GROUP 9-D
POWER BRAKES

SECTIONS IN GROUP 9-D

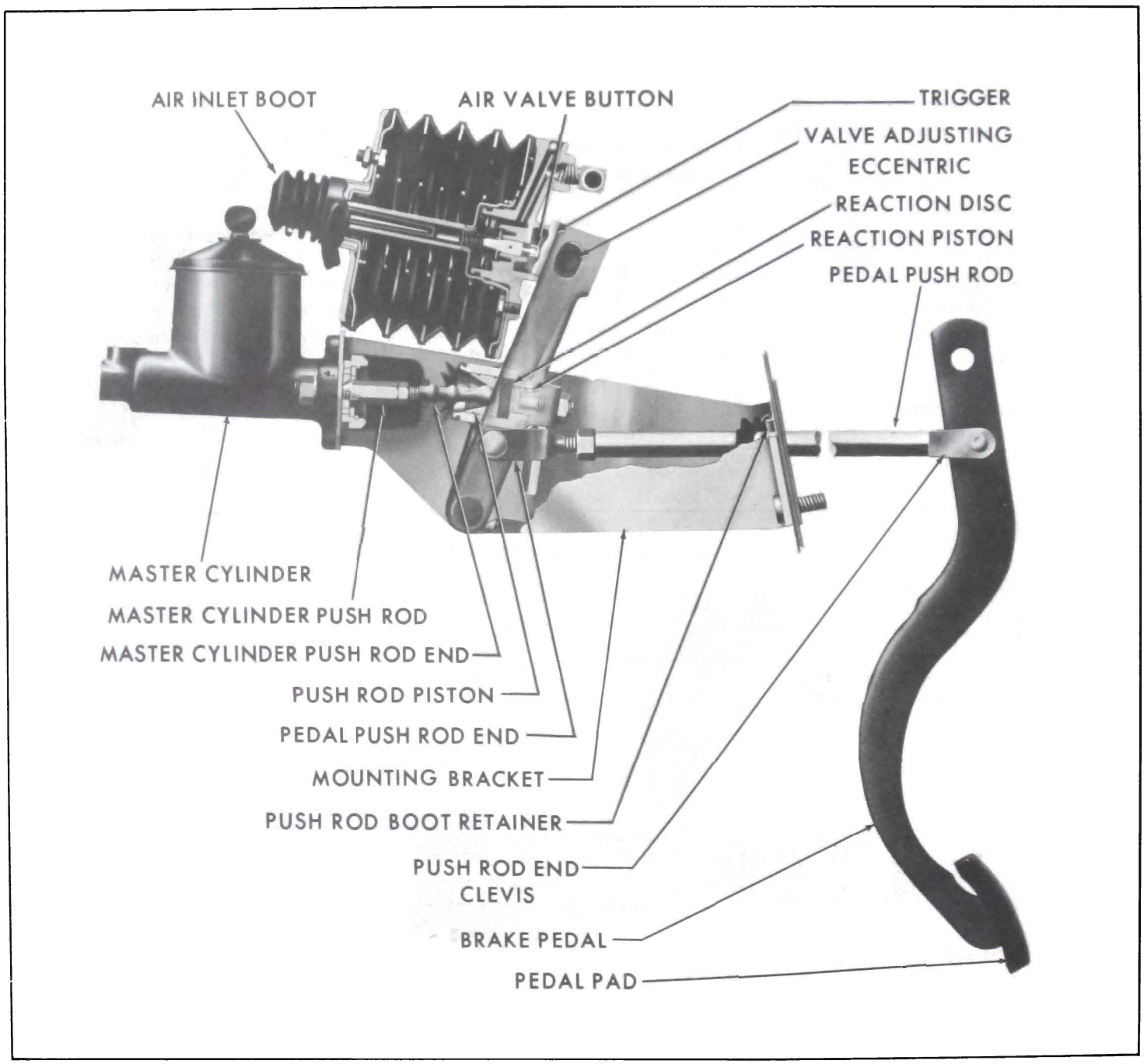

Figure 9-13—Sectioned Assembly

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 power unit which is mounted on the engine side of the cowl and is connected by the pedal push rod to the brake pedal that is identical to the one used on cars equipped with the standard master cylinder. It derives its power from the engine manifold vacuum and, combined with a vacuum check valve, traps vacuum in the vacuum reserve tank which is mounted in left front wheel well to the rear of the headlamp.

