SECTION 9-D

POWER BRAKES

9-15 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 brake pedal is suspended from a bolt between two mounting brackets. As the brake is applied, a pedal lever extending upward operates a link rearward. This link in turn transmits motion to a lever on an idler, causing the idler to rotate. This rotation causes a second idler lever to push forward on the brake cylinder push rod clevis and push rod. The overall mechanical advantage in the power brake linkage is approximately 1½ to 1. See Figure 9-13.

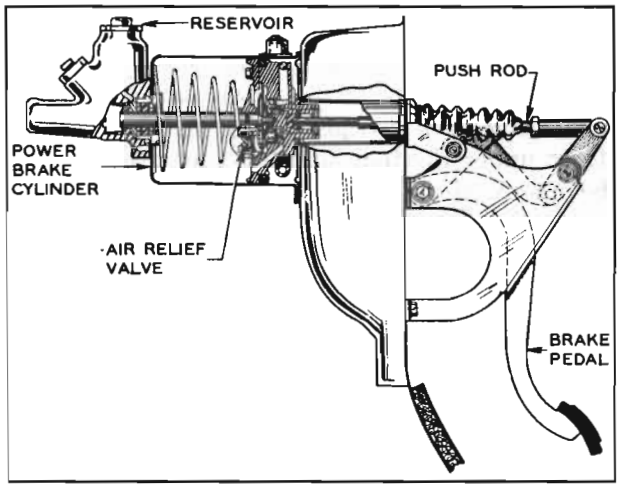


Figure 9-13—Power Brake Installation

All pivot points in the brake linkage have nylon bearings which are lubricated when installed but do not require periodic lubrication. Because there is no pedal stop, the pedal will be stopped in the "off" position by contact of the push rod with the stop plate in the power cylinder. The only linkage adjustment possible is the pedal height adjustment (par. 9-16).

The power brake assembly is a self-contained vacuum and hydraulic unit which utilizes the difference between intake manifold vacuum and atmospheric pressure to reduce brake pedal effort. Both Bendix and Moraine power brake units are used on an optional basis. Internally, the Bendix and Moraine units differ in construction, but both units have the same external dimensions and may be used interchangeably. Both units have an air suspended power cylinder and a displacement type hydraulic cylinder.

The power brake cylinder is connected to the intake manifold through pipes and flexible connections. A vacuum reserve tank of approximately 360 cubic inches capacity 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 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.

9-16 REMOVAL, INSTALLATION, ADJUSTING, TESTING OF POWER BRAKE UNITS

The same procedure is used for removing, installing, adjusting, or testing either the Moraine or the Bendix power brake unit. Operation, disassembly and assembly are different, however, and are covered in separate paragraphs as shown in the index for section 9-D.

a. Removal of Power Brake Unit

1. Disconnect battery ground strap.

2. Remove clevis pin from push rod clevis. See figure 9-13.

3. Lift brake pedal to pull linkage out of the way, then remove large nut holding brake unit to cowl using Wrench 6618.

4. Disconnect stop light wire connector from switch.

5. Disconnect brake pipe from hydraulic cylinder and tape end of pipe to prevent entrance of dirt. Disconnect vacuum hoses from vacuum tee.

6. Remove bolts holding unit to ventilation air duct and remove power brake unit from car.

7. 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. Position power brake unit in ventilation air duct and install bolts to hold unit to air duct.

2. Connect brake pipe to hydraulic cylinder. Connect vacuum hoses to vacuum tee.

3. Connect stop light wire connector to switch.

4. Loosen brake reinforcing bracket bolt and nut. Lift brake pedal to pull linkage out of the way, then install and tighten large nut using Wrench 6618. After large nut is tight, tighten reinforcing bracket bolt and nut.

5. Install spring washer, clevis pin, and cotter key in push rod clevis.

6. Check brake pedal for correct height as described below (subpar. c). Adjust pedal height if necessary.

7. Reconnect battery ground strap.

8. Bleed hydraulic system in same manner as standard brake system. After bleeding bring fluid level to ¼ inch below lowest point of bottom thread in filler opening. 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. Checking and Adjusting Brake Pedal Height

Correct pedal height is important to insure adequate pedal travel and to make sure that the pedal is in the proper position to get the best linkage action.

1. Make certain that brake pedal returns completely when released slowly. If pedal does not return freely, check linkage for binding and check condition of pedal return spring.

2. Measure from left top side of pedal pad perpendicular to toepan using a foot ruler. Pedal height with ruler pressed firmly against floor mat should be 5½ inches plus or minus ¼ inch. See figure 9-7.

3. If pedal height is incorrect, loosen push rod lock nut.

4. Turn push rod as necessary to adjust pedal height to 5½ inches.

5. Hold push rod and tighten lock nut. Recheck pedal height.

6. Start engine and depress brake pedal firmly. If pedal travels to within 1 inch of toeboard and has a hard feel, brake shoes require adjustment or relining. However, if pedal has a spongy feel, brake system needs bleeding.

d. Testing Power Brake Unit

1. *Vacuum Assist.* With engine stopped, apply brakes 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 m.p.h. 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.

9-17 MORAINE POWER BRAKE UNIT

a. Construction of Moraine Power Brake Unit

The power brake cylinder is the "air suspended" type, meaning that atmospheric pressure is present on both sides of the power piston in the unapplied stage.

As shown in figure 9-14, a cover closes the forward end of the cylinder housing to form a large chamber in which the power piston and related parts operate. The section on the cover side of the piston is called the *air* chamber since it is open to atmospheric pressure at all times. The section on the opposite side 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 housing passes through an air cleaner.

The rim of power piston carries a spring expanded leather cup and a felt lubricating wick to seal against passage of air. A flexible rubber hose connecting the piston with a vacuum tee on the side of cylinder 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 the vacuum hose when the control valve is set for power application.

The related parts which operate in the cylinder housing with the power piston form an assembly composed of the air valve, floating control valve, hydraulic piston, and the reaction mechanism. Pedal pressure through a push rod starts the power piston assembly moving when applying the brakes; a single heavy return spring returns the power piston when releasing the brakes.

The hydraulic piston is a solid steel plunger which extends into the hydraulic cylinder through a rubber vacuum cup and rubber secondary and primary cups. To prevent vacuum from drawing brake fluid out of hydraulic cylinder in case of cup leakage, the space between the vacuum cup and the secondary cup is vented to atmosphere through a hole which is kept open by a loose wire.

Movement of the piston into the fluid filled cylinder displaces a corresponding volume of the fluid, which is forced out into the brake pipes and wheel cylinders. Compensating ports in the counterbored end of the piston permit return of surplus fluid to reservoir when brakes are released. The check valve and spring in the hydraulic cylinder maintains a static residual pressure in brake pipes and wheel cylinders.

b. Operation of Moraine Power 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.

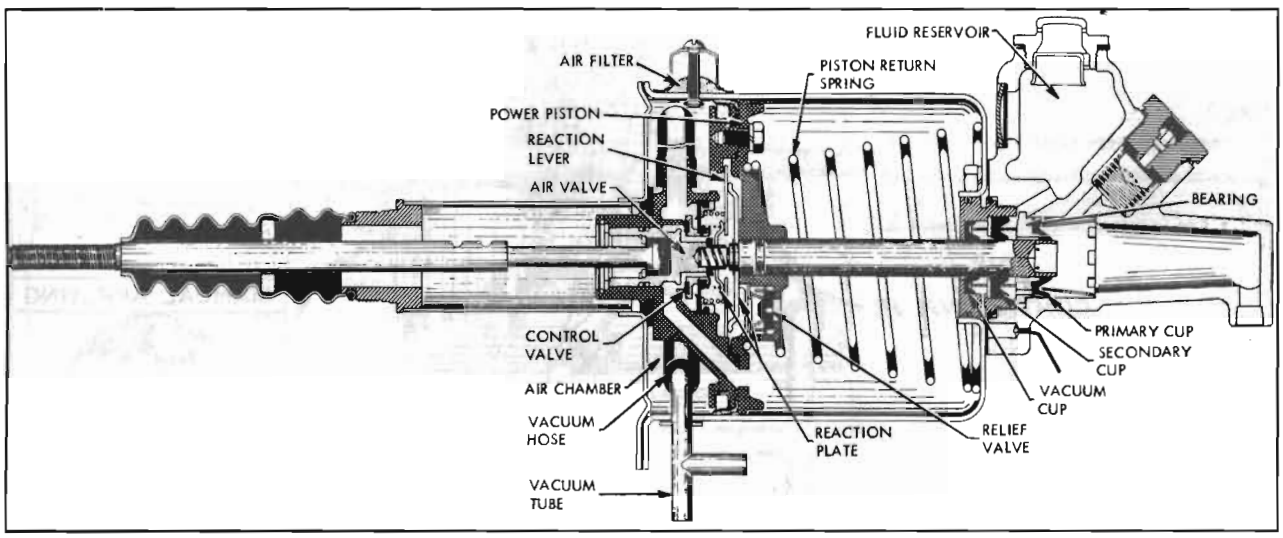


Figure 9-14—Moraine Power Brake Unit—Released Position

(1) *Released Position.* See figure 9-14. The pedal return spring and the valve return spring hold the push rod and attached air valve so that the air valve is held clear of the floating control valve. At the same time, the valve diaphragm spring holds the floating control valve against its seat on the power piston, thereby closing the passage connected to manifold vacuum.

Atmospheric pressure enters through the air cleaner into the *air* chamber, flows through the space between the air valve and the floating control valve, then flows 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 housing cover by the return spring.

The compensating ports in counterbored end of hydraulic piston are rearward of the primary cup, permitting flow of brake fluid between the reservoir and hydraulic cylinder as required. The check valve is seated to maintain static pressure in the brake pipes and wheel cylinders.

(2) *Applying.* See figure 9-15. As the brake pedal is depressed the push rod moves the air valve 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 seat on the power piston, thus connecting the vacuum chamber to manifold *vacuum* through a passage in power piston and the attached vacuum hose. As air is exhausted out of the *vacuum* chamber, atmospheric pressure in the *air* chamber moves the power piston forward toward the hydraulic cylinder. The valve and hydraulic piston move forward as a unit with the power piston.

As the hydraulic piston is forced into the hydraulic cylinder, escape of fluid into the reservoir is cut off when the piston compensating ports pass through the primary cup, and the fluid displaced by the piston is then 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.

