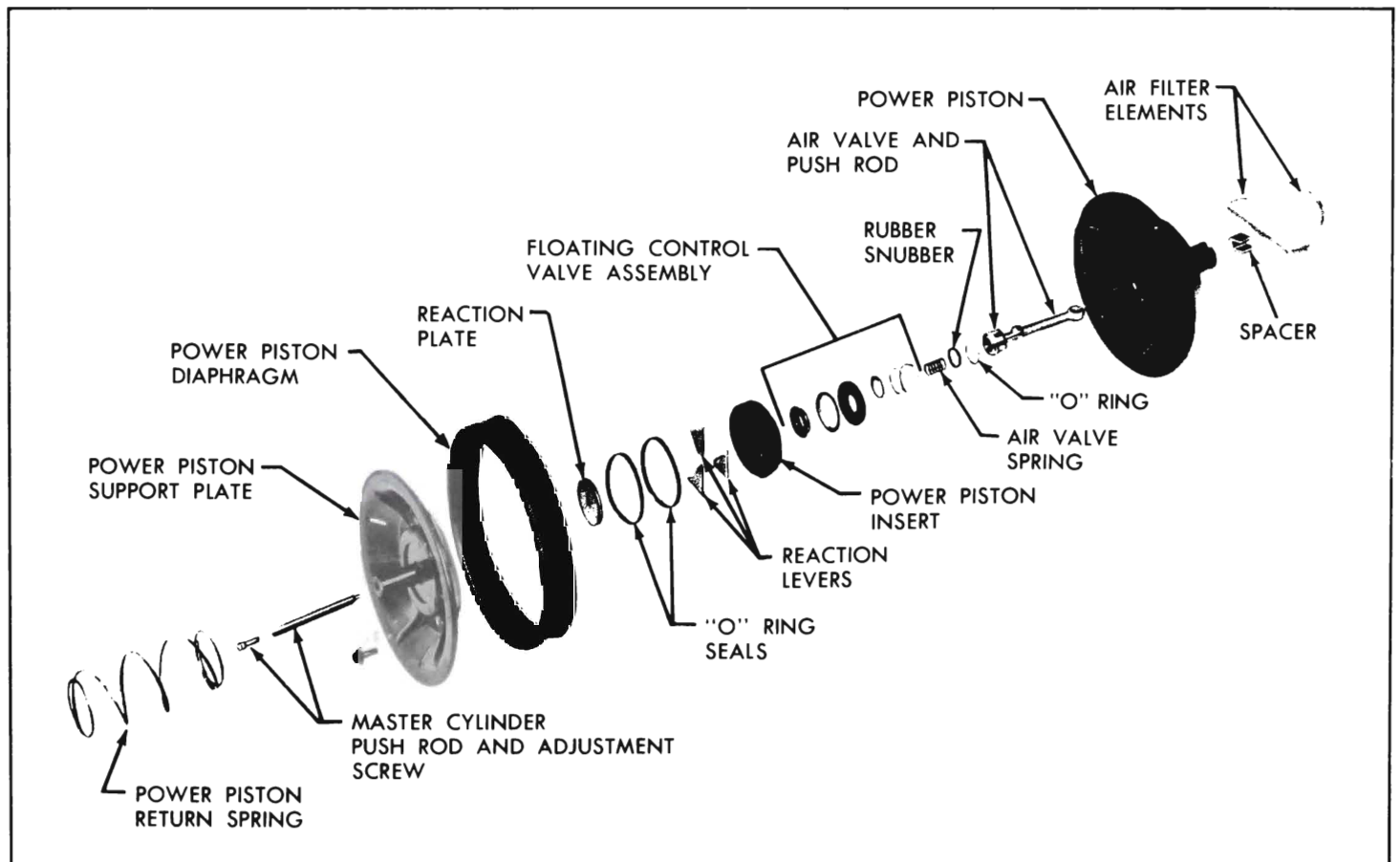


Figure 9-22—Power Piston Assembly - Exploded View

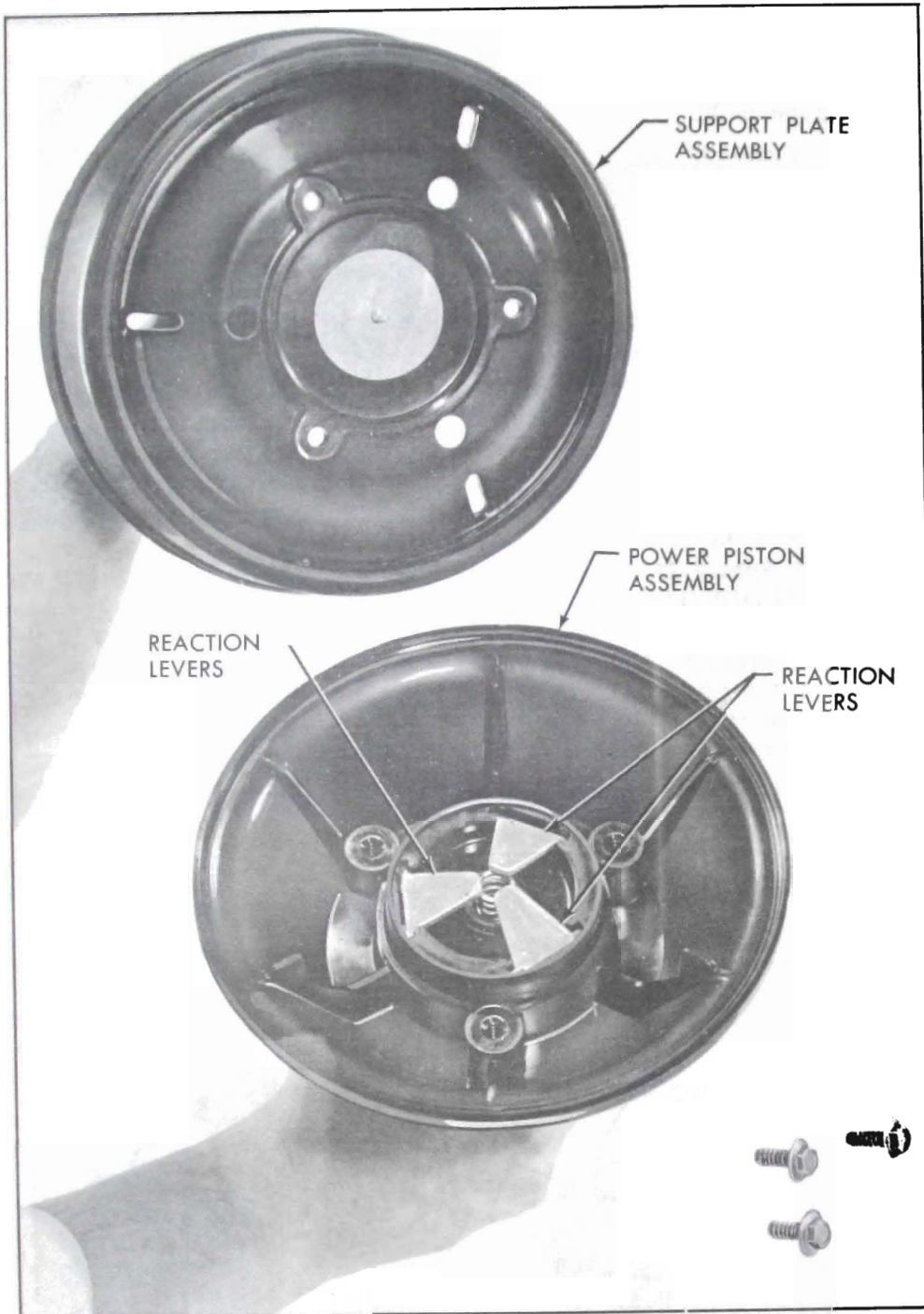


Figure 9-23—Removing Support Plate Assembly from Power Piston Assembly

center of power piston. The removal of the floating control valve exposes the floating control valve spring for removal. See Figure 9-25.

14. From the master cylinder push rod and the diaphragm support plate assembly, remove the power piston diaphragm and inspect for cuts, pin holes, distortion or cracks.

15. The master cylinder push rod can be pushed from the center of the support plate. If necessary, the master cylinder reaction plate can be removed from the push rod by pressing the plate off of the small, knurled end of the rod.

The adjusting screw in the end of the master cylinder push rod need not be removed,

16. From groove in O.D. of master cylinder open end, remove air filter.

17. From master cylinder bore, remove snap ring, master cylinder piston, primary cup, spring and retainer assembly, check valve assembly and valve seat washer. See Figure 9-26.