The power unit itself (see Figure 9-13) consists of the air-vacuum bellows, mounting bracket, power lever assembly, actuating lever assembly, the pedal push rod, and the master cylinder.

9-16 PRINCIPLES OF OPERATION

The power unit consists of an air-vacuum bellows which contracts and expands as the air pressure in it is varied by the introduction of vacuum or atmosphere. (See Figure 9-13.) One end of the assembly is attached to the mounting bracket, and the other end is connected to the power lever assembly. The valves which control the air pressure in the bellows are located in the valve housing, and are controlled by the movement of the actuating lever through the brake pedal. When the bellows contracts, it draws the power lever toward the master cylinder and gives a proportional assist to the operator as he depresses the brake pedal. This movement is transmitted to the master cylinder through the push rod and the brake applying action which results is the same as in any conventional hydraulic brake system.

Figure 9-14 shows the construction of the power lever assembly and actuating lever assembly which pivots in the mounting bracket. The power lever is connected to the valve housing of the power unit through the shank of the valve adjusting eccentric bolt. It is also connected to the master cylinder push rod through the reaction disc and push rod piston. The actuating lever is controlled by the movement of the brake pedal through the pedal push rod and carries the valve actuating bracket or "trigger". It also is connected to the reaction disc through the reaction piston and the reaction adjusting screw.

Refer to Figure 9-13 and note the relative positions of the valve assembly and the brake pedal, and particularly the air valve button and the trigger. The trigger is part of the actuating lever, and its movement, transmitted through the air valve button, controls the operation of the valves. The details of this operation are shown in Figures 9-16, 9-17 and 9-18.

In Figure 9-15, the air and vacuum valves are shown in the unapplied position. At this time, the bellows of the power unit is fully extended and is filled with atmosphere which has entered it through the air filter and the open air valve. The vacuum valve is closed, sealing the bellows off from the vacuum supply. However, as can be seen, vacuum is being applied at all times right up to the vacuum valve, so that any opening of the vacuum valve will immediately begin an evacuation of the air out of the bellows.