(3) *Reaction Pressure.* As pressure is built up in the brake pipes and wheel cylinders during brake application, the hydraulic piston is subjected to the same pressure. Since the hydraulic piston is free to move rearward in the power piston, the pressure on the piston is transmitted through the attached reaction plate to the six reaction levers. The outer ends of the levers press against pivot points in the power

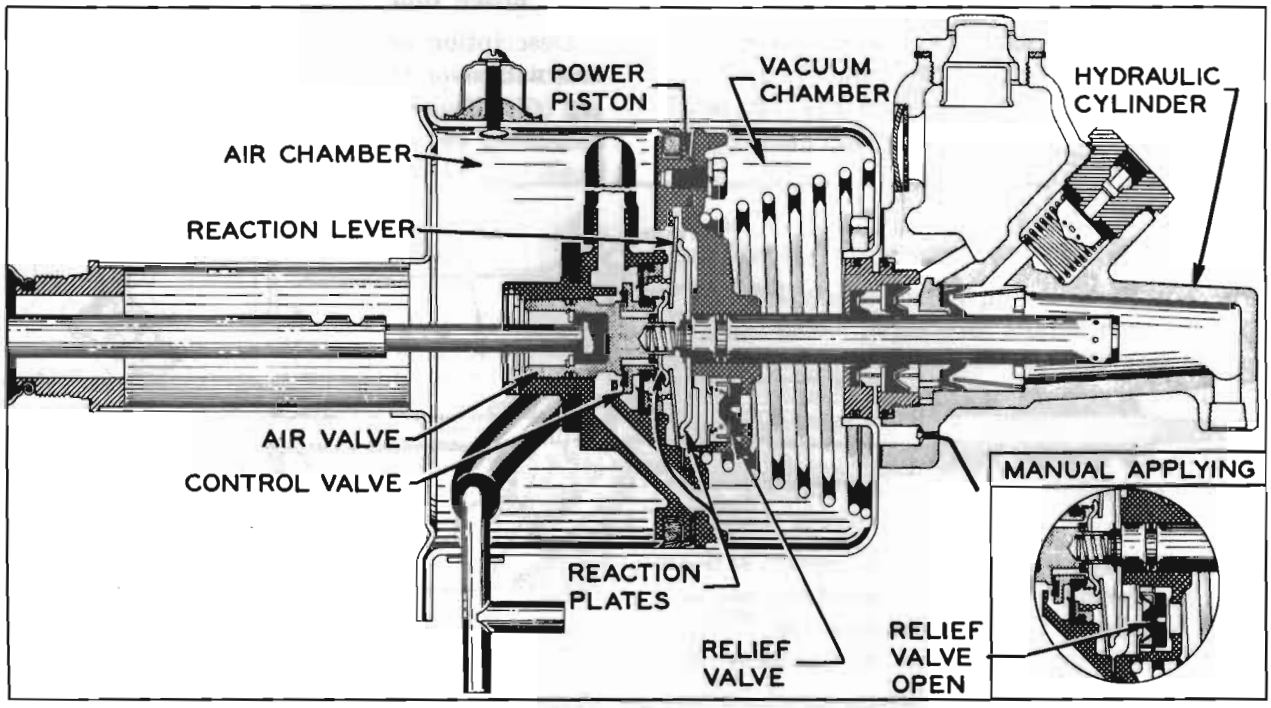


Figure 9-15—Applying

piston and the inner ends press against the valve reaction plate which now bears against a shoulder of the air valve. See figure 9-15.

In this manner approximately 40% of the load on the hydraulic 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 definite indication of "feel" of the pressure being applied to the brake shoes so that he has positive control over the braking operation at all stages.

(4) *Holding*. When the desired brake apply pressure is reached and brake pedal is held poised, the power piston continues forward momentarily until it contacts the floating control valve. See figure 9-16. At this point, the air valve is also in contact with the control valve so that the passages to the *vacuum* chamber are sealed off from atmospheric pressure as well as vacuum; therefore the power piston is held stationary or poised, ready to move in either direction as dictated by brake pedal movement.

(5) *Releasing*. When foot pressure on brake pedal is released, the pedal return spring pulls the push rod rearward to relieve pressure on the air valve. The valve return spring forces the air valve away from the floating control valve, which is seated against the power piston to close the vacuum passage. Since both sides of the power piston are now open to atmospheric pressure, the piston return spring forces the power piston and related parts rearward to the unapplied position (fig. 9-14).

As the hydraulic piston moves out of the hydraulic cylinder the fluid from the wheel cylinders flows back into the hydraulic cylinder through the check valve. When the compensating ports in the piston pass forward through the primary cup, any surplus fluid in the hydraulic system can return to the reservoir. The check valve spring presses the check valve against its seat with sufficient pressure to maintain some 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 depressed, the air valve and control valve move first. A shoulder on the air valve then contacts the end of the hydraulic piston. The hydraulic piston moves into the hydraulic cylinder, causing the brakes to be applied in the usual way. However, the pedal pressure for a given brake application is considerably greater. See figure 9-15.

As the hydraulic piston moves it carries the complete power piston assembly along with it.

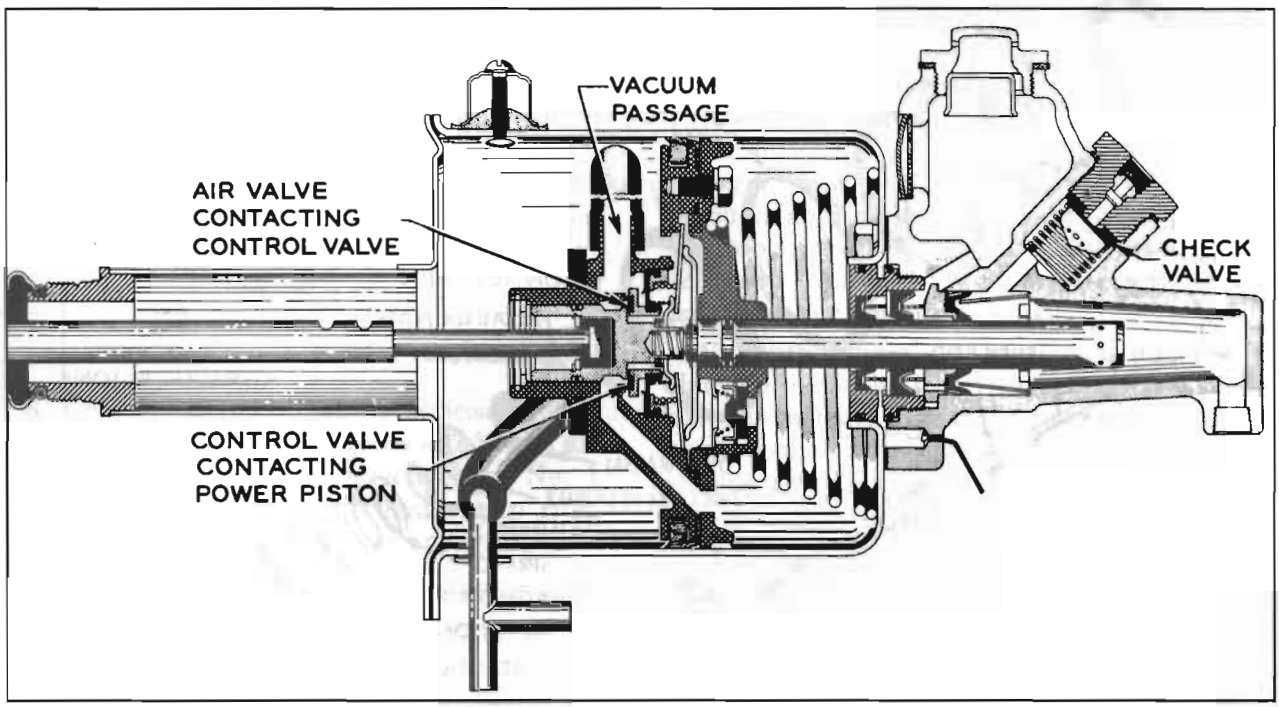


Figure 9-16—Holding

Under a sudden manual brake application, the rapid movement of the power piston tends to compress air ahead of it, resulting in a "dashpot" effect. To eliminate this possibility, a spring-loaded relief valve in the power piston allows air to flow very easily from the forward side of the power piston to the rear side.

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 foot pressure will be required to hold the pedal in the applied position.

9-18 DISASSEMBLY, INSPECTION, ASSEMBLY OF MORAINE POWER BRAKE UNIT

NOTE: *Refer to figures 9-14 and 9-15 for identification of parts not shown in figures next to overhaul steps.*

a. Disassembly of Power Unit

1. Measure distance push rod projects through clevis. Record this dimension so that clevis can be reinstalled in same position. Then remove clevis.

2. Mount power brake unit in vise with hydraulic cylinder down, being careful not to damage the loose vent pin in flange of hydraulic cylinder. Tighten vise only enough to hold cylinder firmly; excessive tightening will distort or crack cylinder.

3. Remove push rod boot from housing cover tube and from push rod. Remove felt air silencer from push rod boot. Take out air cleaner screw and remove air cleaner cover and filter.

4. Take out vacuum tube screws. Remove housing end cover screws, cover and gasket.

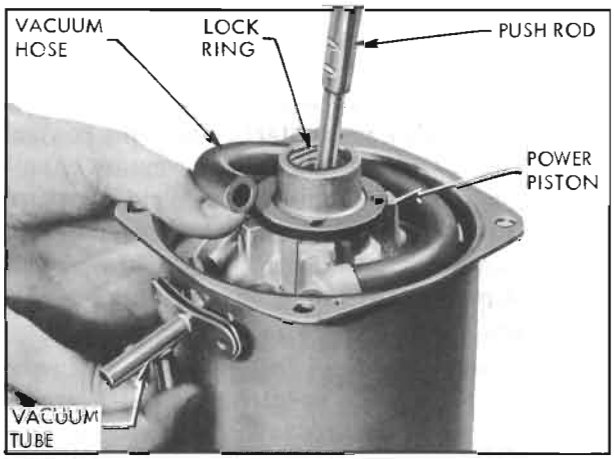


Figure 9-17—Removing Vacuum Tube

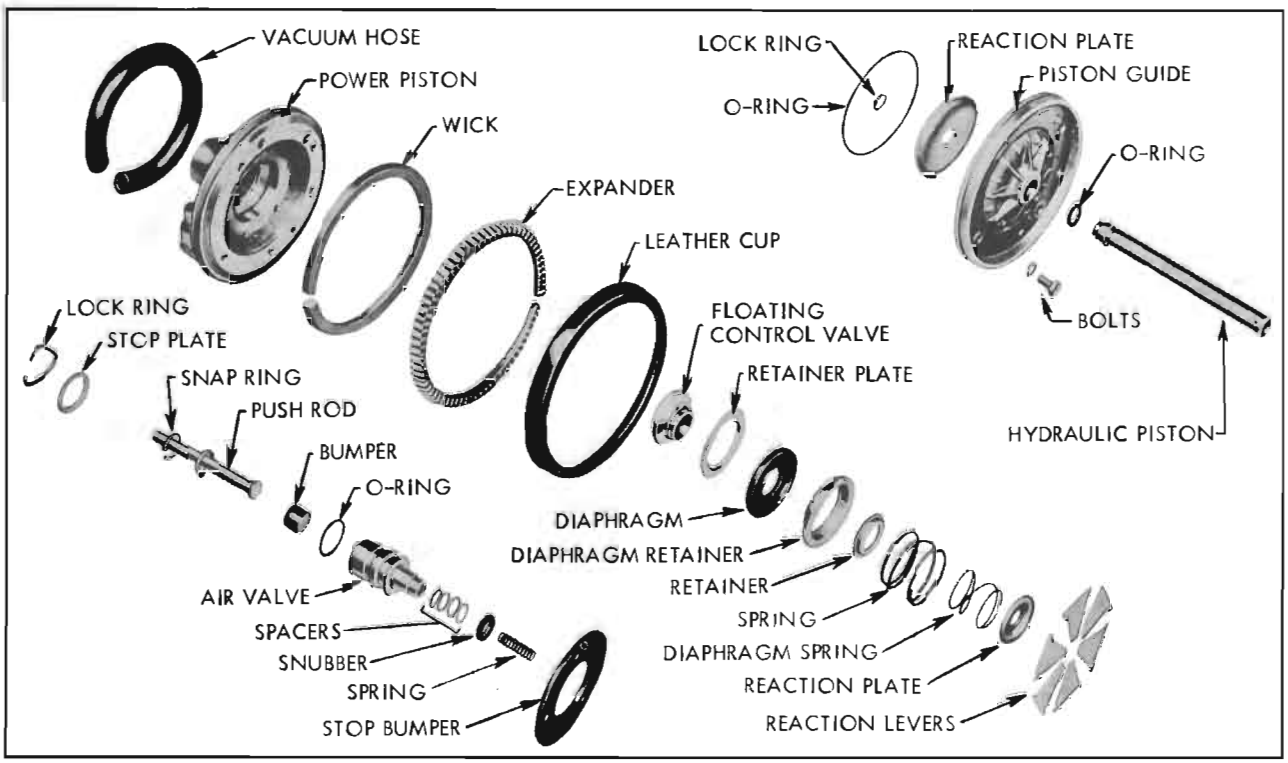


Figure 9-18—Power Piston Assembly—Exploded

While holding power piston down, disconnect vacuum hose from vacuum tube and remove tube and gasket from housing. See figure 9-17.

