

SECTION 9-D POWER BRAKES

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9-14 DESCRIPTION OF POWER BRAKE MECHANISM

Wheel brake assemblies used in a power brake system are identical with those used in a regular brake system. The power brake unit provides lighter pedal pressures due to vacuum assist. These lighter pedal pressures are obtained with reduced pedal travel making it possible to have the brake pedal height more nearly the same as the accelerator pedal height.

The power brake pedal is suspended from a shaft which is held firmly by a bracket mounted on the dash panel. The pedal pivots on two nylon bushings. The push rod from the power brake unit is connected directly to a brake pedal pin with a special washer and retainer. The mechanical ratio from the pedal to the hydraulic piston is 2-1/2 to 1.

Pivot points in the brake linkage having nylon bushings must be lubricated during assembly, but 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.

The power brake assembly is a self-contained vacuum unit which utilizes the difference between intake manifold vacuum and atmospheric pressure to reduce brake

pedal effort. The unit has an air suspended power cylinder. It has a direct acting hydraulic master cylinder which is very similar to the standard master cylinder.

The power brake cylinder is connected to the intake manifold through pipes and flexible connections. A large capacity vacuum reserve tank is connected into the vacuum line near the power brake cylinder to insure quick and smooth response of the brake cylinder on all power brake applications. A check valve installed in the vacuum line closes to maintain existing vacuum at the power cylinder and in the reserve tank whenever manifold vacuum falls below that in the brake system.

When the engine is stopped and the check valve is closed, the tank provides sufficient reserve vacuum for four to seven normal power brake applications. When reserve vacuum does not exist, the brakes can be applied manually in the same manner as the regular brakes, except that somewhat more effort is required.

9-15 REMOVAL, INSTALLATION, ADJUSTING, TESTING OF POWER BRAKE UNIT

a. Removal of Power Brake Unit

1. Remove connector from stop light switch.

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 air silencer from power cylinder air intake.

5. Remove two nuts holding power brake unit to dash panel.

6. Disconnect vacuum hoses from cylinder.

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

8. Remove filler cap 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 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 and connect vacuum hoses to vacuum tee. This will hold unit in position for installation.

2. Install four nuts on studs and torque to 30 ft. lbs.

3. Install air intake silencer.

4. Install push rod eye over pedal pin. Install special washer and retainer.

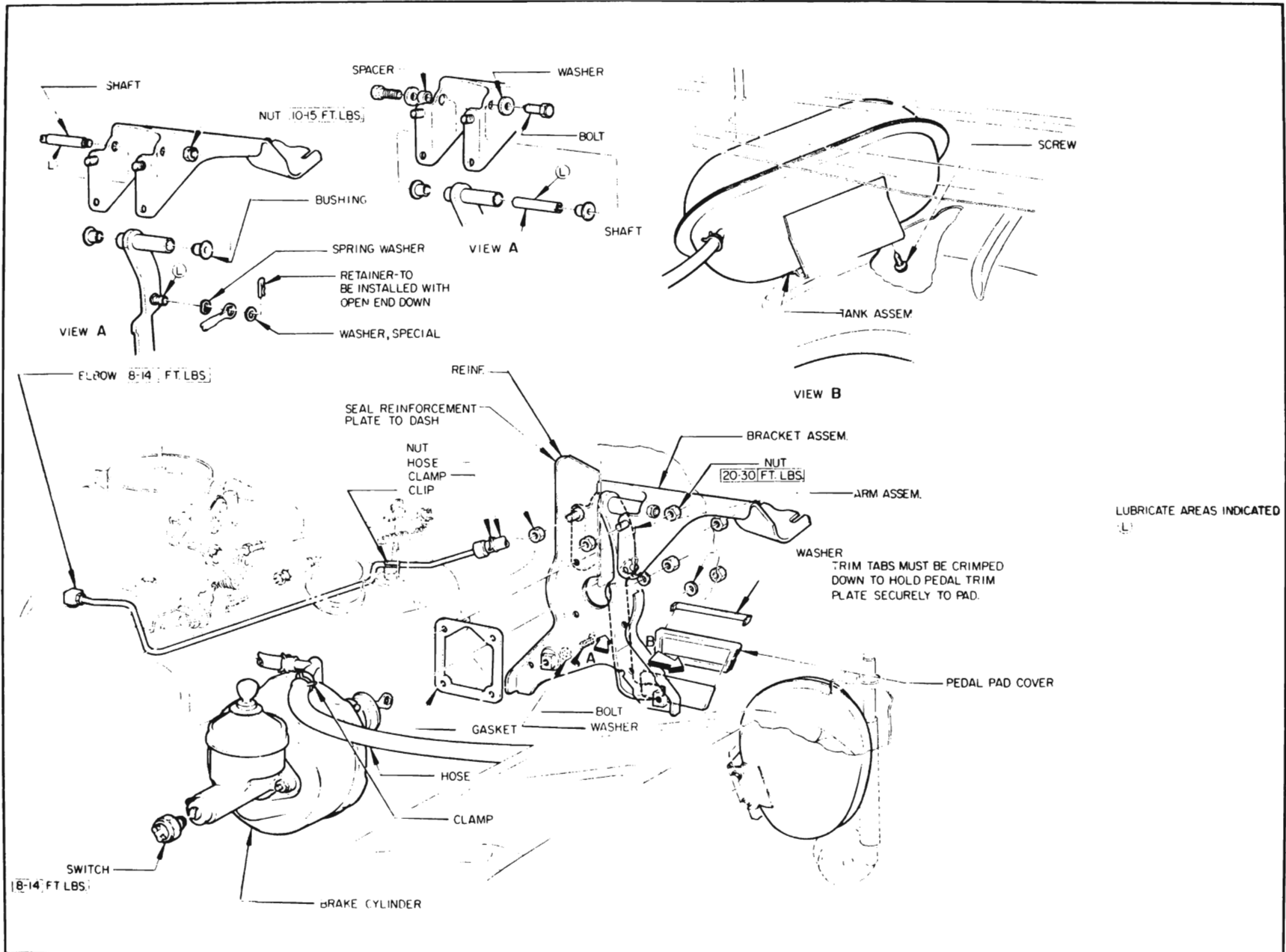


Figure 9-15—Power Brake Installation (4400-4600 & 4800 Series)