18. Remove master cylinder reservoir cap and rubber diaphragm.

b. Cleaning, Inspection, Replacement of Parts

As an aid in determining the cause of improper power brake operation, wipe fluid from all rubber parts, then carefully examine these parts for nicks, cuts or other damage. After examination discard all these parts.

Thoroughly clean the remaining parts in diacetone alcohol or clean brake fluid. Blow out all passages, orifices, or holes.

CAUTION: Do not use anti-freeze alcohol, gasoline, kerosene, or any other cleaning fluid that might contain even a trace of mineral oil, as this could cause serious damage to all rubber parts in the brake system.

Carefully examine the cleaned parts for nicks, burrs, stripped threads, damage or excessive wear. Replace damaged or excessively worn parts or housings. If inside of vacuum power cylinder is rusted or corroded, polish with steel wool or fine emery cloth. Replace if scored.

Make certain that the small compensating port in the master cylinder reservoir is clear.

If the outer surface of the air valve or the master cylinder piston show evidence of abrasion, polish out light scores with crocus cloth or very fine polishing

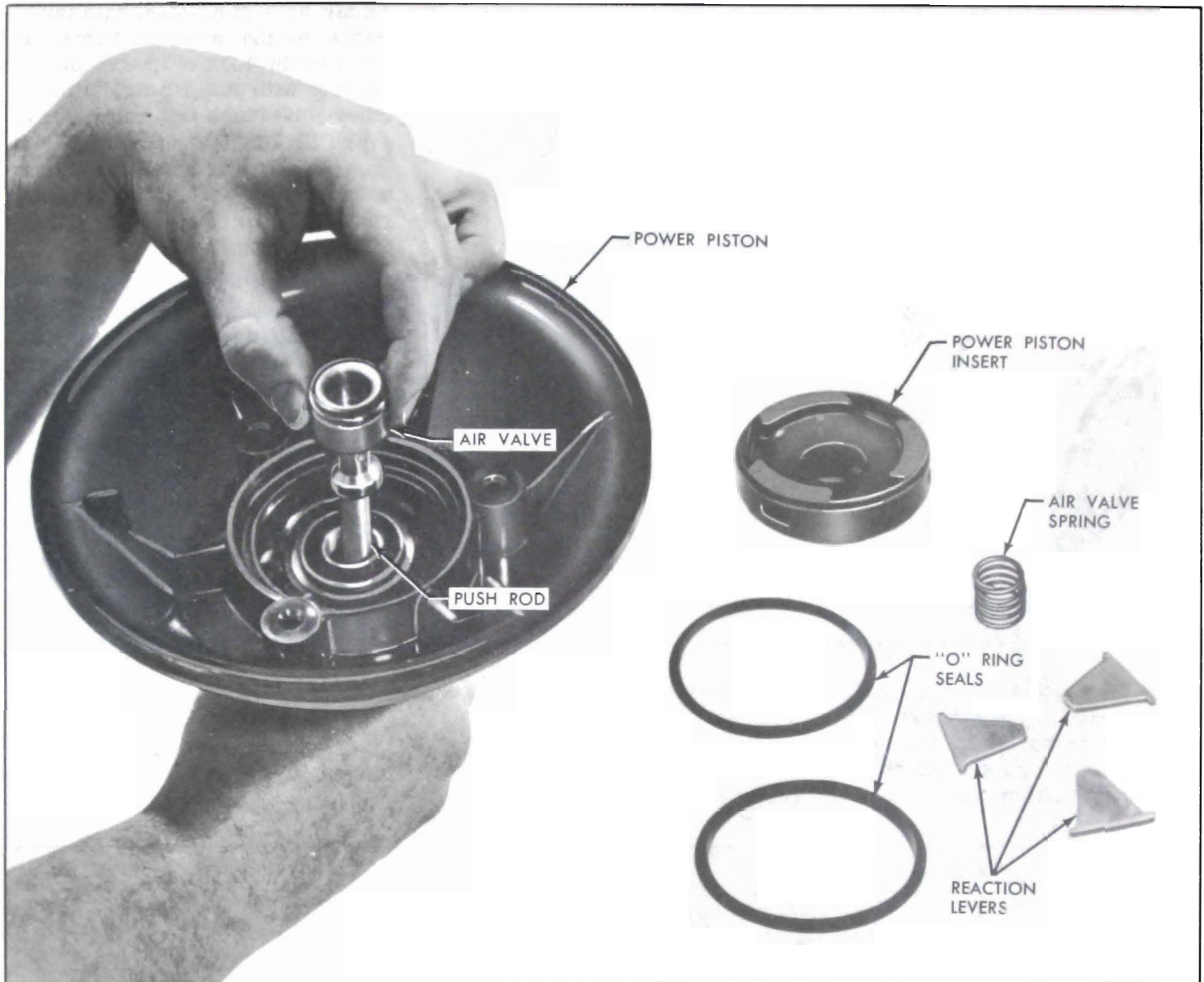


Figure 9-24—Removing Power Piston Parts

paper, then wash and dry thoroughly. Inspect master cylinder bore for corrosion or pits.