Slowly release power piston to control pressure of piston return spring as piston and attached parts emerge from housing. Make sure that lip of leather piston cup does not catch in holes in housing.

5. Pull vacuum hose off power piston, if hose is defective.

6. On push rod side of power piston, remove wire lock ring and stop plate.

7. Hold power piston assembly with push rod down and pull out push rod and air valve. See figure 9-19. Lift off the spring, snubber, and spacers (note number of spacers). Remove "O" ring from air valve.

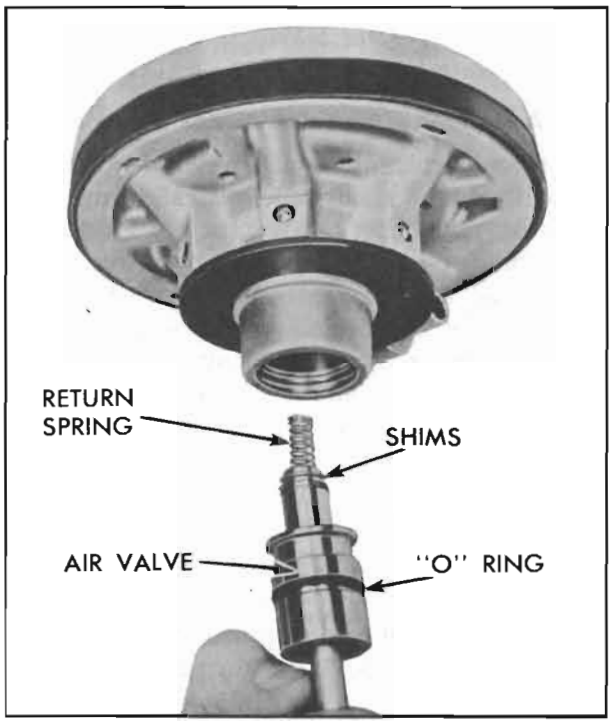


Figure 9-19—Removing or Installing Air Valve Assembly

8. Unless push rod is noisy or noticeably loose in air valve it need not be disconnected from air valve. If it must be disconnected, use No. 1 Truarc Pliers J-5403 to disengage snap ring. Then pull out push rod, bumper and washer.

9. Remove sponge rubber piston stop bumper.

10. Remove four cap screws holding piston guide to power piston while holding assembly together against inner spring load. With piston flat, carefully lift piston guide straight up to avoid disturbing loose parts under piston guide. Lift off loose "O" ring.

11. Push hydraulic piston out through piston guide and remove "O" ring from hydraulic piston.

12. If reaction plate or hydraulic piston is defective, separate them using No. 2 Truarc Pliers J-4880 to remove snap ring.

13. Inspect relief valve which is staked in place in piston guide. Remove relief valve if it is defective. See figure 9-20.

14. From power piston assembly, remove reaction levers, reaction spring, small reaction plate, and diaphragm spring. See figure 9-20.

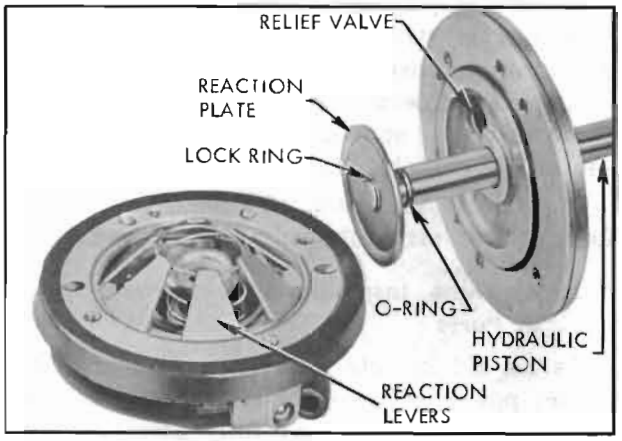


Figure 9-20—Reaction Levers and Related Parts

15. Remove leather cup, cup expander and felt wick.

16. Remove floating control valve assembly from power piston and disassemble as follows: With small screwdriver, pry retainer off diaphragm, then push floating control valve through diaphragm. This frees retainer plate in the process. Pull diaphragm from diaphragm retainer. This completes disassembly of the power piston assembly.

17. With hydraulic master cylinder still clamped vertically in a vise, remove power piston return spring. Remove four bolts and pull power cylinder straight up. Remove gasket. Unscrew master cylinder plug, using Wrench J-5794. Remove two "O" rings. See figure 9-21.

18. From inside plug, remove secondary cup expander, secondary cup, flat support, vacuum seal retainer and vacuum seal.

19. From bore of master cylinder body, pull out cup retainer, piston bearing, flat primary cup ring, primary cup and conical cup retainer.

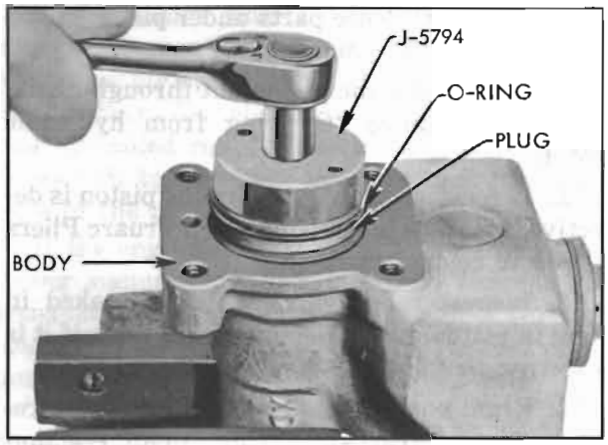


Figure 9-21—Removing Cylinder Plug

20. Reclamp hydraulic cylinder in vise so that head nut is straight up. Unscrew head nut, guarding against escape of check valve and spring as nut leaves threads of body. Remove check valve and spring from body. Remove gasket and check valve seat washer from head nut.

21. Inspect vent and vent pin. If necessary for cleaning, straighten pin and remove.

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.

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 when scored.

Make certain that the small compensating ports in end of hydraulic piston are clear. If these ports are plugged, clean them thoroughly and flush the hydraulic system to remove all dirt.

If the outer surface of the air valve or the hydraulic piston show evidence of abrasion, polish out light scores with crocus cloth or very fine polishing paper, then wash and dry thoroughly.

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

Make sure that the loose pin is properly retained in vent hole in flange of hydraulic cylinder body, and that vent hole is clear.

The Power Brake Cylinder Overhaul Kit 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 piston parts where lubrication is specified with Dynaflow oil. *Do not lubricate parts until just before installation.*

c. Assembly of Moraine Power Brake Unit

1. Clamp hydraulic master cylinder body in vise with threaded outlet hole straight up. Into this hole, place check valve spring. Place new check valve, concave side out, on spring. Place new gasket and stretch new seat washer onto head nut. Set head nut squarely against check valve and press against spring to hold check valve in position while head nut is started in threads. Run down finger tight, back off one or two turns to allow check valve to center, then torque to 85-90 ft. lbs.

2. Reposition hydraulic cylinder in vise with large bore straight up. Wipe bore and threads with a thin coat of clean brake fluid.

3. Into bore, set conical primary cup retainer with notched end in first. Dip primary cup in clean brake fluid and install lip side first over retainer. Center lip of cup must fit in hole. Set primary cup ring of thin blued steel on flat of primary cup. With notched face out, place piston bearing on primary cup ring with hub of bearing fitting into opening in cup, then press home to solid seat. Now set dark secondary cup retainer to center on bearing and position expander on retainer with notched side in.

4. On master cylinder plug, install two "O" rings on first and third grooves of plug. *Do not place an "O" ring in center groove which has four small vent holes.* Install vacuum seal in bottom of bore in plug flat side down. Position

light colored retainer on seal, then install flat support on shoulder in bore. Place secondary cup flat side down against support.

5. Moisten "O" rings on plug with clean brake fluid and screw plug assembly into hydraulic body, checking that secondary cup retainer and expander are centered. Use Wrench J-5794 to tighten plug to 20-30 ft. lbs.

6. If vent pin was removed, install in vent hole and bend to about 45° angle to hold in place. Set assembled hydraulic cylinder aside to protect from dirt or damage.

7. To assemble floating valve assembly, stretch new diaphragm to fit in groove on diaphragm retainer. See figure 9-22. Hold flat side of plate against flat side of diaphragm while pressing floating control valve into center hole of diaphragm. Use thumbs to stretch diaphragm over hub of floating control valve, then press spring retainer over valve hub and diaphragm lip. Lubricate O.D. of floating valve with Dynaflow oil and press into place in power piston with rubber face of floating control valve facing in.

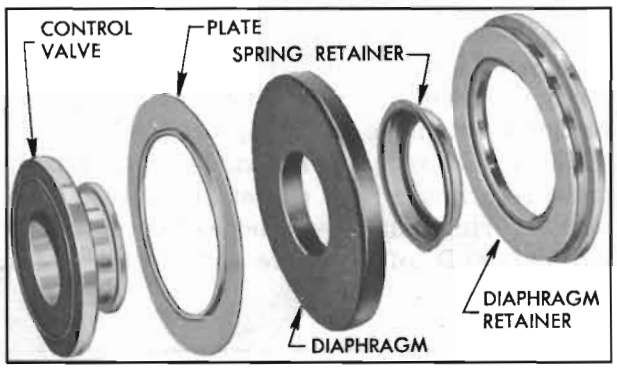


Figure 9-22—Floating Valve Assembly—Exploded

8. Soak felt wick in Dynaflow oil and allow excess to drain. Position wick in cup expander and install these parts in groove on O.D. of power piston with expander fingers pointing toward piston hub. Hold in groove while leather piston cup is slipped over expander with its lip pointing toward piston hub. See figure 9-23. If new leather cup is being installed, use cardboard cylindrical retainer to confine cup during installation.