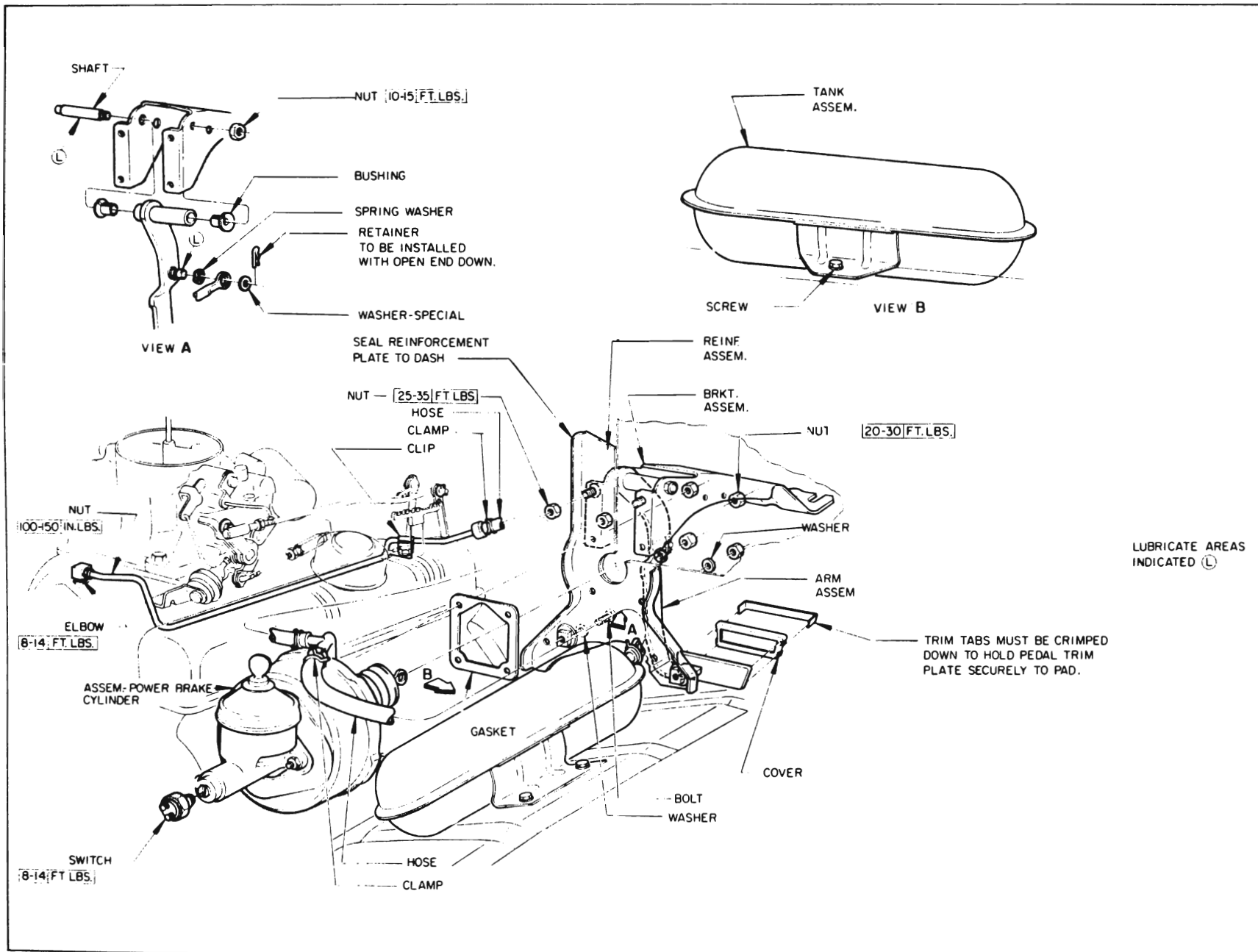


Figure 9-16—Power Brake Installation (4700 Series)

5. Connect brake pipe to hydraulic cylinder.
6. Install wiring connector on stop light switch.
7. Connect vacuum hoses to cylinder.
8. 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.
9. 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.

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 5 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 DESCRIPTION OF POWER BRAKE UNIT

a. Construction of Power Brake Unit

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

The power cylinder is the "air-suspended" type, meaning that atmospheric pressure is present on both side of the power piston in the unapplied stage. 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 section to the rear of the piston is called the Air chamber

since it is open to atmospheric pressure at all times. The section to the front of the piston is called the vacuum chamber since it is subjected to manifold vacuum during power application of brakes. All air entering the cylinder passes through an air filter located in the passenger compartment.

The air chamber is sealed-off from the vacuum chamber by a diaphragm. The inner edge of this diaphragm is held between two parts of the power piston assembly; the outer edge is clamped between the front and rear housing. A flexible rubber hose connecting the piston with a fixed tube at the top of the rear housing permits the piston to move back and forth while connected to manifold vacuum. Air is exhausted out of the vacuum chamber through passages in the piston and through the hose when the control valve is positioned for power application.

The power piston assembly houses the control valve and reaction mechanism. The control valve is made up of the air valve and the floating choke valve assembly. The reaction mechanism consists of a master cylinder piston reaction plate, a reaction disc, three reaction levers, and an air valve reaction extension. A push rod, which operates the air valve, projects out of the power cylinder housing through a boot.

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 hole in the casting. When the brake pedal is released quickly,

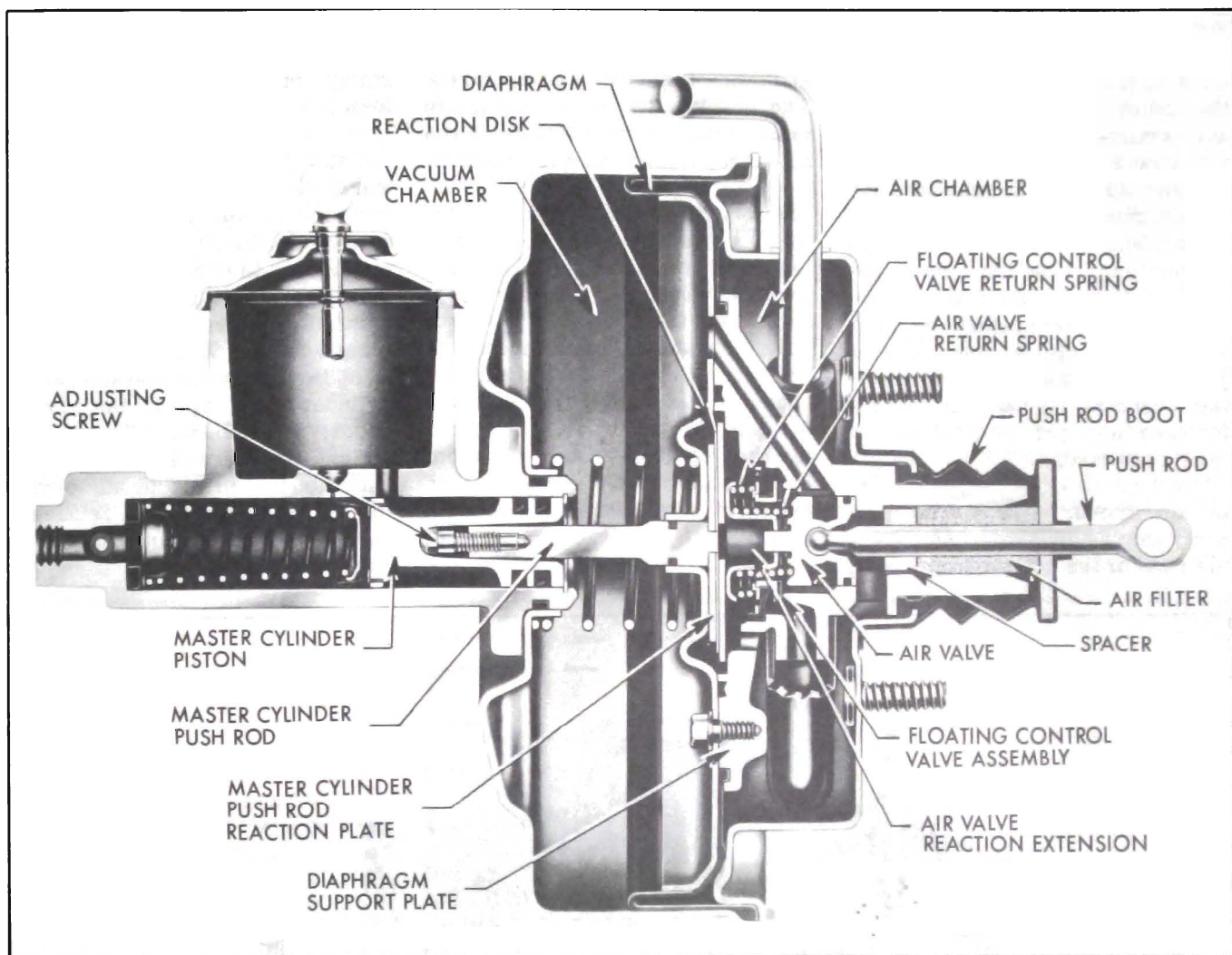


Figure 9-17—Power Brake Unit—Released Position

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.

b. Operation of Power Brake Unit

Description of power brake cylinder operation will cover (1) Released Position, (2) Applying, (3) Reaction Pressure, (4) Holding, (5) Releasing, (6) Manual Applying.