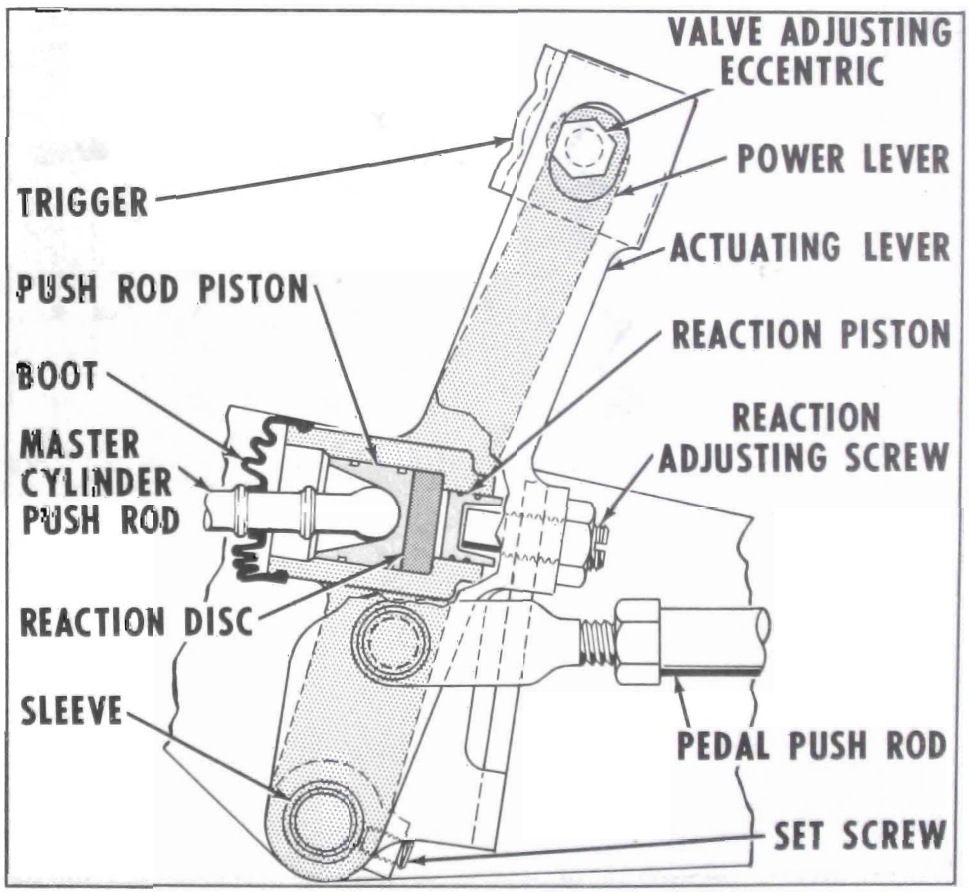

Figure 9-14—Power Lever Assembly

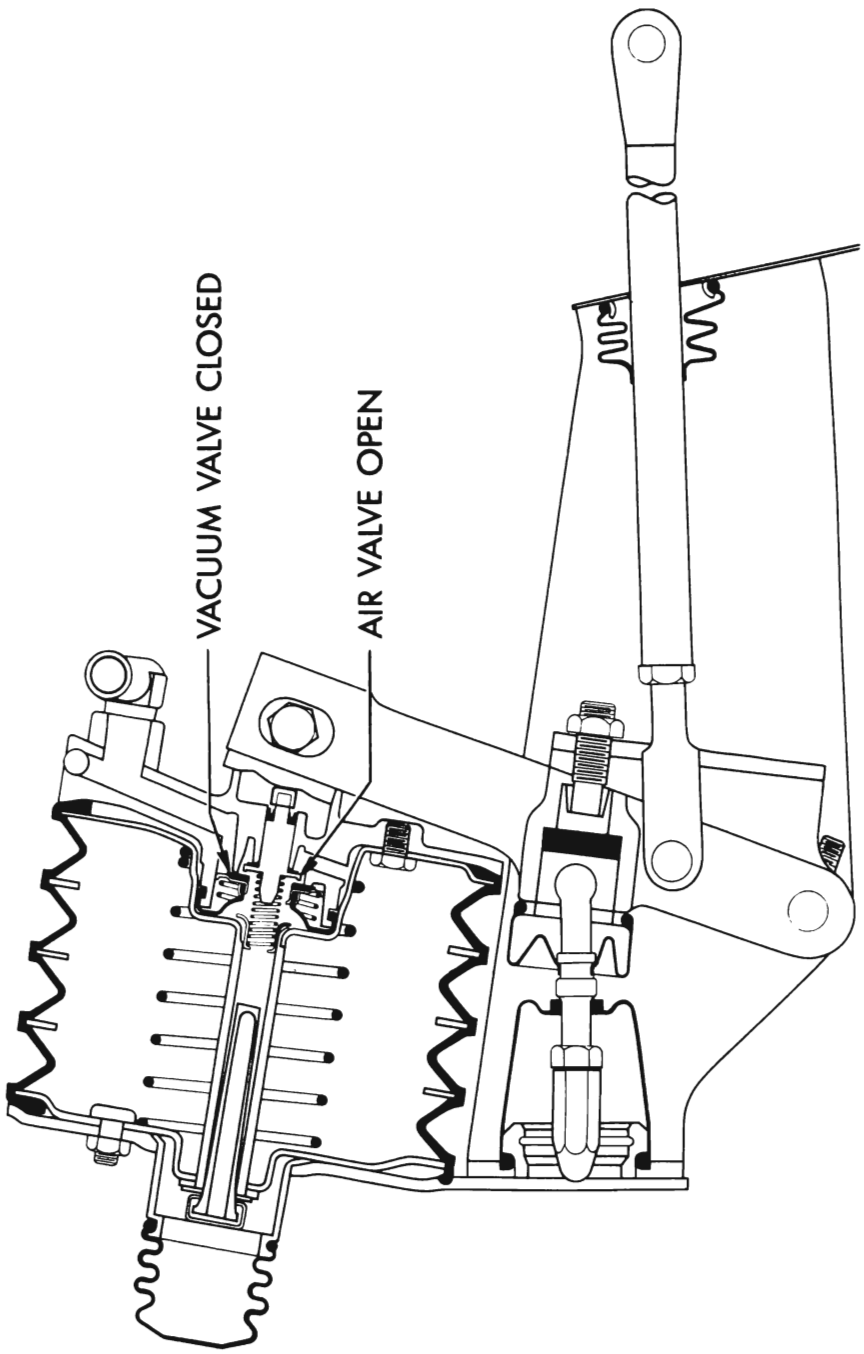