9. Set piston on flat surface hub down. Install lighter diaphragm spring on spring retainer, then place smaller reaction plate on spring. Lower heavier reaction spring to seat in recess of diaphragm retainer. Set six reaction levers

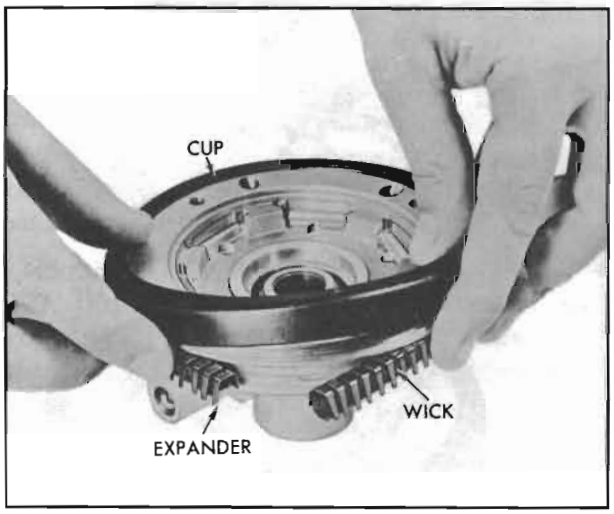


Figure 9-23—Installing Leather Piston Cup

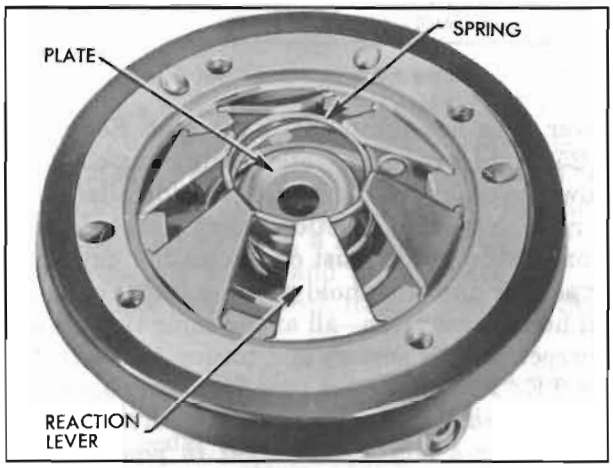


Figure 9-24—Installing Reaction Levers

in place with small ends resting on reaction spring as shown in figure 9-24.

10. If relief valve was removed from piston guide, install new relief valve and stake it securely being careful not to damage piston guide.

11. Lubricate a new "O" ring and install in groove on hydraulic piston. If reaction plate was removed from hydraulic piston, install it on piston with raised portion away from piston. Engage snap ring using No. 2 Truarc Pliers J-4880.

12. Lubricate a new "O" ring and install it on shoulder of piston guide.

13. Lubricate center hole of power piston guide. Holding hydraulic piston vertical with reaction plate down, start piston guide ribbed side up on piston. Set reaction plate square and centered over reaction levers, then lower quickly to hold levers in position while compressing springs. In this step, watch that wide end of a

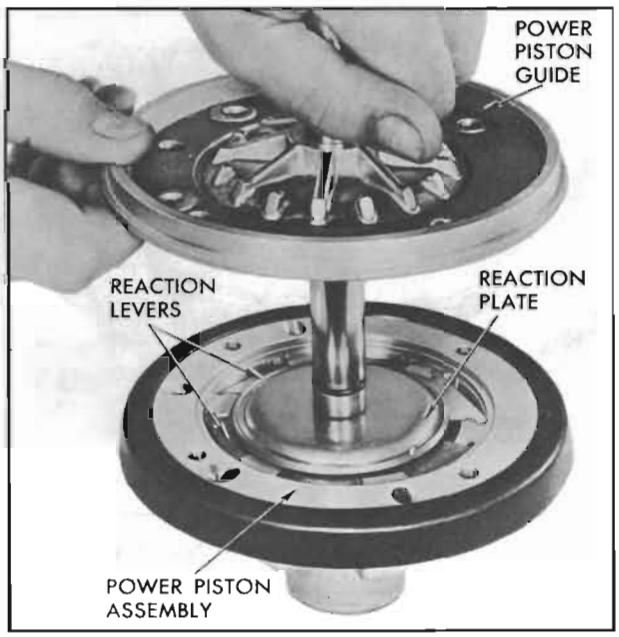


Figure 9-25—Installing Piston Guide

lever does not jump out of its seat. See figure 9-25. Hold pressure while sliding piston guide down over hydraulic piston for installation of screws. Note that reaction levers must hold position, piston guide must clamp leather cup while expander and wick hold position under cup, and all holes must align—all at the same time. When correct, install screws and torque to 5-6 ft. lbs. NOTE: *To assure that reaction levers are properly seated, check to see that master cylinder piston has a slight movement in power piston assembly.*

14. Coat one side of sponge rubber piston stop bumper with weatherstrip adhesive and air dry for 30-60 seconds. Install bumper in groove on hub of power piston.

15. If push rod was disconnected from air valve, install bumper, push rod and washer. Then install snap ring using No. 1 Truarc Pliers J-5403. *Check for proper seating of snap ring with a hard pull on push rod.*

16. Set spacers (shims) on Gauge J-5805. Hold power piston assembly with air valve bore down and insert gauge and spacers as shown in figure 9-26. (The body of the gauge sets against the smaller reaction plate while the pin of the gauge extends through to contact the master cylinder piston.) Now turn whole assembly over to bring gauge on top and observe gauge pin in gauge body as shown in figure 9-26. CAUTION: *Hydraulic master cylinder piston must be at lowest limit for correct use of gauge. Do not hold assembly by hydraulic piston or allow hydraulic piston to contact bench.*

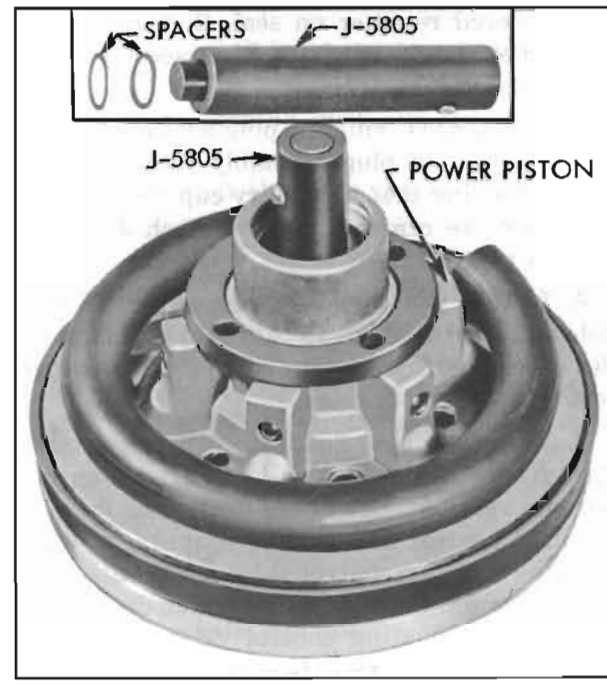


Figure 9-26—Checking Spacer Thickness

17. If pin is flush with body or sticks out no more than .010 inch, spacers are correct. If pin is high or low, add or remove spacers respectively until within limits. When spacers are correct, pull out gauge and set spacers and snubber (rubber face out) on air valve. Then set air valve return spring in end of air valve. Install new "O" ring in narrow groove of air valve and lubricate O.D. of air valve and "O" ring. See figure 9-27.

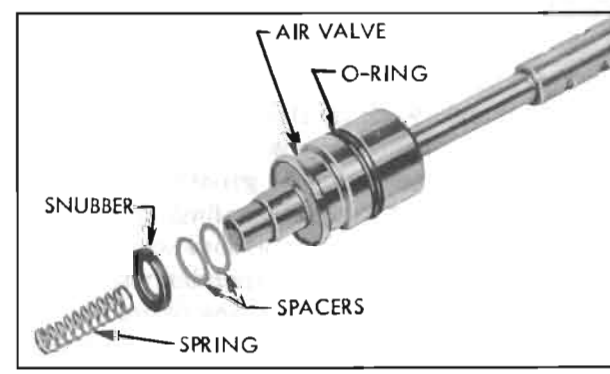


Figure 9-27—Air Valve and Related Parts

18. Hold power piston assembly with air valve bore down and install complete air valve assembly. Hold air valve in position and turn power piston over. Install stop plate and wire lock ring in hub of power piston. Check to see that air

valve has about 1/32 inch movement before it picks up floating valve, then pull out hard on push rod to check seating of lock ring.

19. If vacuum hose was removed from power piston, coat O.D. of vacuum hose tube with adhesive, allow 30-60 seconds to air dry, then slip vacuum hose fully on tube so that it lays parallel to power piston.

20. Clamp assembled master cylinder vertically in vise. Lubricate O.D. of "O" ring on cylinder plug and install gasket properly aligned so that vent passage is open. Install power cylinder housing so that the air cleaner holes are in the same direction as the master cylinder filler cap. Install four bolts and lock washers and torque to 12 ft. lbs. Wipe light coat of Dynaflow oil on inside of housing.

21. Set power piston return spring in housing with large end in position so that bent end fits between a bolt head and closest dimple.

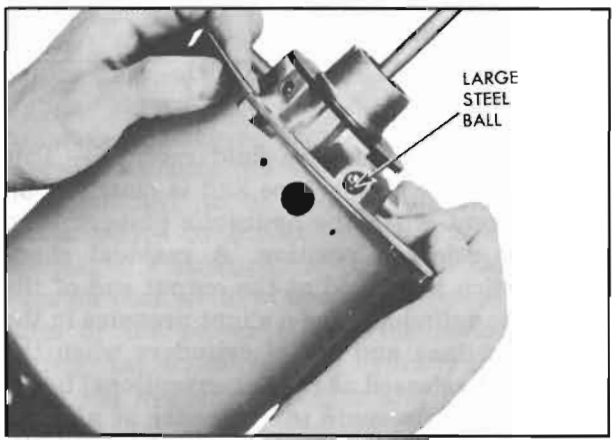


Figure 9-28—Positioning Piston in Housing

22. Wipe a light coat of Dynaflow oil on O.D. of leather cup. Position power piston assembly on spring with large steel ball aligned with vacuum tube hole in housing. See figure 9-28. Push piston assembly into housing past vacuum tube hole. Place gasket against vacuum tube flange, then insert vacuum tube through hole and slide into vacuum hose. Hold piston assembly in until vacuum tube attaching screws are tightened, then release piston slowly against tube.

23. Operate power piston several times, then check vacuum hose to see that it lays flat against power piston without rubbing either on power piston hub or cylinder housing. If hose rubs, rotate power piston position in relation to small end of return spring to correct.

24. Install housing cover and gasket. Hold against spring load to install two screws.

25. Place felt silencer halfway up boot. Slide boot over push rod 1/2 inch past threads, then install in groove on cover tube.

26. Install air cleaner filter, cover and screw.

27. Install push rod clevis so that push rod projects through clevis the exact amount as measured before removing clevis. Tighten clevis lock nut.