(1) **Released Position**, See Figure 9-17. The air valve return spring holds the air valve, push rod, and brake pedal rearward so that the air valve is clear of the floating control valve. Although vacuum is present at the floating control valve through the flexible hose, the control valve return spring holds the rubber face of the valve against its annular seat in the

power piston, thereby closing off manifold vacuum.

Atmospheric pressure enters through the air filter into the air chamber and flows through holes in the power piston into the reaction lever area. From here it flows past the open annular seat on the air valve and through a passage in the power piston into the vacuum chamber. With the vacuum passage closed and the vacuum chamber open to outside air, the power piston is balanced by atmospheric pressure on both sides and is held against the rear housing by the return spring.

The air valve return spring and the floating control valve return

spring are holding the air valve reaction plate against the inner ends of the reaction levers. Since the outer ends of these levers are against their pivot points in the power piston, the levers are pushing forward against the reaction disc. This disc, in turn, is holding the master cylinder piston and reaction plate assembly forward so that the reaction plate is against its stop. To sum it up, in the released position of the power cylinder, the reaction mechanism is fully forward and the two valves are fully rearward.

In the master cylinder the primary cup is in a position just to the rear of the compensating port,

permitting flow of brake fluid between the master cylinder bore and the reservoir as required. The check valve is seated and is maintaining static pressure in the brake pipes and wheel cylinders.

(2) Applying. See Figure 9-18. As the brake pedal is depressed, the push rod moves the air valve forward until its annular seat contacts the floating control valve, at which point atmospheric pressure is sealed off from the vacuum chamber. Further movement of the air valve pushes the floating control valve away from its annular seat in the power piston, thus connecting the vacuum chamber to the vacuum source. As air is exhausted out of the

vacuum chamber, atmospheric pressure in the air chamber starts moving the power piston forward.

As the power piston moves forward, the master cylinder push rod forces the master cylinder piston forward. As the primary cup passes the compensating port, pressure starts to build up in the hydraulic system. The fluid displaced by the piston is forced out into the brake pipes and wheel cylinders to apply the brake shoes. At the same time, a reaction pressure is transmitted back to the brake pedal to give the driver an indication or "feel" of the pressure being applied to the brake shoes.

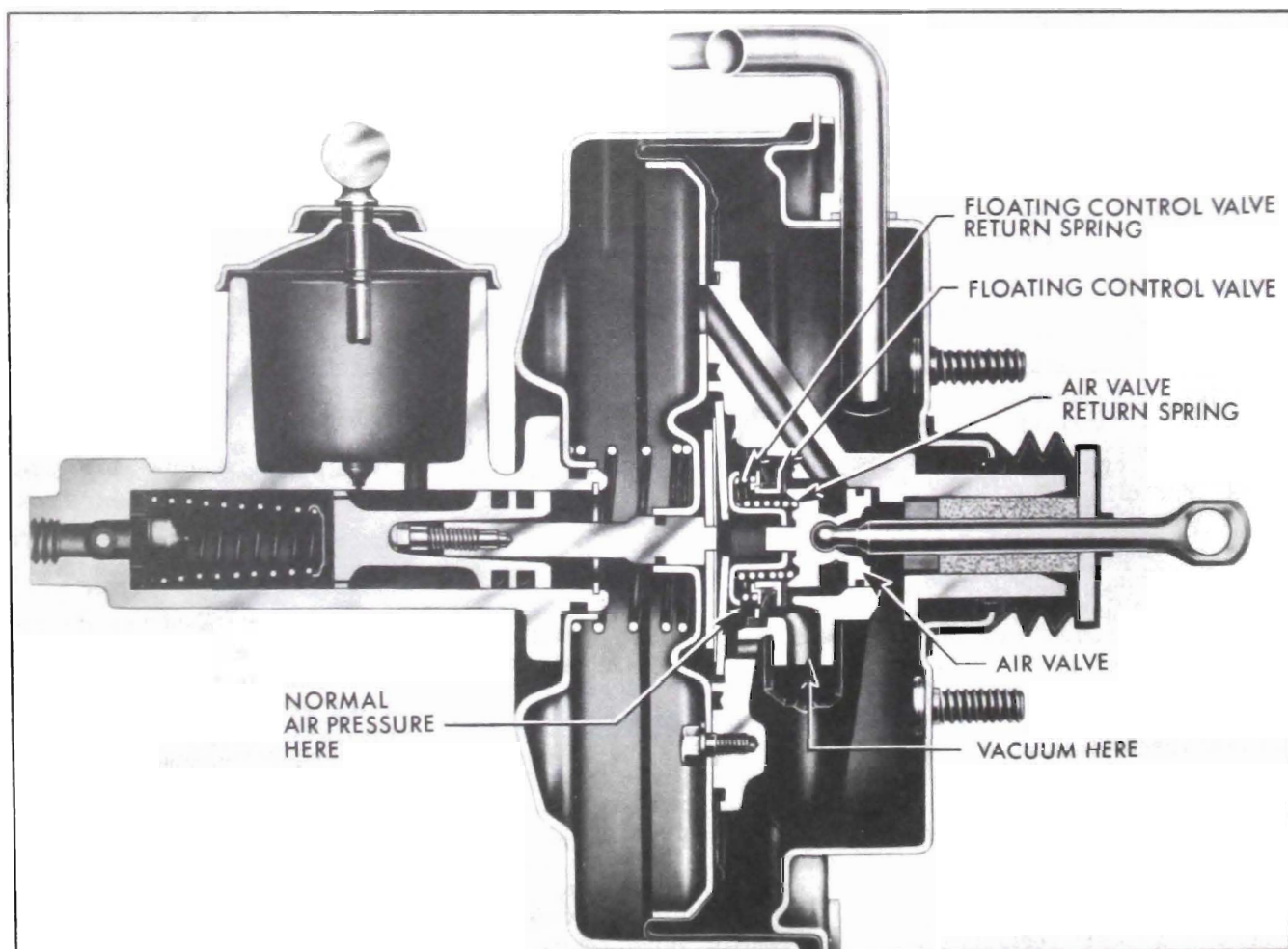


Figure 9-18—Power Brake Unit—Applying

(3) Reaction Pressure. As soon as pressure starts to build up in the hydraulic system, the pressure on the end of the master cylinder piston causes the master cylinder piston push rod reaction plate to move away from its stop and press against the reaction discs and the reaction levers. The levers in turn swing around their pivots in the power piston and push the air valve reaction extension back against the air valve. See Figure 9-18.

In this manner approximately 40% of the load on the master cylinder piston is transferred through the air valve and push rod to the brake pedal to oppose the foot pressure applied by the driver.

This reaction pressure gives the driver a "feel" proportional to the degree of brake application, so that he has positive control over the braking operation at all stages. Thus, about 40% of the effort is supplied by the driver's foot on the brake pedal, the remainder being supplied by "boost" from the power piston.

(4) Holding. When the desired brake apply pressure is reached and the brake pedal is held still, the air valve and floating control valve are also held motionless. The power piston, however, continues forward momentarily until its annular seat contacts the floating control valve. See Figure 9-19. At this point, both the air

valve and the power piston are seated on the floating control valve so that the passage to the vacuum chamber is closed to atmospheric pressure as well as vacuum; therefore, the power piston is held stationary or poised until the brake pedal is moved in either direction.