If any parts indicate that heavy corrosion or abrasive action has resulted from contamination of the brake fluid, replace damaged parts and be sure to thoroughly flush the reservoir and wheel cylinder lines.

The Power Brake Cylinder Overhaul Kit (Group 4.898) contains all necessary replacement parts for the power brake cylinder. When reassembling the brake cylinder

use all the new parts in the kit regardless of whether the old parts appear fit for use. Discard all old rubber parts. In addition, replace any other parts which inspection indicates to be unfit for use.

Lubricate all hydraulic master cylinder parts with clean brake fluid. Lubricate vacuum power cylinder parts with silicone grease as specified. The recommended silicone grease is supplied in the power brake cylinder overhaul kit. Do not lubricate parts until just before installation.

c. Assembly of Power Brake Unit

1. Install master cylinder filler cap and diaphragm.
2. Place assembly in vise with master cylinder bore up and clamp firmly on sides of master cylinder reservoir.
3. Wipe master cylinder bore with a coat of clean brake fluid. Into bore, place valve seat washer. See Figure 9-26. Press check valve in open end of spring and retainer; place assembly in

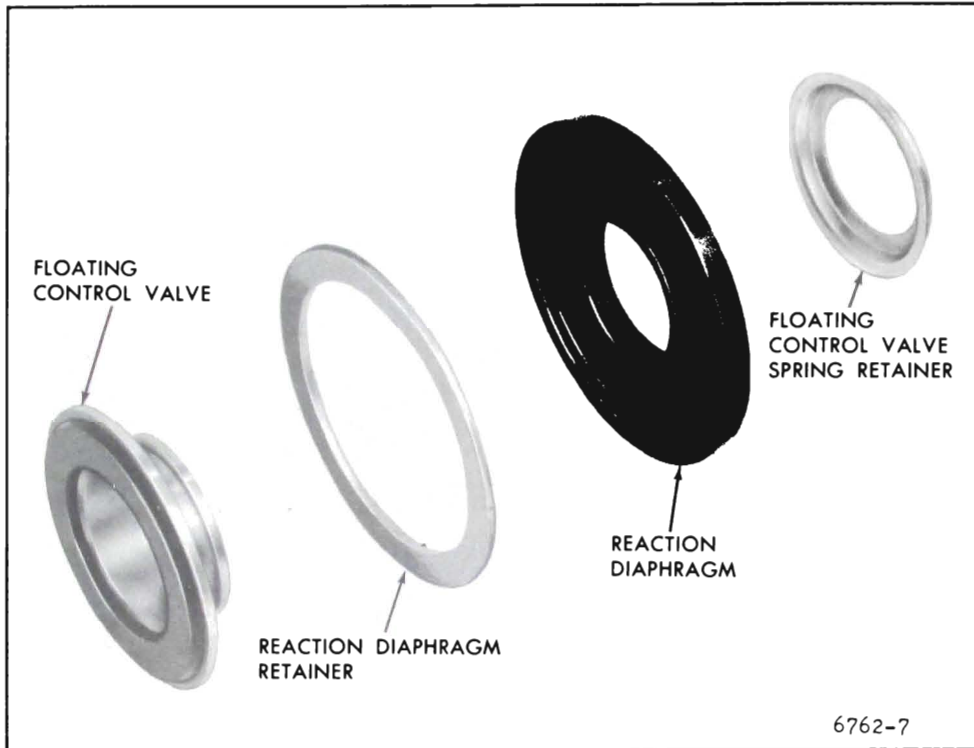


Figure 9-25—Floating Control Valve Assembly

bore with check valve down. Dip primary cup in clean brake fluid and place in bore with lip down. Insert master cylinder piston and place snap ring in place. Place a

new filter in groove in open end of master cylinder.