9-19 BENDIX POWER BRAKE UNIT

a. Construction of Bendix Power Brake Unit

The Bendix power brake unit consists of two basic sections combined into a single unit; these are the vacuum power cylinder and the hydraulic master cylinder. The vacuum power cylinder consists of a cylinder, a power piston and valve assembly, a piston return spring, a valve operating rod and a hydraulic plunger assembly. The hydraulic master cylinder consists of a hydraulic cylinder, a reservoir, a residual check valve, a compensating valve, and the forward end of the hydraulic plunger with its cup and seal. See figure 9-29.

The power piston and the components which make up the valve assembly are connected to the brake pedal through the valve operating rod. The valve operating rod is connected to the valve plunger which operates within the power piston. The valve return spring is incorporated to return the valve plunger and the valve operating rod to the released position when the brakes are released. A separate poppet type air relief valve is built into the power piston; this valve functions only when a brake application is made without vacuum assist.

The valve portion of the power piston consists of a poppet valve, an atmospheric port and a vacuum port. The atmospheric port seat is located on the valve plunger while the vacuum port seat is located in the rear half of the power piston.

The poppet valve is assembled into a flexible diaphragm in the power piston. A diaphragm plate is used in conjunction with the diaphragm to limit the effective area of the diaphragm. When the power cylinder is in the released position, the poppet return spring overcomes the force present on the poppet as a result of

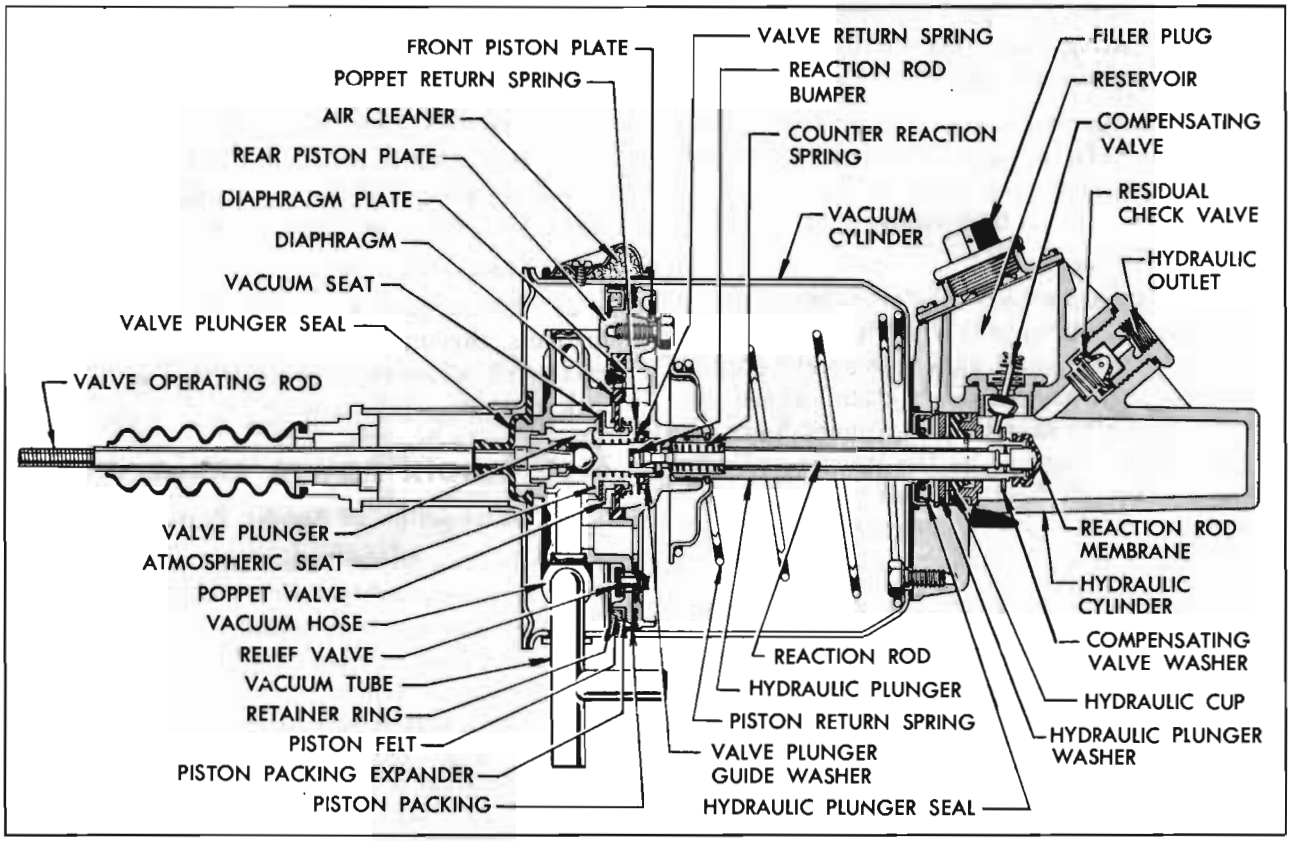


Figure 9-29—Bendix Power Brake Unit

the atmospheric pressure on the left side of the poppet and the vacuum on the right side of the poppet so that the return spring holds the poppet on the vacuum seat. A valve plunger seal is used to seal the opening between the rear piston plate and the valve operating rod.

The power piston is in contact with the hydraulic plunger at all times and thereby transmits the force of the piston to the fluid in the hydraulic cylinder. A reaction rod which is a part of the hydraulic plunger assembly operates within the hydraulic plunger to transmit a "reaction force" back through the rod against the valve plunger. A counter reaction spring located between the power piston and reaction rod, permits initial application of power before sufficient hydraulic pressure is developed within the hydraulic cylinder to react through the reaction rod membrane at the end of the hydraulic plunger and the reaction rod.

The hydraulic cylinder with the fluid reservoir is attached to the end of the vacuum cylinder. The hydraulic cylinder is sealed off from the vacuum cylinder at the hydraulic plunger by a leather wiper seal and a rubber cup. A compensating valve is placed between the hydraulic cylinder and the fluid reservoir. This valve is of the tilting type and is closed at all times except when the hydraulic plunger is in its fully released position. A residual check valve which is located at the output end of the hydraulic cylinder traps a slight pressure in the hydraulic lines and wheel cylinders when the brakes are released as in the conventional brake system. This prevents the entrance of air into the hydraulic brake lines upon release of the brakes.

b. Operation of Bendix Power Brake Unit

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

(1) *Released Position.* See figure 9-30. When the engine is running and the brakes are released, vacuum from the engine intake manifold is transmitted through the vacuum check valve to the power brake vacuum tube and to the vacuum reservoir. Vacuum is transmitted into the power brake unit through an internal vacuum hose which is attached to the power piston at the rear side. Atmosphere is always present on the left side of the power piston

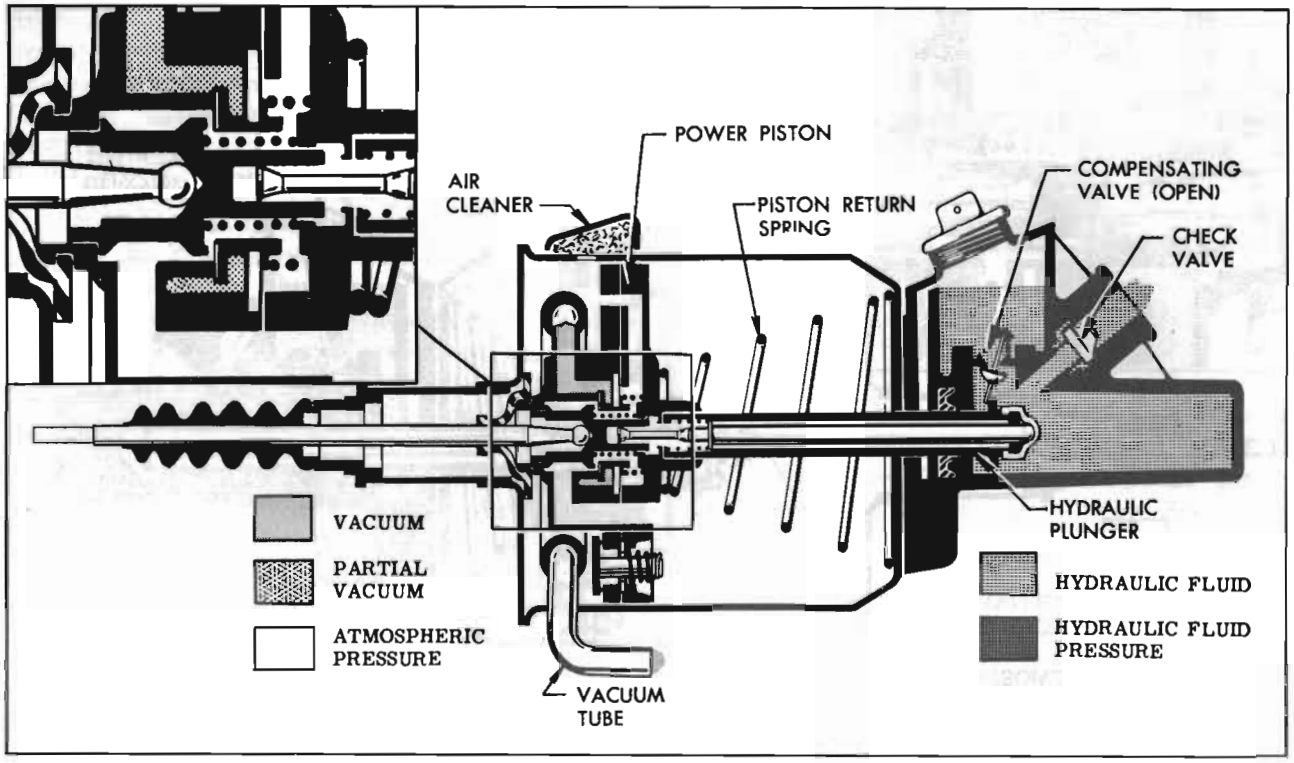


Figure 9-30—Released Position

through the air cleaner. In the released position, as shown in figure 9-30, the driver's foot pressure is removed from the valve operating rod. This allows the valve operating rod and valve plunger to be held to the rear in the power piston by the valve return spring, thus opening the atmospheric port and closing the vacuum port. With atmosphere present on both sides of the power piston, the piston return spring (attached to the hydraulic plunger) holds the hydraulic plunger and power piston assembly in the released position.

When the power piston and valve operating rod are in their released positions, the various parts of the hydraulic master cylinder are also in their released positions. The compensating valve is tilted by the washer at the end of the hydraulic plunger permitting fluid flow from the reservoir to the hydraulic cylinder. The expansion, contraction or leakage of fluid is thereby compensated for as in a conventional brake system. The residual pressure check valve maintains fluid under slight pressure in the lines and wheel cylinders to prevent the entrance of air into the hydraulic system.

(2) *Applying*. See figure 9-31. As the brake pedal is depressed, the valve operating rod moves the valve plunger and closes the atmospheric port. After the atmospheric port is closed against the poppet, further movement of the valve operating rod and plunger moves the poppet valve, compressing the poppet return spring and opening the vacuum port. With the vacuum port open, vacuum is admitted through the piston passages to the forward side of the power piston. With partial vacuum on the forward side of the power piston and atmosphere on the rear side of the piston, the differential in pressure creates a force which moves the power piston forward, moving the hydraulic plunger with it. Initial movement of the plunger allows the compensating valve to seat and trap fluid in the hydraulic cylinder. Fluid under pressure is then forced through the residual pressure check valve and brake lines to the wheel cylinders.