Figure 9-15—Unapplied Position

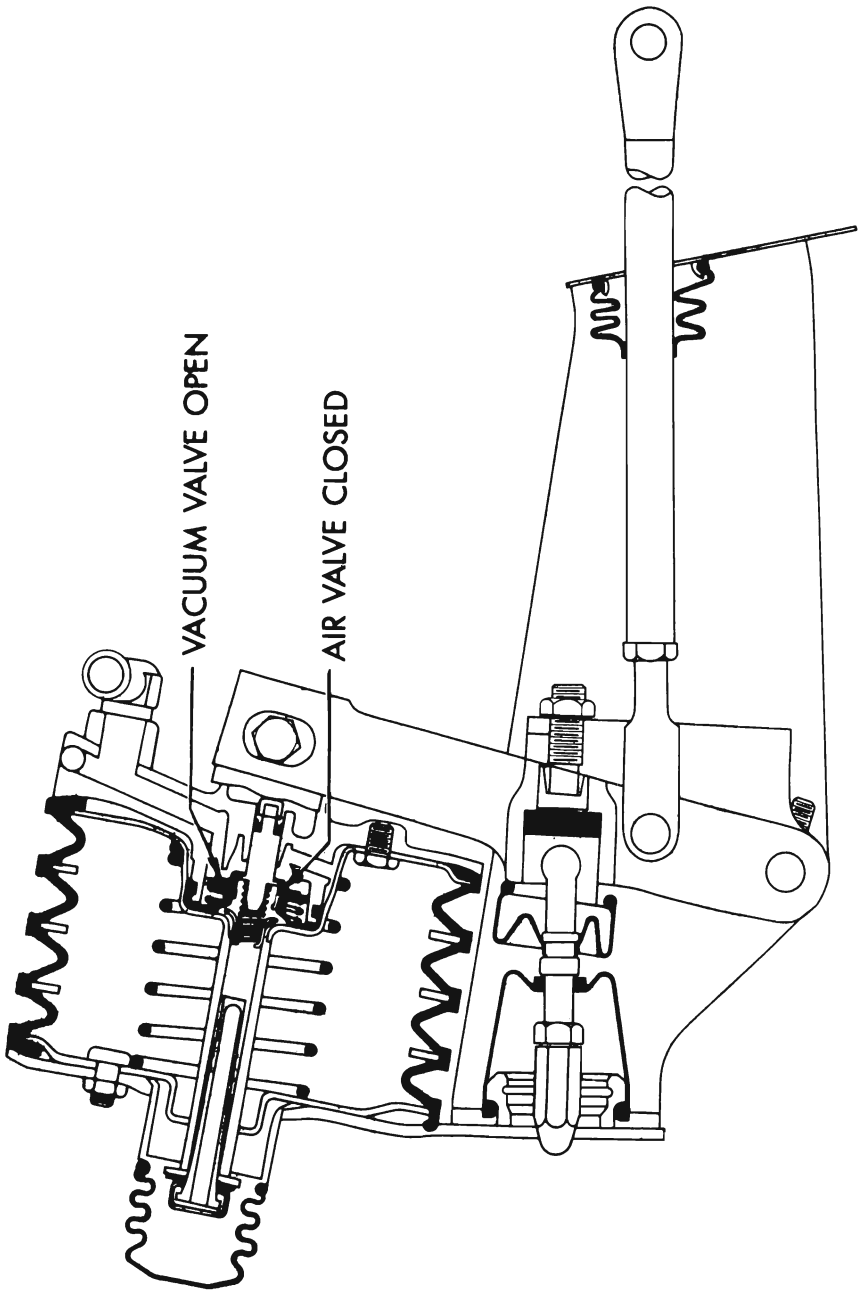