4. To reassemble rear housing, replace power piston bearing in

center hole of housing, with large flange to the outside. Lubricate grooves in I.D. of power piston bearing with power brake silicone lubricant. Place flat rubber band over O.D. of seal so that it covers joint where bearing and rear housing meet. Stretch the push rod boot over the O.D. of power piston bearing.

5. To reassemble front housing, replace vacuum check valve, using new grommet if old one is cracked or damaged.

6. Place new support plate seal in support plate seal retainer so that flat surface of cup lies against bottom of retainer. Place new gasket on O.D. of support plate seal retainer, and insert it into front housing so that gasket is between flange on retainer and surface of front housing. See Figure 9-21.

7. To reassemble support plate assembly, press the hydraulic reaction plate over the small,

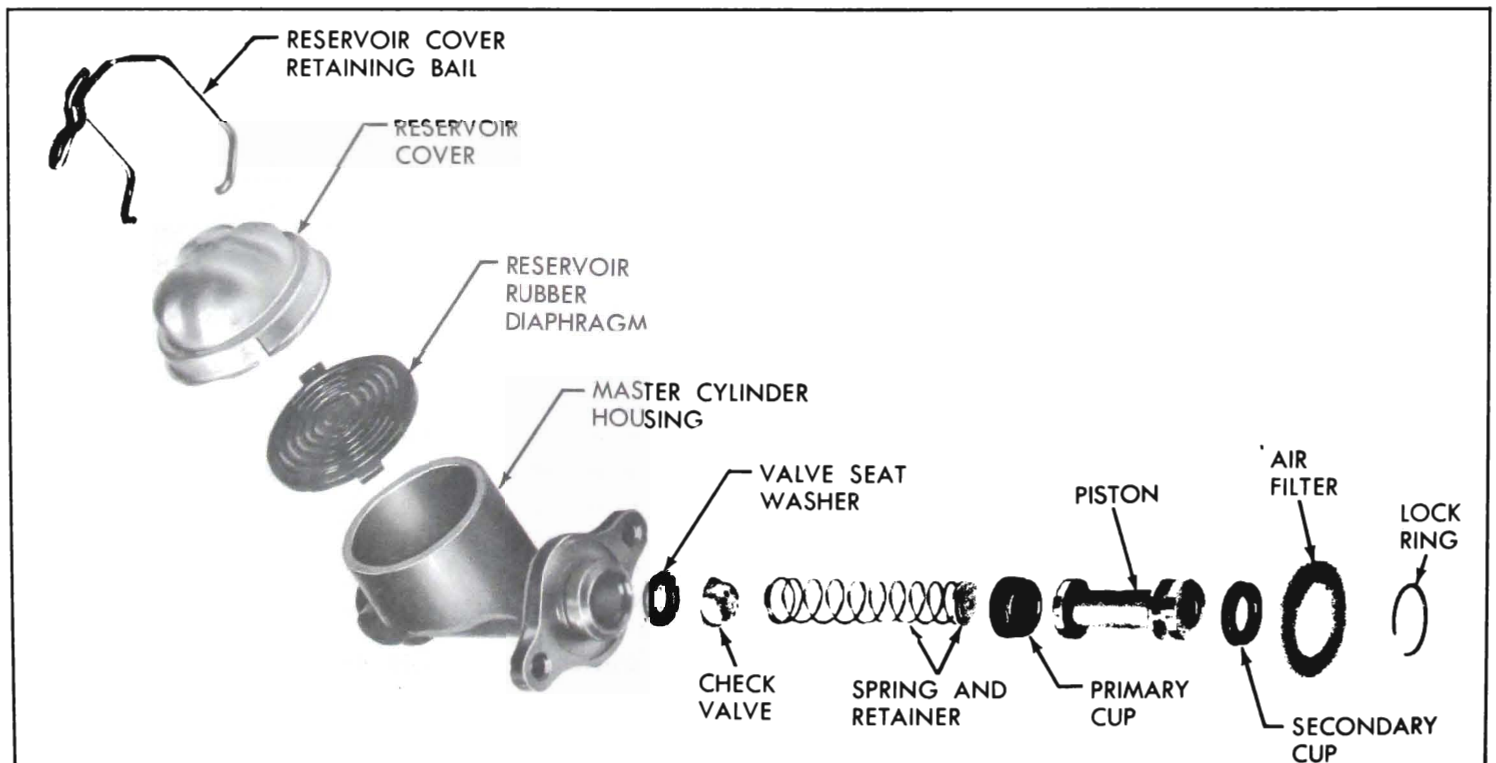


Figure 9-26—Master Cylinder - Exploded View

knurled end of the master cylinder push rod so that it lies against the shoulder of the push rod. The master cylinder push rod is now inserted through the support plate so that the hydraulic reaction plate lies flat against rear side of support plate. See Figure 9-27.

8. Reassemble power piston assembly by positioning the power piston in a vise with the long tube down. (DO NOT CLAMP). Place the floating valve spring in the center of the power piston.

9. Assemble the floating valve diaphragm over the flanged hub of the floating control valve. The flat surface of the diaphragm will be on the opposite side from the rubber face on the floating control valve. Insert the control valve diaphragm plate under the lip of the valve diaphragm. Place the spring retainer down over the hub of the floating control valve. See Figure 9-25.

10. Place a thin film of power brake silicone lubricant on the O.D. of the valve diaphragm. Press the floating control valve and diaphragm assembly to seat in the power piston, making sure that the floating valve spring seats on the spring retainer.

NOTE: Check that the rubber diaphragm is not distorted, as the assembly is pressed into the power piston.

11. Assemble the two (2) power piston insert "O" ring seals in the two (2) grooves in the O.D. of the power piston insert. See Figure 9-22. Press the insert to seat in the power piston.

12. Install the air valve "O" ring into the groove in the O.D. of the air valve. Place the air valve bumper over the flanged end of the air valve. See Figure 9-27. Lubricate the "O" ring with power brake silicone lubricant and press the air valve (push rod first) into the power piston insert.