(3) *Reaction Pressure*. See figure 9-31. Any pressure in the hydraulic cylinder causes the membrane at the end of the hydraulic plunger to transmit a force to the reaction rod. This force acts back through the reaction rod and counter reaction spring against the valve plunger and valve operating rod. Since the reaction force is in proportion to the pressure developed within the hydraulic cylinder and the wheel cylinders, it gives the driver a sense of "feel" of the amount of braking.

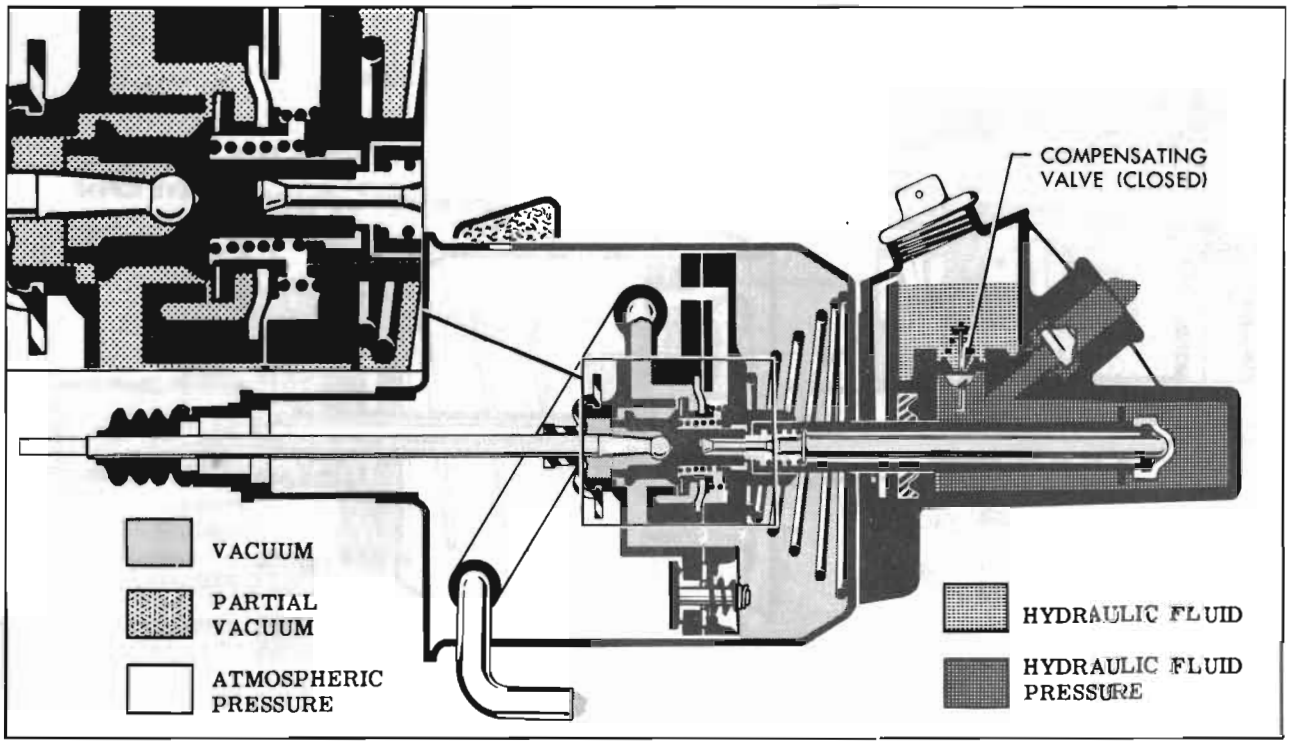


Figure 9-31—Applying

(4) *Holding*. See figure 9-32. When the force applied by the driver remains constant, the valve is allowed to remain in its holding position. In the holding position both the vacuum and the atmospheric ports of the poppet valve are closed. However, any increase in the force applied by the driver to the valve operating rod and plunger will cause the vacuum port

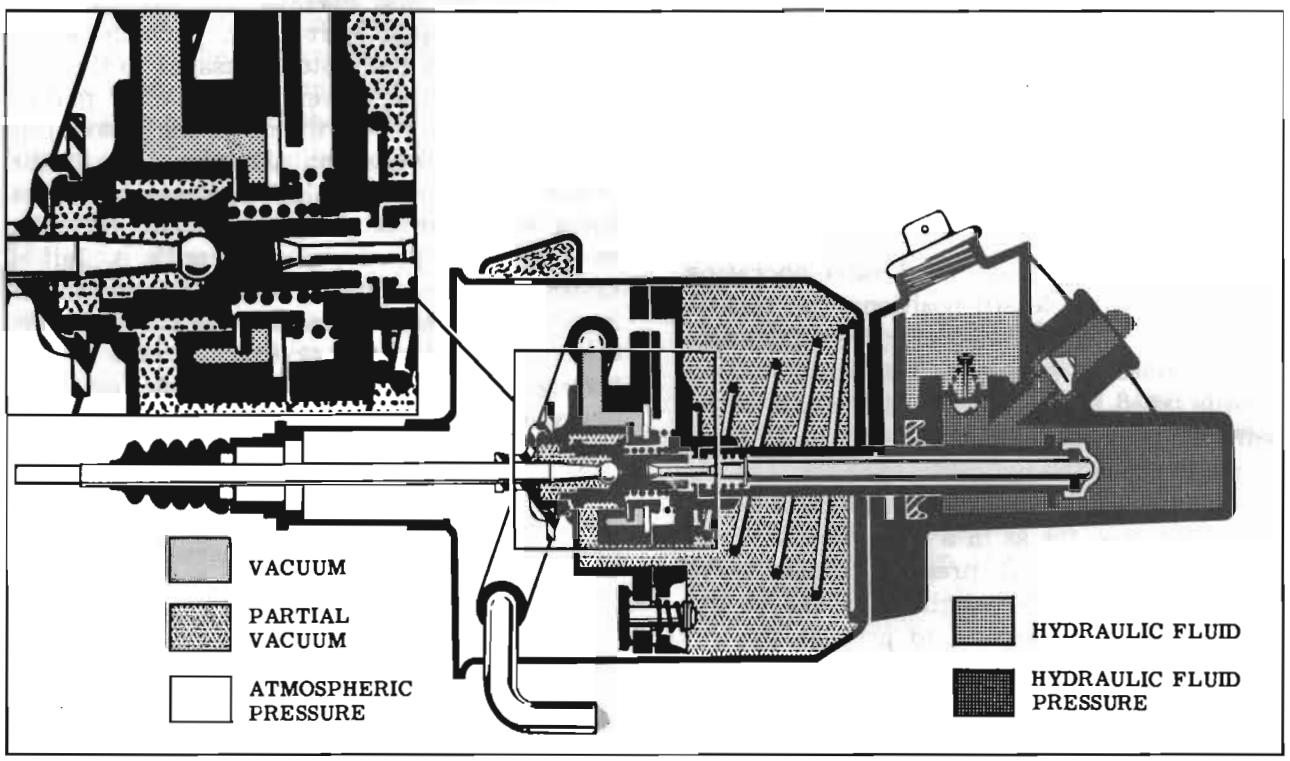


Figure 9-32—Holding

to reopen, admitting more vacuum to the forward side of the power piston. This will cause the power piston to move farther forward until it again "catches-up" with the valve plunger and poppet. The vacuum port will then close and the valve is again in the holding position.

(5) *Releasing.* Upon the release of the effort applied to the valve operating rod by the driver, the valve plunger returns to its released position with the vacuum port closed and the atmospheric port reopened to admit atmosphere to the forward side of the power piston to again balance the piston in atmosphere. See figure 9-30. The piston return spring then returns the power piston and hydraulic plunger to the released position. As the hydraulic plunger approaches the released end of the stroke, the washer on the hydraulic plunger again contacts the compensating valve stem and opens the valve port to allow the excessive fluid in the hydraulic cylinder to return to the fluid reservoir.

(6) *Manual Applying.* If it should be necessary to use the brakes at a time when the engine is not running and there is no reserve vacuum remaining in the system, the brakes can still be applied manually. In the case of "no power" the force supplied by the driver against the end of the valve operating rod will be transmitted directly to the hydraulic plunger and to the wheel cylinders. See figure 9-31. However, for a given amount of vehicle braking, more foot pressure must be supplied by the driver.

Because of the tendency of the air in the cylinder on the forward side of the power piston to compress when the brake is manually applied, there is a relief valve in the power piston to allow this air to escape more rapidly. This relief valve eliminates any "dash pot" effect in the power cylinder when it is operated without vacuum.

9-20 DISASSEMBLY, INSPECTION, ASSEMBLY OF BENDIX POWER BRAKE UNIT

NOTE: *Refer to figures 9-29 and 9-34 for identification of parts not shown in figures next to overhaul steps.*

a. Disassembly of Power Unit

1. Measure distance push rod projects through clevis. Record this dimension so that clevis can be reinstalled in same position. Then remove clevis.

2. Clamp unit in vise with push rod straight up and remove rubber dust boot from tube on end plate and from push rod. Bend out tabs on end plate. Remove end plate and gasket.

3. Slide vacuum hose off vacuum tube. Remove vacuum tube attaching screws, vacuum tube and gasket.

4. Remove air cleaner attaching screw and screw gasket. Remove air cleaner shell, hair, and rubber gasket.

5. Remove burrs from inside of vacuum cylinder at air cleaner and vacuum tube attaching screw holes. Then pull out power piston and valve assembly from cylinder. See figure 9-33.

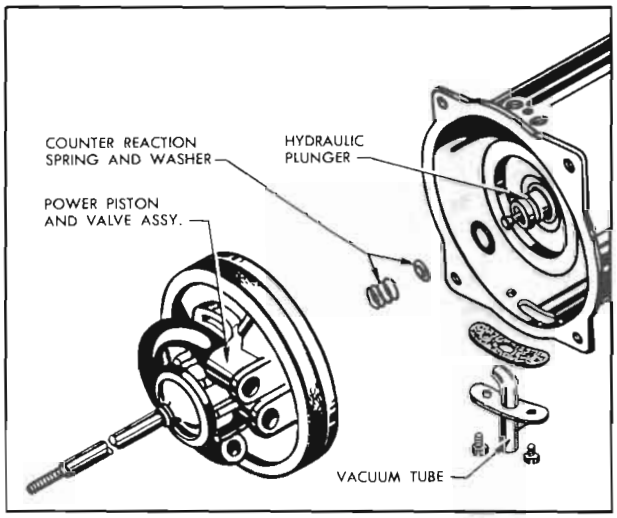


Figure 9-33—Removing Power Piston Assembly

6. Remove valve operating rod seal from rod and piston.

7. Remove vacuum hose, retainer ring, felt, and expander from piston assembly.

8. Turn piston over, hold in vise and remove four cap screws. Separate front and rear piston plates. Then remove diaphragm plate and poppet return spring from rear piston plate. Remove diaphragm assembly and then separate poppet return spring retainer, diaphragm, diaphragm plate and poppet. Lift off leather piston packing and valve plunger return spring.