(5) Releasing. When foot pressure on the brake pedal is released, the air valve return spring forces the air valve away from the floating control valve. This allows the floating control valve return spring to seat the control valve against the power piston, closing the vacuum passage. Since both sides of the power piston are

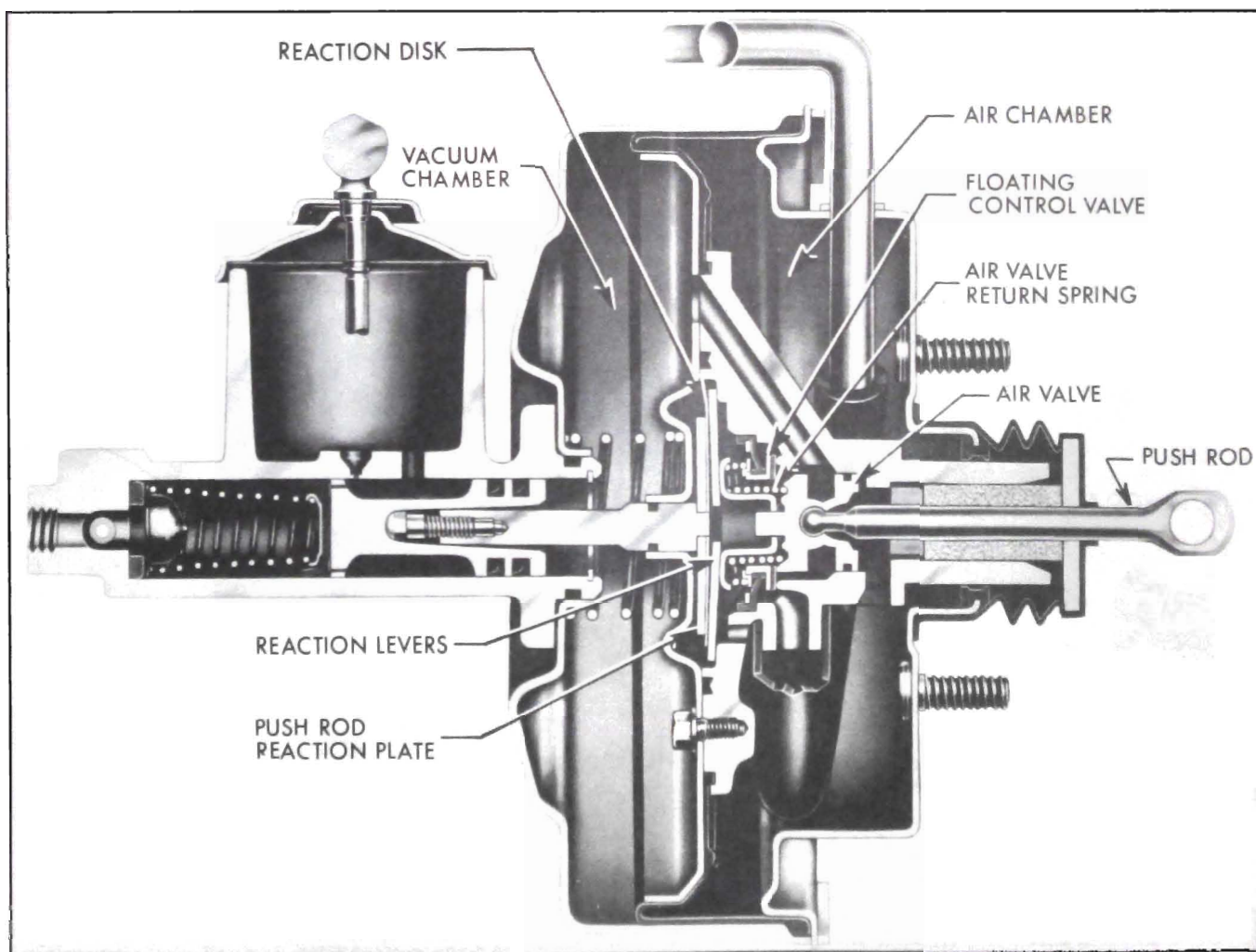


Figure 9-19—Power Brake Unit—Holding

now open to atmospheric pressure, the piston return spring forces the power piston and related parts rearward to the unapplied position (Figure 9-17).

As the master cylinder piston moves rearward in the master cylinder, the fluid from the wheel cylinder flows back into the master cylinder through the check valve. When the primary cup passes the compensating port, any surplus fluid in the hydraulic system returns to the reservoir. The check valve spring presses the check valve against its seat with sufficient force to maintain a static pressure in the brake pipes and wheel cylinders.

(6) Manual Applying. When the engine is not running and all reserve vacuum is exhausted, the

brakes are applied entirely by foot pressure on the brake pedal. As the pedal is pushed down, the air valve moves forward beyond its normal travel until it contacts the end of the air valve reaction extension. The air valve reaction extension then contacts the reaction levers and master cylinder push rod reaction plate. Further movement pushes the master cylinder piston into the master cylinder, causing the brakes to be applied in the usual way. However, the pedal pressure for a given brake application is considerably greater.

If the engine is started while the brakes are being manually applied, manifold vacuum will exhaust air from the vacuum chamber through the wide open

vacuum port at the control valve, and the power piston will move forward. This will make the pedal "fall-away" slightly from under the foot, and less pressure will be required to hold the pedal in the applied position.

9-17 DISASSEMBLY, INSPECTION, ASSEMBLY OF POWER BRAKE UNIT

NOTE: Refer to Figures 9-17 thru 9-20 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