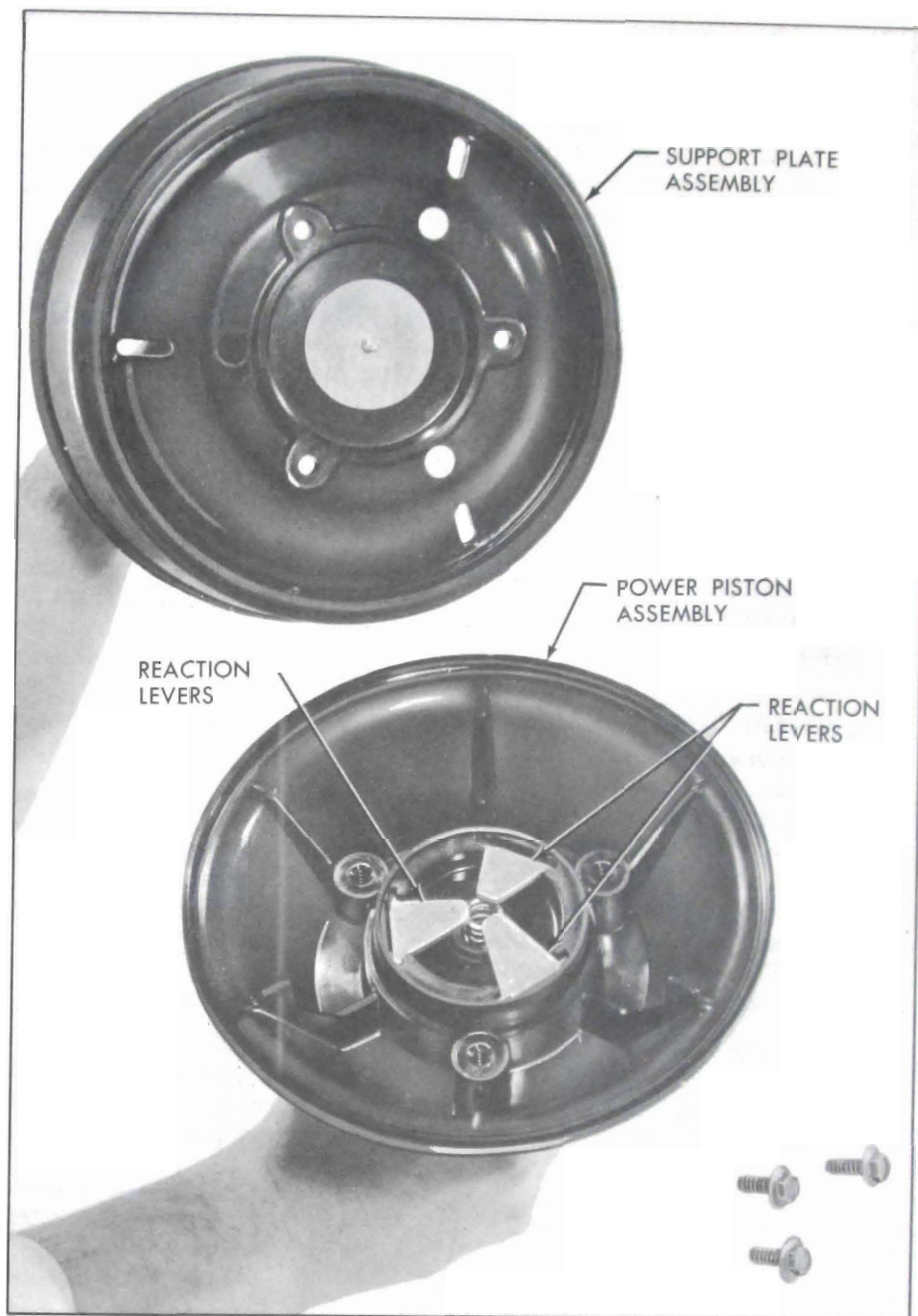


Figure 9-27—Installing Parts into Power Piston

13. Place the air valve spring into the counterbored end of the air valve. Position the ears of the reaction levers in the molded locations in the power piston insert and rest the small ends of the levers on the air valve spring. See Figure 9-27.

14. Place the unfolded diaphragm over the support plate so that the

raised bead on the small I.D. of the diaphragm faces away from the support plate. Position the power piston support plate assembly on the power piston, making sure that the beaded edge of the diaphragm is located between the flange on the support plate assembly and the flange on the edge of the power piston assembly.

NOTE: When locating the power piston support plate on the power piston, be sure that the reaction levers maintain their positions in the seats in the power piston insert, as the support plate contacts the power piston. (Torque to 80-100 inch pounds).

15. Wrap the first piece of filter material around the push rod and press down into the power piston tube.

16. To complete assembly of overall power brake unit, clamp the front housing and master cylinder assembly in a vise, with open end of the master cylinder bore accessible. Place the power piston return spring to seat over the support plate seal retainer.

17. Lubricate lightly with power brake silicone lubricant, both the tube extension on the master cylinder end of the power piston, as well as the tube extension on the push rod end. Also, lubricate lightly with talcum powder the beaded edge of the rolling diaphragm. This is done to ease the assembly of the rear housing.