9. Remove push rod and valve plunger as an assembly from rear piston plate. Then remove rubber reaction rod bumper from end of valve plunger using an ice pick.

10. Hold finger against relief valve and remove hair pin, washer, spring, and poppet

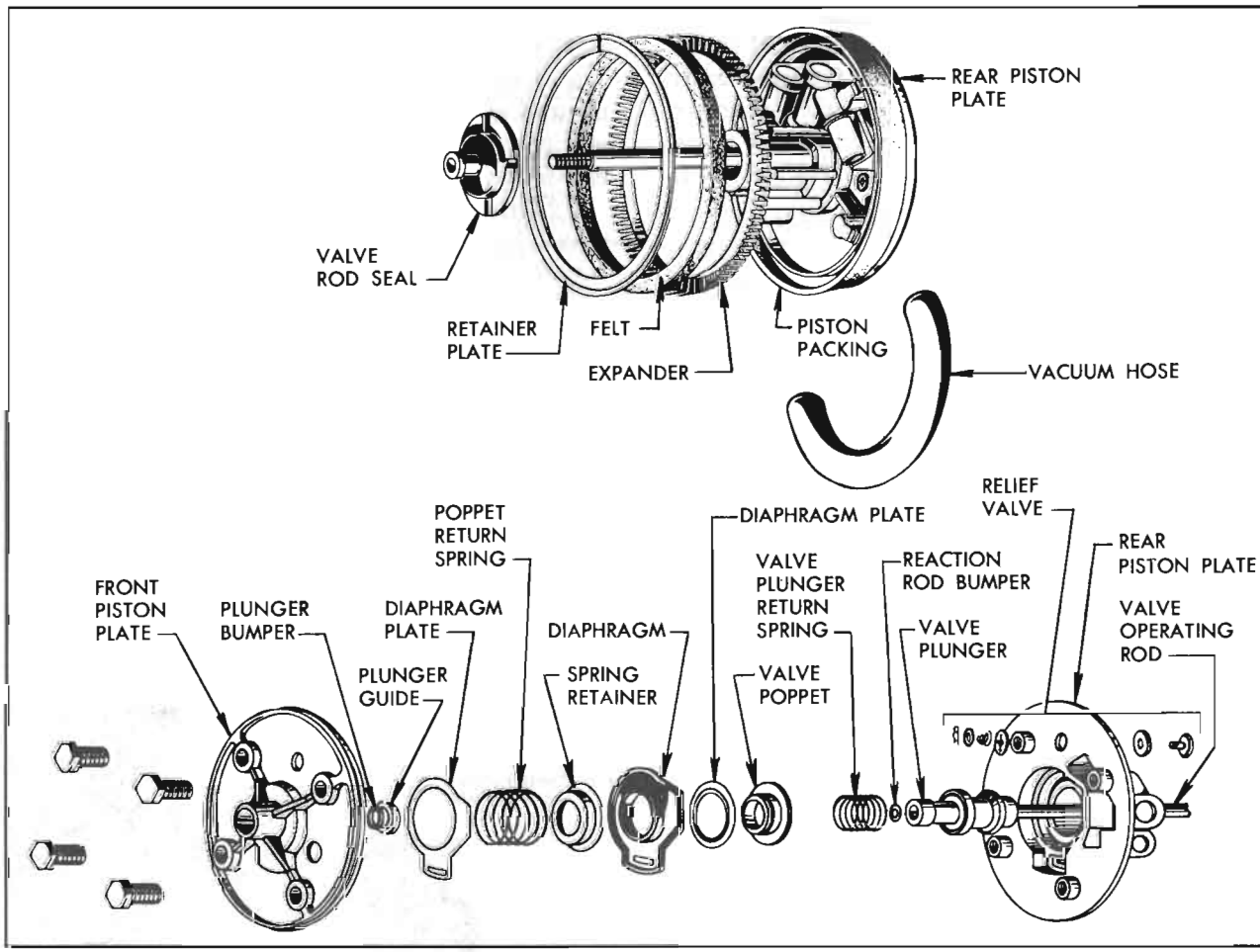


Figure 9-34—Power Piston Assembly—Exploded

guide from rear piston plate. Then remove relief valve seal from valve seal retainer.

11. If fibre guide washer in front piston plate is worn so that valve plunger fits into it loosely, remove valve guide washer and rubber bumper from front piston plate. If fibre guide washer is not worn, remove rubber bumper only.

12. Remove O-ring seal from groove in hydraulic plunger. Push in on piston return spring retainer plate sufficient to release C-

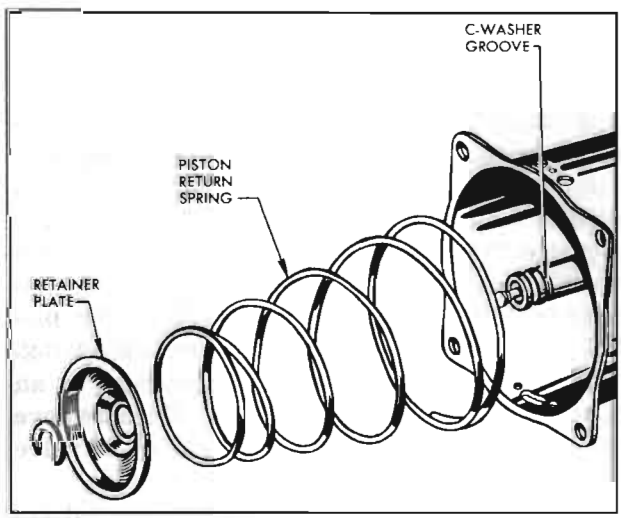


Figure 9-35—Removing Piston Return Spring

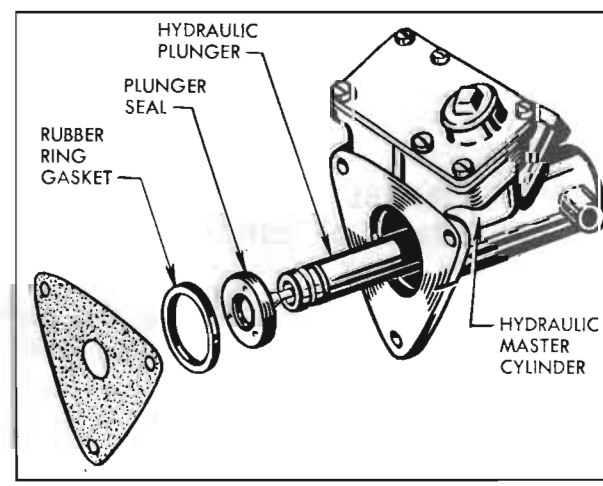


Figure 9-36—Removing Vacuum Cylinder from Hydraulic Cylinder

washer. While holding spring compressed, slide C-washer out of groove in hydraulic plunger. Remove retainer plate and vacuum piston return spring. See figure 9-35.

13. Remove three vacuum cylinder attaching screws and lockwashers. Lift off vacuum cylinder. Remove vellumoid gasket and rubber ring gasket. See figure 9-36.

14. Remove counter reaction spring and washer from end of hydraulic plunger. Push hydraulic plunger in and out of hydraulic cylinder to remove leather plunger seal from master cylinder.

15. Remove six reservoir cover attaching screws, cover and gasket. Remove compensating valve assembly.

16. Remove hydraulic cup retainer ring, using Truarc Pliers J-4245.

17. Pull hydraulic plunger out of hydraulic cylinder and remove steel stop washer, fibre plunger guide washer, rubber hydraulic cup and cup retainer from hydraulic plunger. Remove membrane seal and nylon washer from other end of plunger using an ice pick if necessary to get under washer.

18. Loosen outlet fitting. Remove hydraulic

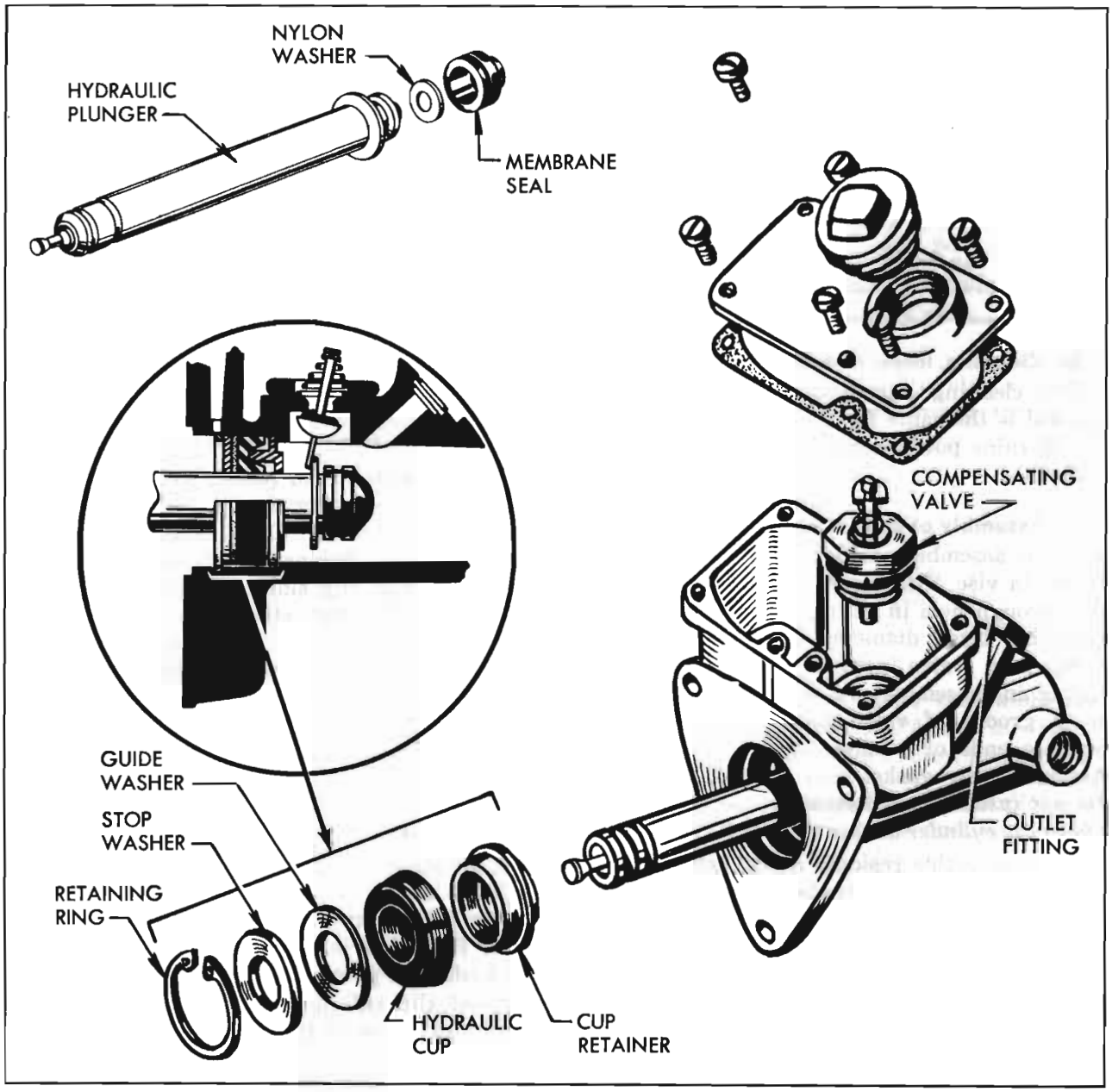


Figure 9-37—Hydraulic Cylinder Assembly—Exploded

master cylinder from vise. Remove outlet fitting, residual check valve cup, retainer and spring from master cylinder. Remove gasket from outlet fitting. See figure 9-37.