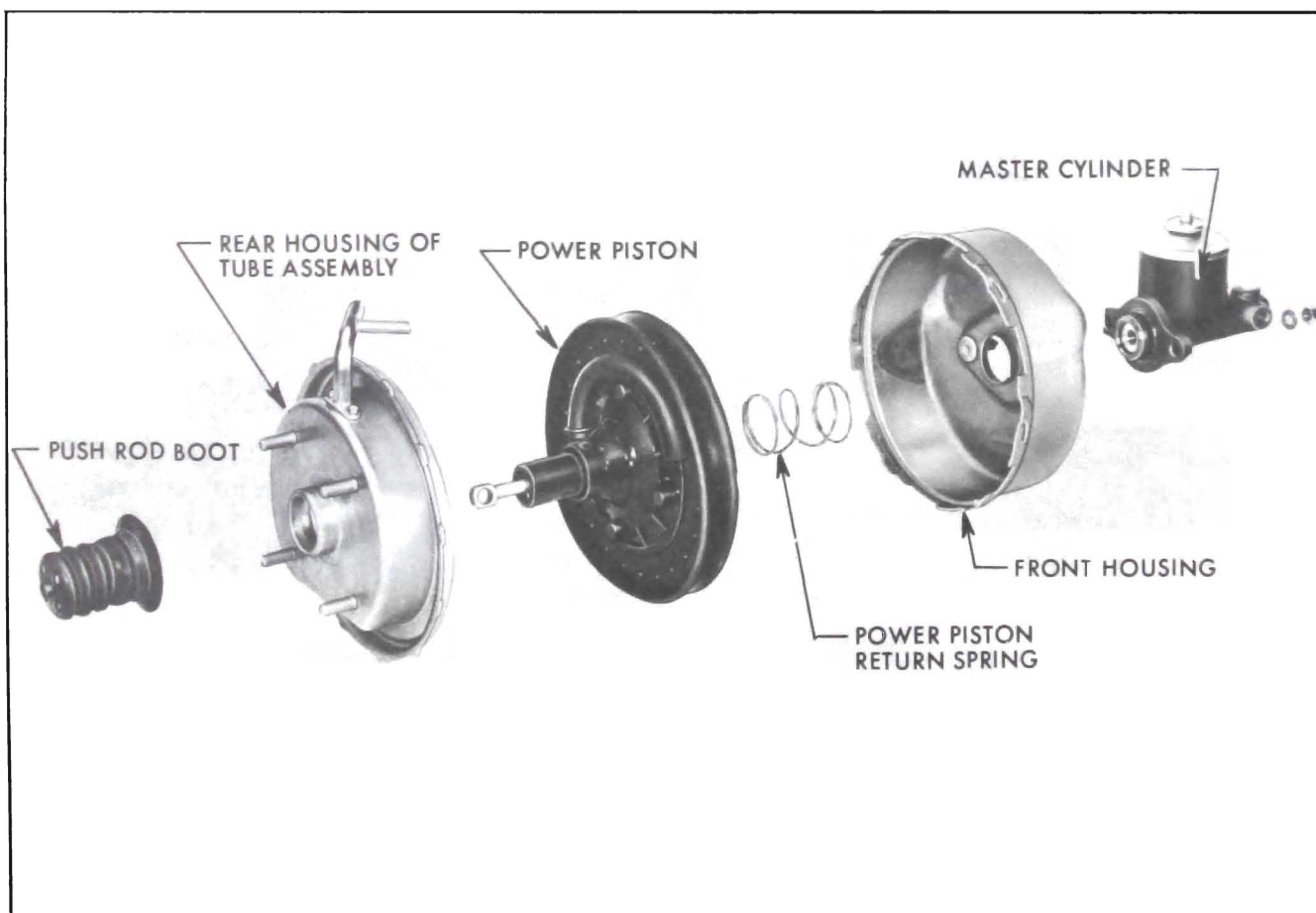


Figure 9-20—Major Parts of Power Brake Unit

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 hose from tube in rear housing. Pull push rod through rear housing and remove

push rod boot. Lay rear housing and tube assembly aside.

5. Remove power piston return spring from front housing.

NOTE: Unless front housing or master cylinder assembly is damaged and must be replaced, there is no need to remove front housing from master cylinder assembly.

6. In handling the power piston assembly, special care must be taken to guard the diaphragm

against grease, oil, or foreign matter and to protect it from nicks or cuts. Loosen the four screws holding the power piston assembly together.

7. With master cylinder push rod up, remove screws and lift master cylinder push rod, rolling diaphragm support plate, master cylinder push rod reaction plate, and power piston diaphragm from power piston. Remove power piston diaphragm and inspect for cuts, pin holes, distortion or cracks.