18. Insert the power piston, push rod first, into the rear housing. The extension on the end of the power piston will fit through the

power piston bearing and the push rod through the boot. Fold the rolling diaphragm back into position on the rear housing flange.

19. Place the rear housing and power piston assembly into front housing. Line up the scribe mark on the top of the housing so that when the housing is rotated into the locked position, the scribe mark will be in line with the scribe mark on the front housing.

20. Place a long wooden hammer handle in position to bear on the rear housing studs. Press down and check to be sure that the bend on the edge of the rolling diaphragm is correctly positioned between the edges of the front and rear housings. If this is satisfactory, put additional pressure down on the rear housing, and at the same time, rotate the housing clockwise into the locked position.

CAUTION: Do not put pressure on the plastic power piston tube, when locking the housings. Care must be taken not to damage or loosen studs in rear housing.

d. Gauging Power Brake Piston

The following gauging operation is necessary only when a major structural part such as the front

or rear housing, the power piston assembly, the master cylinder piston, or the master cylinder assembly is replaced with a new part. The gauge measures how far the master cylinder push rod projects from the front housing. This dimension must be correct to insure the proper clearance on the master cylinder between the primary cup and the compensating port.

Make check as follows:

1. Remove master cylinder assembly from front housing by removing two nuts and lock washers; then pull master cylinder from front housing. (Do not disturb support plate seal retainer.)