19. Clamp compensating valve fitting in vise. Spread and remove spring retainer. Then remove spring, valve stem and poppet. Remove fitting gasket from fitting. See figure 9-38.

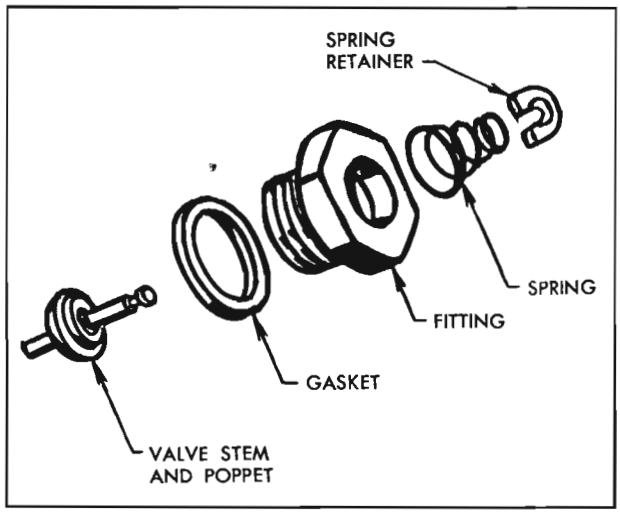


Figure 9-38—Compensating Valve Assembly

b. Cleaning, Inspection, Replacement of Parts

The cleaning and inspection procedure in general is the same for the Bendix as it is for the Moraine power brake unit. See Paragraph 9-18 (b).

c. Assembly of Bendix Power Brake Unit

1. To assemble compensating valve, clamp fitting in vise, then insert valve stem and poppet through hole in fitting from threaded end. Assemble large diameter end of spring over stem, hold valve poppet on seat, compress spring and assemble new spring retainer washer in groove of valve stem. See figure 9-38. Squeeze ends of washer together with pliers. Assemble new gasket over threads of fitting. *Do not install compensating valve assembly in hydraulic cylinder at this time.*

2. To assemble residual check valve, assemble new gasket over threads of hydraulic outlet fitting. Insert cone end of check valve cup and retainer in fitting. Place check valve spring in recess of retainer. Hold hydraulic master cylinder so that outlet hole is straight down and thread outlet fitting and check valve assembly into hydraulic cylinder hand tight. See figure 9-39.

3. Clamp hydraulic cylinder in vise. Assemble nylon washer and rubber membrane on end of hydraulic plunger. Insert membrane end of plunger in cylinder. Then install cup retainer (smaller hole against fixed washer), rubber hydraulic cup (lip side in first), fibre plunger guide washer and steel stop washer. Slide plunger and hydraulic cup parts in hydraulic cylinder as far as possible, then install hydraulic cup retainer ring in ring groove. See figure 9-37.

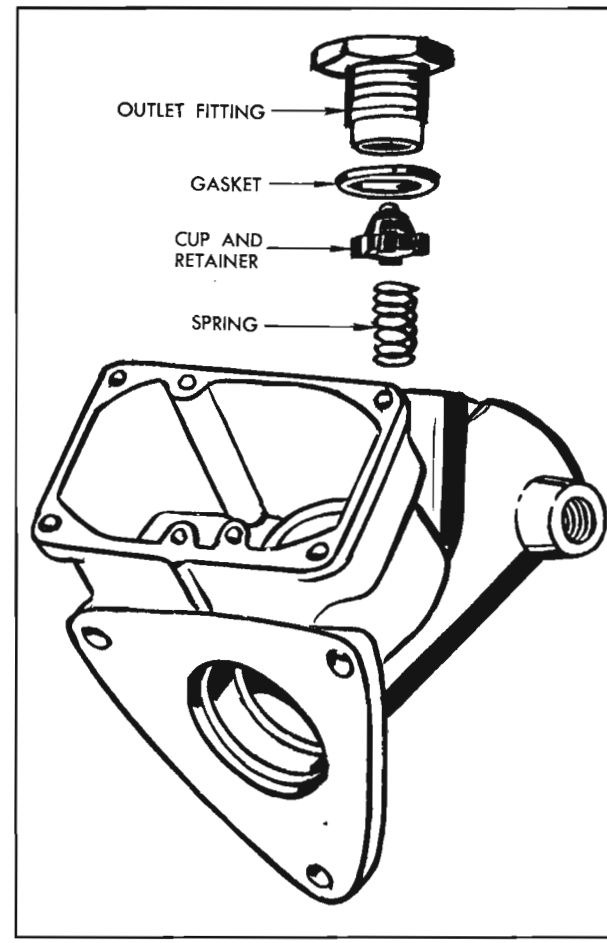


Figure 9-39—Removing or Installing Residual Check Valve

4. Install compensating valve assembly in threaded hole at bottom of reservoir and tighten securely. Tighten outlet fitting securely.

5. Install new reservoir cover gasket, aligning all holes with reservoir. Align cover so that filler is toward center of car. Install reservoir cover screws and tighten securely.

6. Place Seal Assembly Tool J-5405 over end of hydraulic plunger and install leather plunger seal (lip side first). See figure 9-40. Press seal into recess of hydraulic cylinder and then remove tool.

7. Install new rubber ring gasket in recess in hydraulic cylinder.

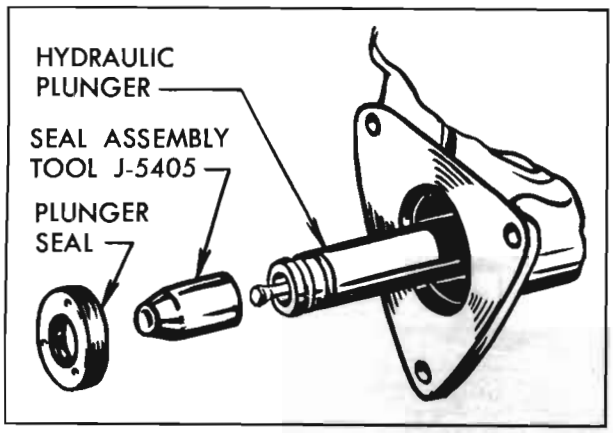


Figure 9-40—Installing Plunger Seal

8. Place new vellumoid gasket on machined face of hydraulic cylinder. Then install vacuum cylinder with air cleaner holes up. See figure 9-36. Wipe out inside of vacuum cylinder and then pull out hydraulic plunger to end of stroke.

9. Place large diameter end of piston return spring in vacuum cylinder and install retainer plate over end of hydraulic plunger. Compress return spring and install "C" washer in inner groove of hydraulic plunger. See figure 9-35. Install new O-ring in outer groove of hydraulic plunger.

10. To assemble power piston and valve assembly, first install new valve plunger bumper in recess of *front* piston plate. If fibre valve guide washer was removed, install new fibre washer and stake in place at three points.

11. In *rear* piston plate, assemble relief valve by dipping relief valve seal in clean brake fluid and installing over stem of valve seal retainer. Then insert seal and retainer through hole in piston plate from rear and hold with finger. Install poppet guide, spring, washer and hair pin.

12. If push rod and valve plunger were separated, install rod in plunger using a new grommet and grommet retainer. Make sure ball end of rod is locked securely in plunger.

13. Install new rubber reaction rod bumper in end of valve plunger. Then install push rod and plunger assembly in rear piston plate.

14. Place leather piston packing on rear piston plate with lip toward push rod. Install valve plunger return spring (smaller spring).

15. Install circular diaphragm plate in groove of diaphragm with beveled edge away from diaphragm. Then install valve poppet through diaphragm from the same side. Place this assembly in recess of rear piston plate. Install poppet return spring retainer and poppet return spring. Install diaphragm plate on diaphragm with cut-out in plate over cut-out in diaphragm. See figure 9-34.

16. Place front piston plate carefully on rear piston plate, making certain relief valve hole is aligned with relief valve. Make sure leather piston packing is centered, then install four cap screws and tighten securely.

17. Install piston packing expander with fingers against edge of leather packing. Saturate piston felt with Dynaflow oil, then install felt and retainer ring, making certain that ring is securely anchored in grooves of piston with beveled edge away from felt.

18. Install vacuum hose on power piston so that it lays parallel to piston. Install combination valve operating rod seal and power piston stop on rod and piston, making certain that seal is seated in groove at hub of piston.

19. Apply thin film of Dynaflow oil to inside of vacuum cylinder. Install counter reaction washer flat side first. Then install spring in recess at end of hydraulic plunger. See figure 9-33.

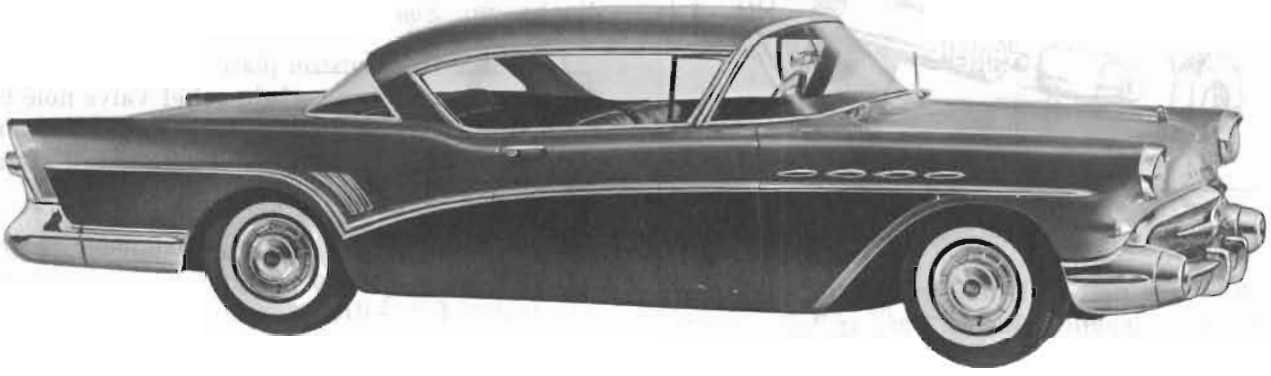
20. Install piston assembly in cylinder so that free end of vacuum hose is in line with center of elongated hole. Install new gasket over vacuum tube and slide tube into free end of vacuum hose approximately $\frac{5}{8}$ inch. Install vacuum tube attaching screws.

21. Place hair in air cleaner shell and rubber gasket over edges of shell. Attach air cleaner to vacuum cylinder using a screw and gasket.

22. Install end plate gasket and end plate on vacuum cylinder. Align holes and bend over two tabs to secure end plate and gasket to cylinder.

23. Install rubber dust boot with large end in groove of tube and small end $\frac{1}{2}$ inch from push rod threads.

24. Install push rod clevis so that push rod projects through clevis the exact distance as measured before removing clevis. Tighten clevis lock nut.



Model 56R

Model 73