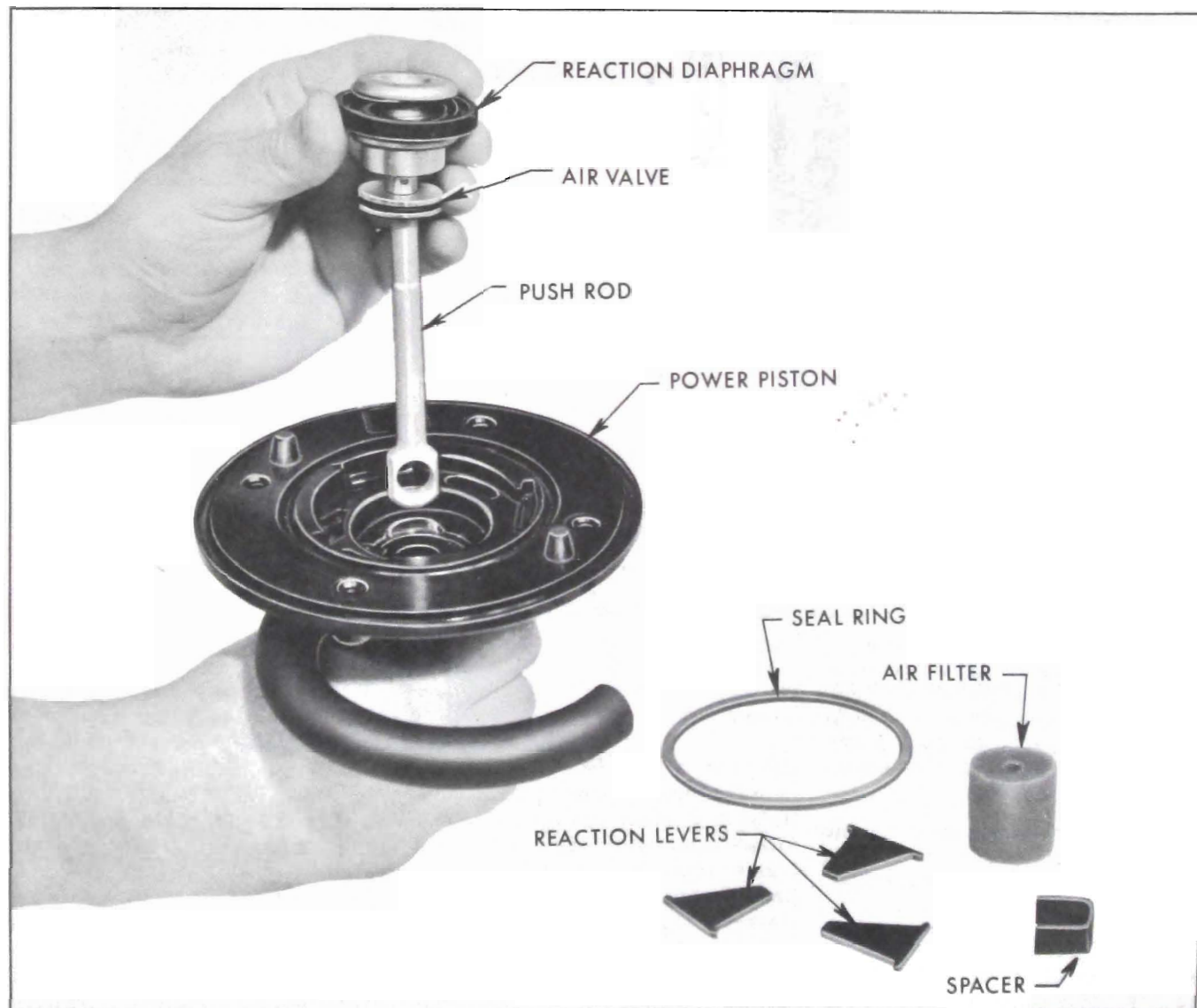


Figure 9-21—Removing Power Piston Parts

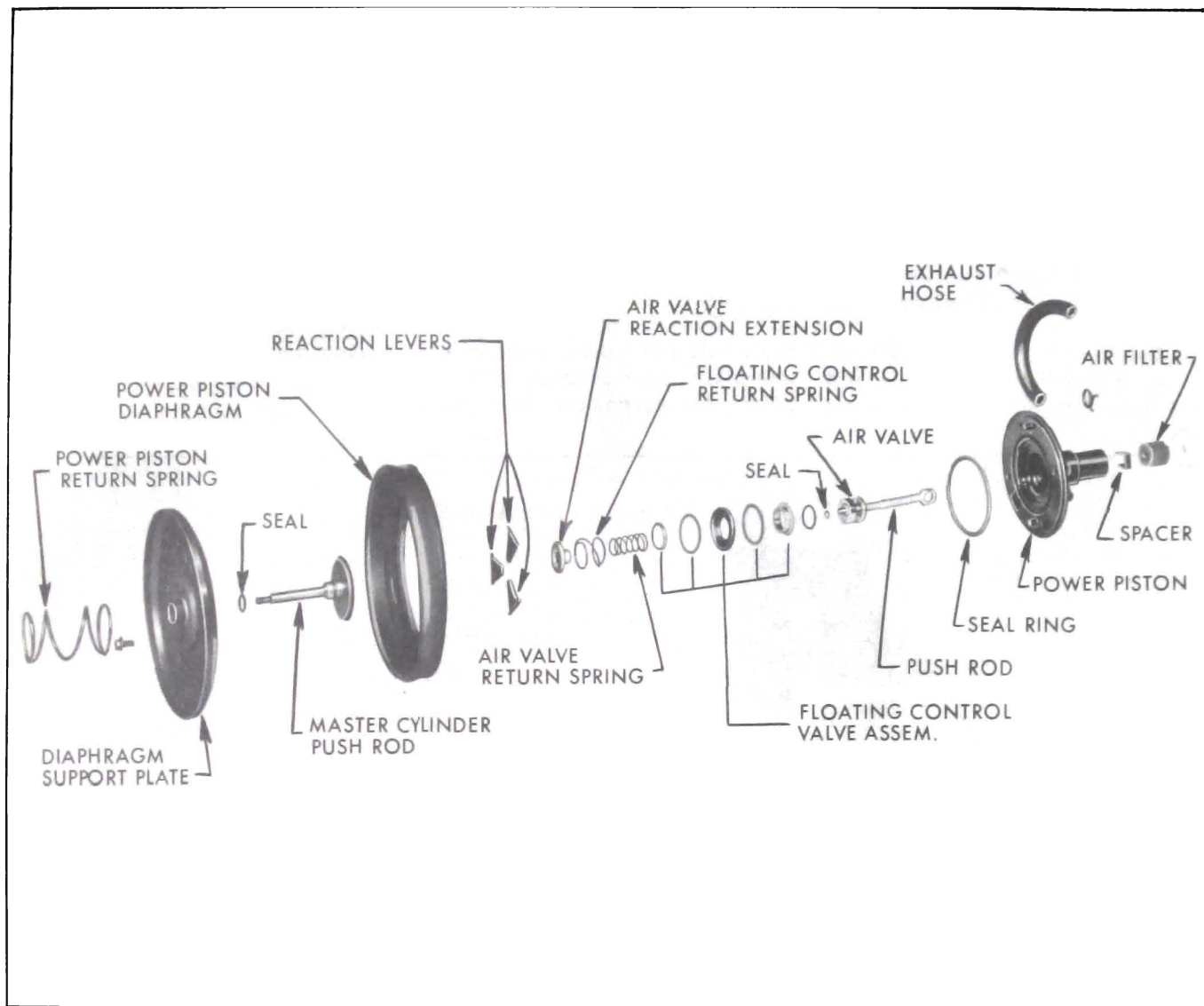


Figure 9-22—Exploded View of Power Piston Assembly

9. Push master cylinder push rod and reaction disc assembly through support plate. From master cylinder push rod and remove "O" ring.

10. From power piston assembly remove three reaction levers. Remove power piston seal ring. See Figure 9-21.

11. Turn power piston over. Inspect hose carefully. If hose is to be replaced, remove hose clamp using Pliers J-5284 and remove hose. Remove air filter

and spacer from inside tube on power piston.

12. Force push rod-air valve assembly through power piston, dislodging floating control valve and diaphragm assembly. Turn air valve reaction extension until it unlocks from air valve. This releases the air valve return spring, floating valve return spring and floating control valve-diaphragm assembly. Push rod cannot be disassembled from air valve; therefore, if either part is

defective, a new assembly must be installed. Reaction diaphragm support plate may not come out with floating control valve. Remove large "O" ring from groove in O.D. of air valve and small "O" ring from extension on air valve.

13. From floating control valve and diaphragm assembly (Figure 9-20), remove floating control valve spring retainer. Remove reaction diaphragm retainer from under lip of reaction diaphragm,

then remove reaction diaphragm and support plate from hub of floating control valve. See Figure 9-23.

14. From master cylinder bore, remove snap ring, master cylinder piston, primary cup, spring and retainer assembly, check valve assembly and valve seat washer.

15. Remove master cylinder reservoir cap and gasket.

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 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 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 gasket finger tight.

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 9-24. Press check valve in open end of spring and retainer; place assembly in 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.

4. To assemble floating control valve and diaphragm assembly, place the reaction over hub of floating control valve flat side first so that diaphragm fits into