2. Place Gauge J-7723-01 so that it stands perpendicular to front housing next to two studs, and bridges over end of master cylinder push rod. Push rod should be flush with gauge. See Figure 9-28.

3. Adjust screw in end of push rod to match height of gauge.

4. Insert master cylinder on studs and press into housing. Install two lock washers and nuts. Torque nuts to 15-20 ft. lbs.

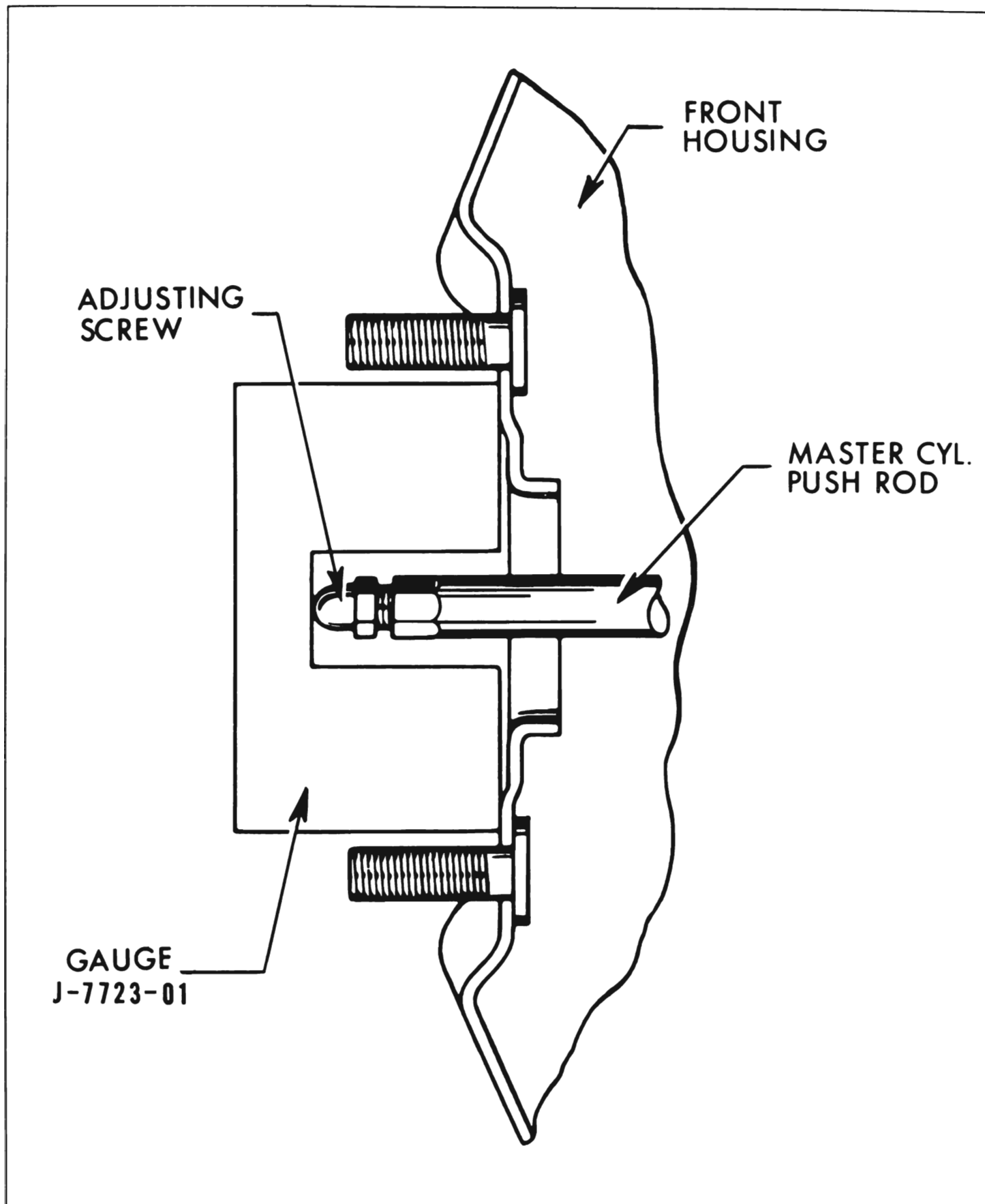


Figure 9-28—Gauging Master Cylinder Push Rod