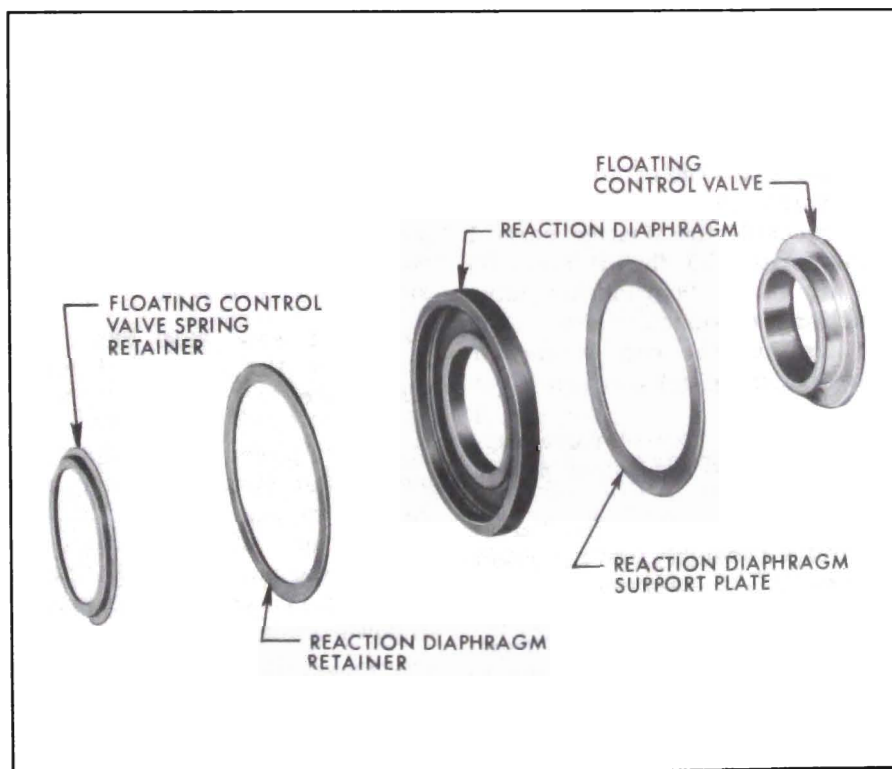


Figure 9-23—Floating Control Valve and Diaphragm Assembly

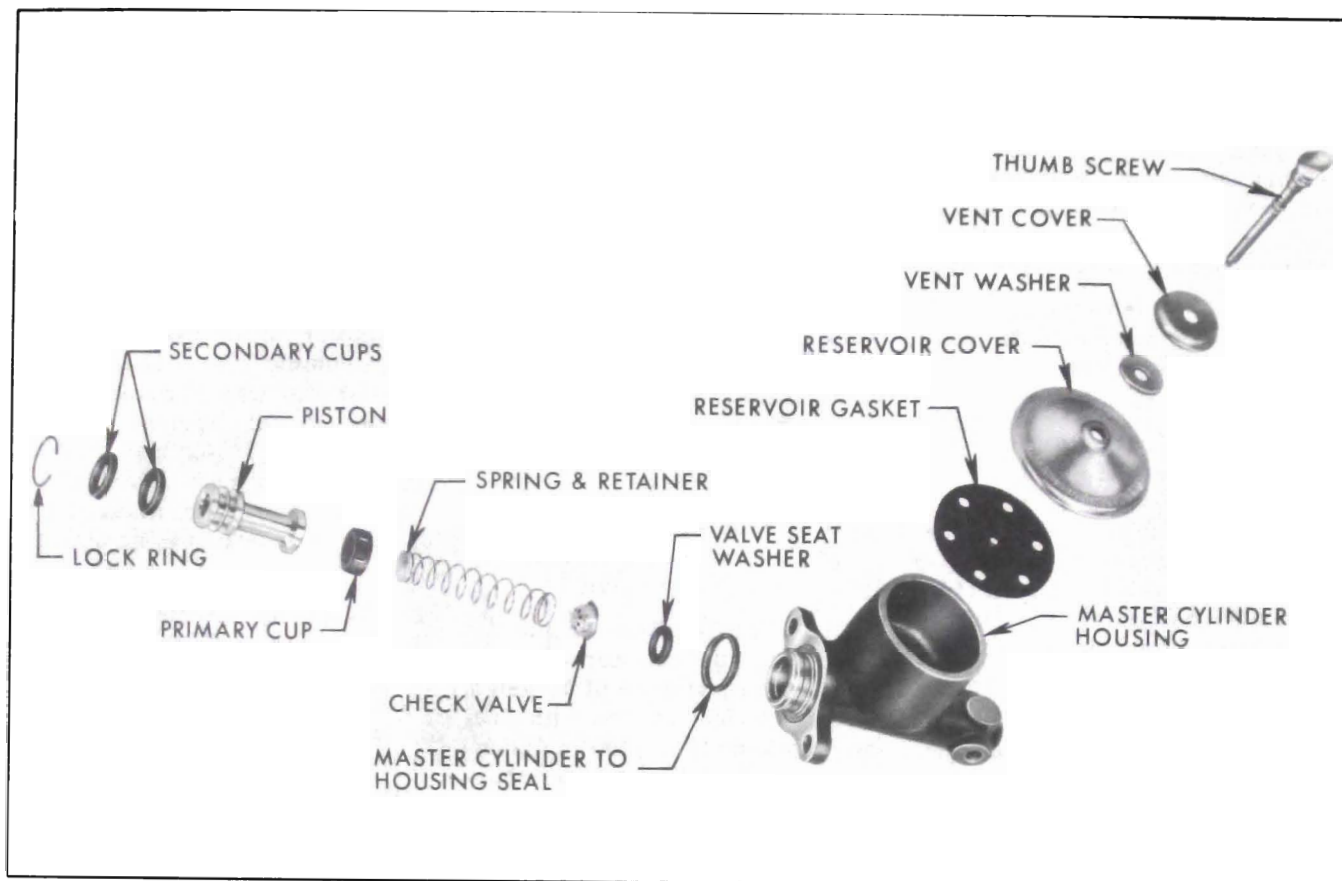


Figure 9-24—Internal Parts of Master Cylinder

groove in O. D. of control valve. Insert reaction diaphragm retainer under lip of reaction diaphragm. Firmly press floating control valve spring on retainer and place aside. Place new large "O" ring in groove on O.D. of air valve and new small "O" ring on air valve extension so that it fits into groove in face of air valve.

5. Set power piston on jaws of vise with flat surface up. Do not clamp. Wipe a thin coat of silicone grease (from tube included in overhaul kit) on portion of air valve which will slide in center of power piston.

6. Wipe a thin film of silicone grease on O.D. of reaction diaphragm. Place floating control valve and diaphragm assembly down over air valve so that rubber face of control valve rests

on its seat on air valve. Place floating control valve spring and retainer over hub of floating control valve. Put air valve return spring inside the floating control valve spring so that it rests on the air valve. Position air valve reaction extension down over springs and the end of the air valve. Turn to lock position.

Place floating control valve support plate into the power piston.

Insert the floating control valve-air valve assembly into the power piston. Press outer edge of diaphragm against shoulder in power piston. Make sure that diaphragm is not distorted as assembly is placed into power piston. Push air valve to firm seat in power piston by pushing on the part of the air valve which holds the reaction extension in place.

9. Wipe a thin coat of silicone grease on both sides of reaction levers. Place wide ends of reaction levers in their seats in the power piston, and rest narrow ends on air valve reaction extension. See Figure 9-25.

10. Insert seal ring into inner groove on flat surface of power piston face.

11. Place power piston diaphragm over power piston with stop buttons down and with diaphragm folded-over into the shape in which it normally operates. Insert bead of diaphragm in outer groove of power piston.

12. Lubricate master cylinder push rod in area of "O" ring and also center hole in rolling diaphragm support plate with a thin coat of silicone grease. Push push rod (adjusting screw first) through

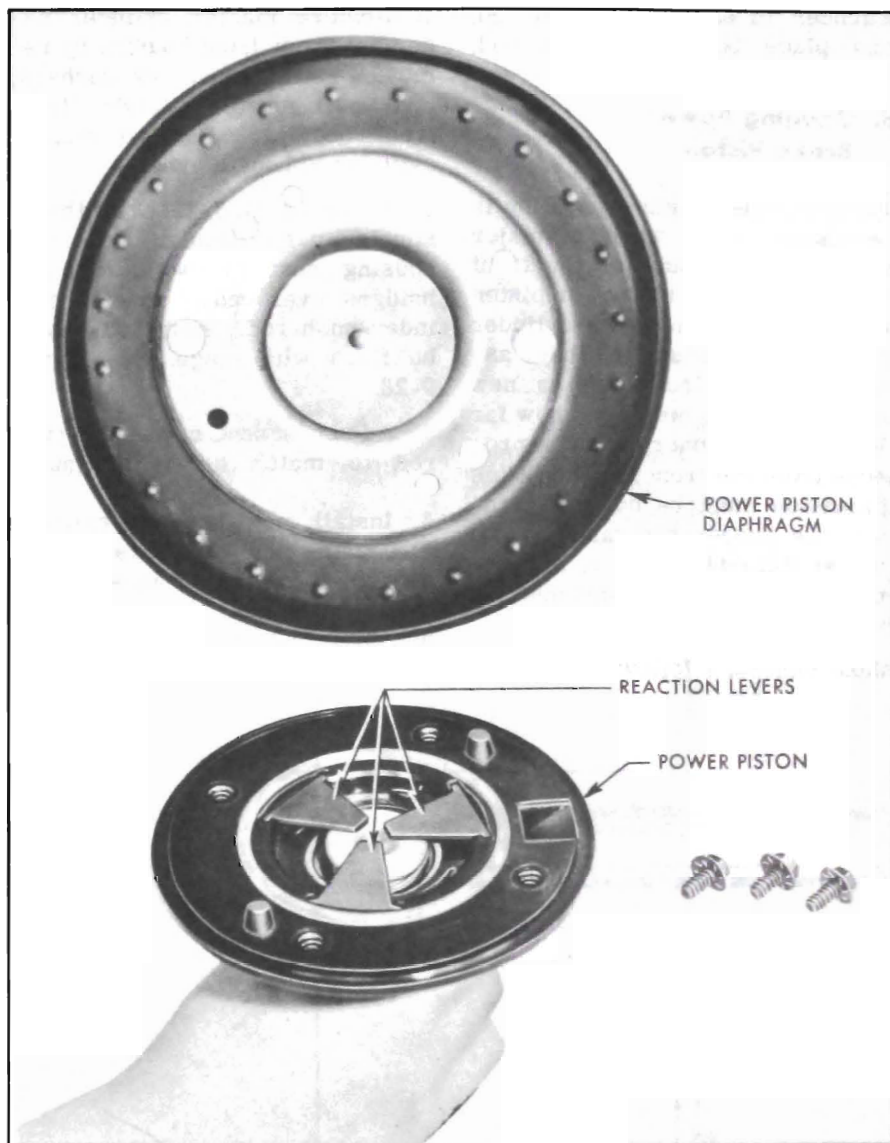


Figure 9-25—Installing Parts in Power Piston

support plate from side opposite the flange side. See Figure 9-26.

13. Make sure power piston assembly parts are correctly located. Then position master cylinder push rod and support plate assembly carefully over power piston assembly and align lugs on power piston with holes in support plate. Lower assembly carefully until support plate is pressed tight against power piston. In this step, make sure that wide end of a reaction lever does not jump out of its seat.

Hold pressure while installing the four screws.

14. If hose was removed, install new hose fully on boss so that it is parallel to power piston. Install hose clamp using Pliers J-5284. Rotate hose clamp outward so that it nearly contacts power piston; otherwise it will strike the rear housing and prevent full return of power piston assembly. See Figure 9-27.

15. Place return spring over flange in center of front housing.

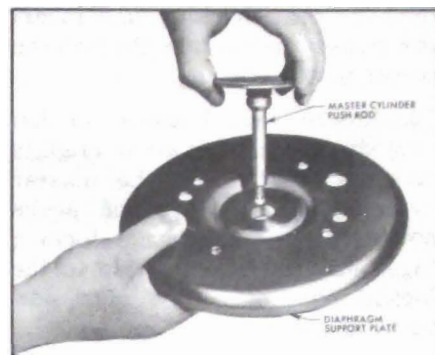


Figure 9-26—Installing Master Cylinder Piston

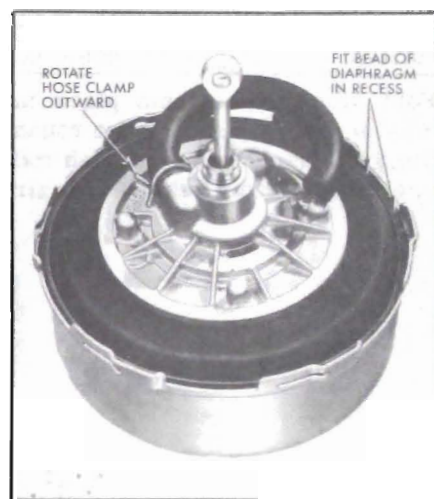


Figure 9-27—Installing Power Piston Assembly in Front Housing

Wipe a thin layer of silicone grease on diaphragm bead. With diaphragm folded-over into the shape in which it will operate, position power piston assembly over front housing, and insert master cylinder push rod into master cylinder piston.

16. Rotate power piston assembly so that unattached end of hose is in line with master cylinder filler cap. Press power piston down and hold in position while fitting bead of diaphragm into recess in rim of front housing. See Figure 9-27.

17. Wipe a thin film of silicone grease on the I.D. of power piston bearing which is in the center of the rear housing. Install hose on

tube in rear housing and insert the power piston tube through the power piston bearing.

18. Rotate rear housing so that projecting exhaust tube is slightly counterclockwise of the master cylinder filler cap. Then press housing down to engage locking lugs and rotate clockwise to the locked position. Tube must now be in line with filler cap.

CAUTION: Extreme care must be taken to keep the diaphragm bead in the recess of the front housing or the bead will be pinched into the slots as the rear housing is rotated into the locked position.

Fold fiber spacer and place in tube on power piston. Push round filter element down over push rod into power piston tube. Place air

silencer in end of push rod boot and place boot over push rod.

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 in 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. Remove master cylinder to housing seal.
2. Place Gauge J-21183 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. Install new master cylinder to housing seal in groove in master cylinder. Insert master cylinder on studs and press into housing. Install two lock washers and nuts. Torque nuts to 20 ft. lbs.

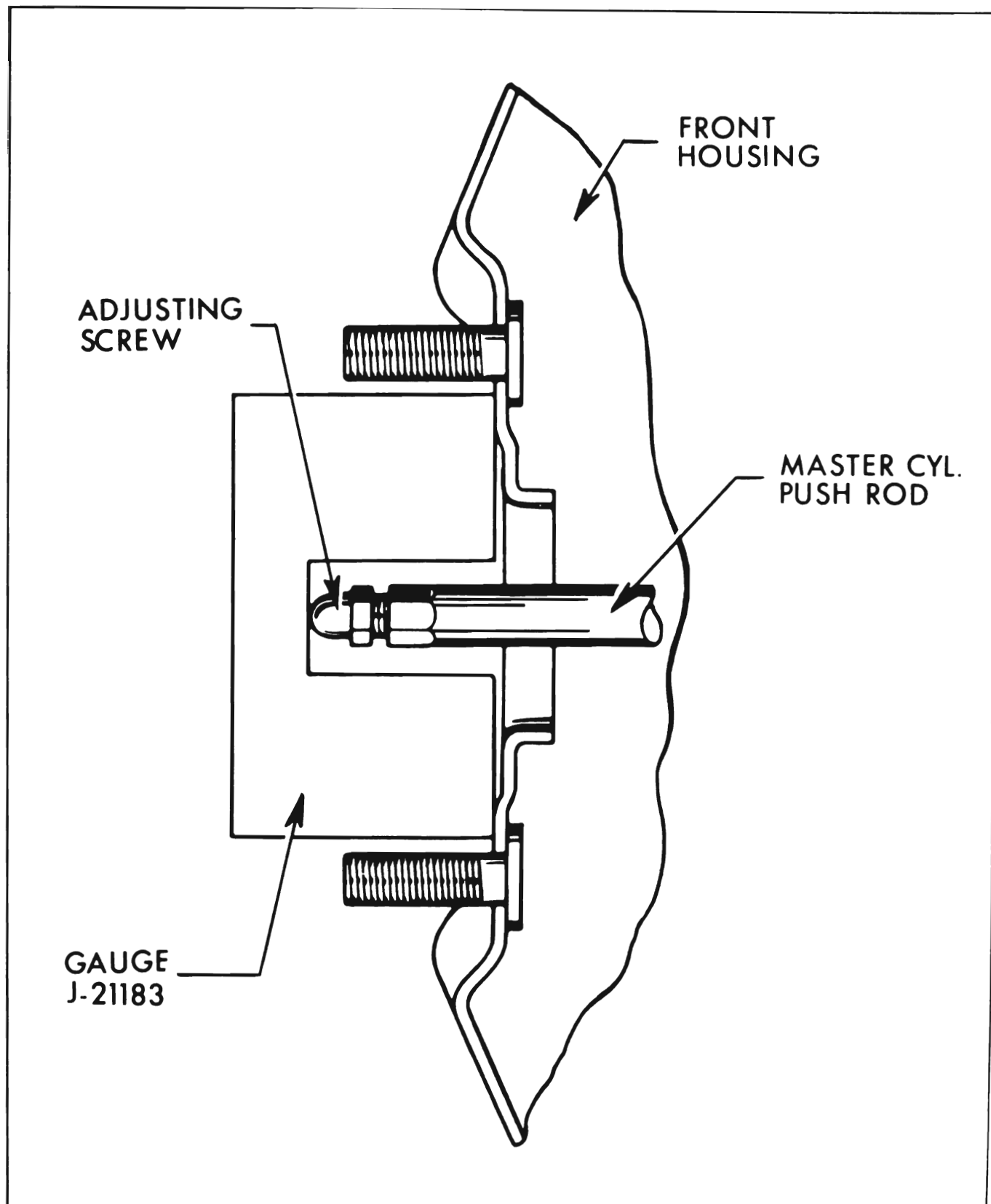


Figure 9-28—Brake Special Tools