Figure 9-16—Applying Position

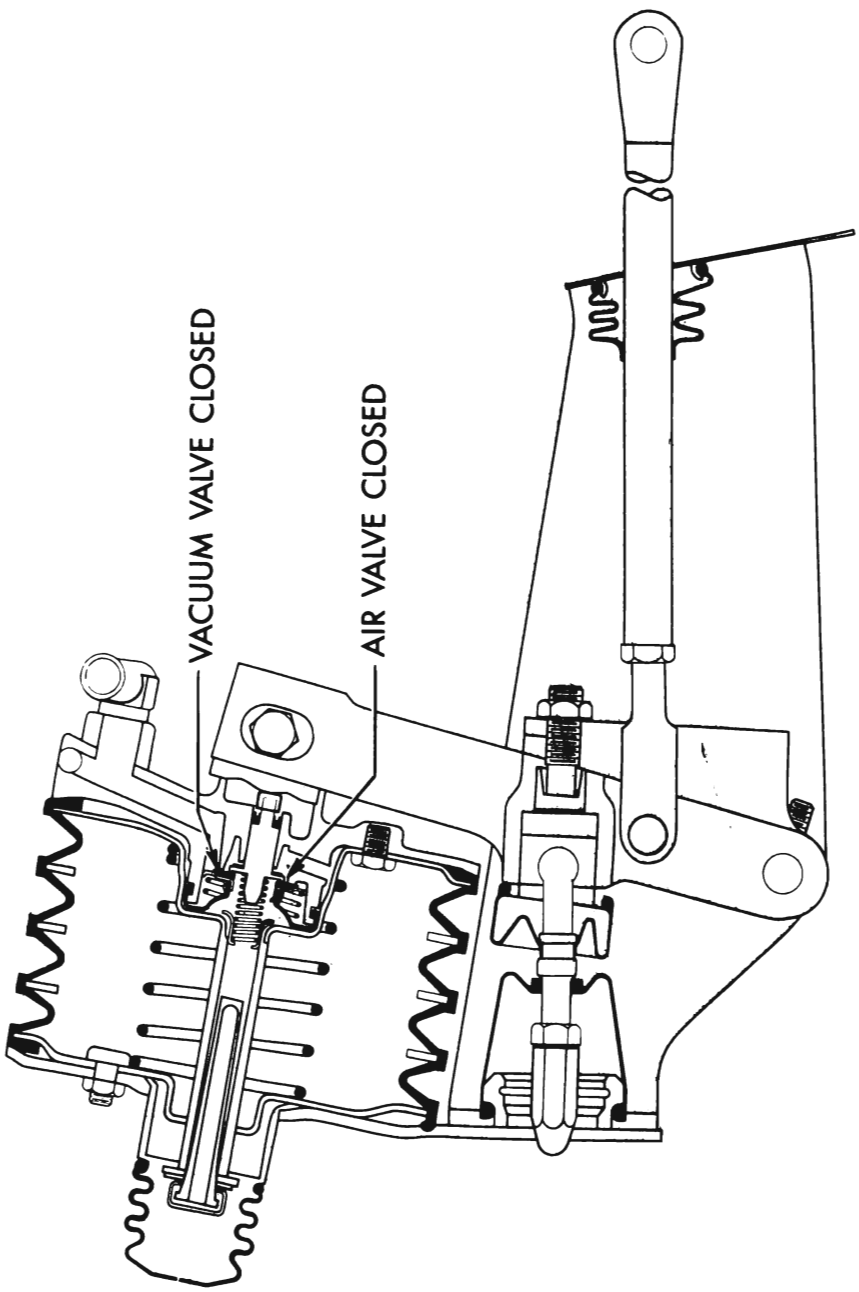

Figure 9-17—Holding Position

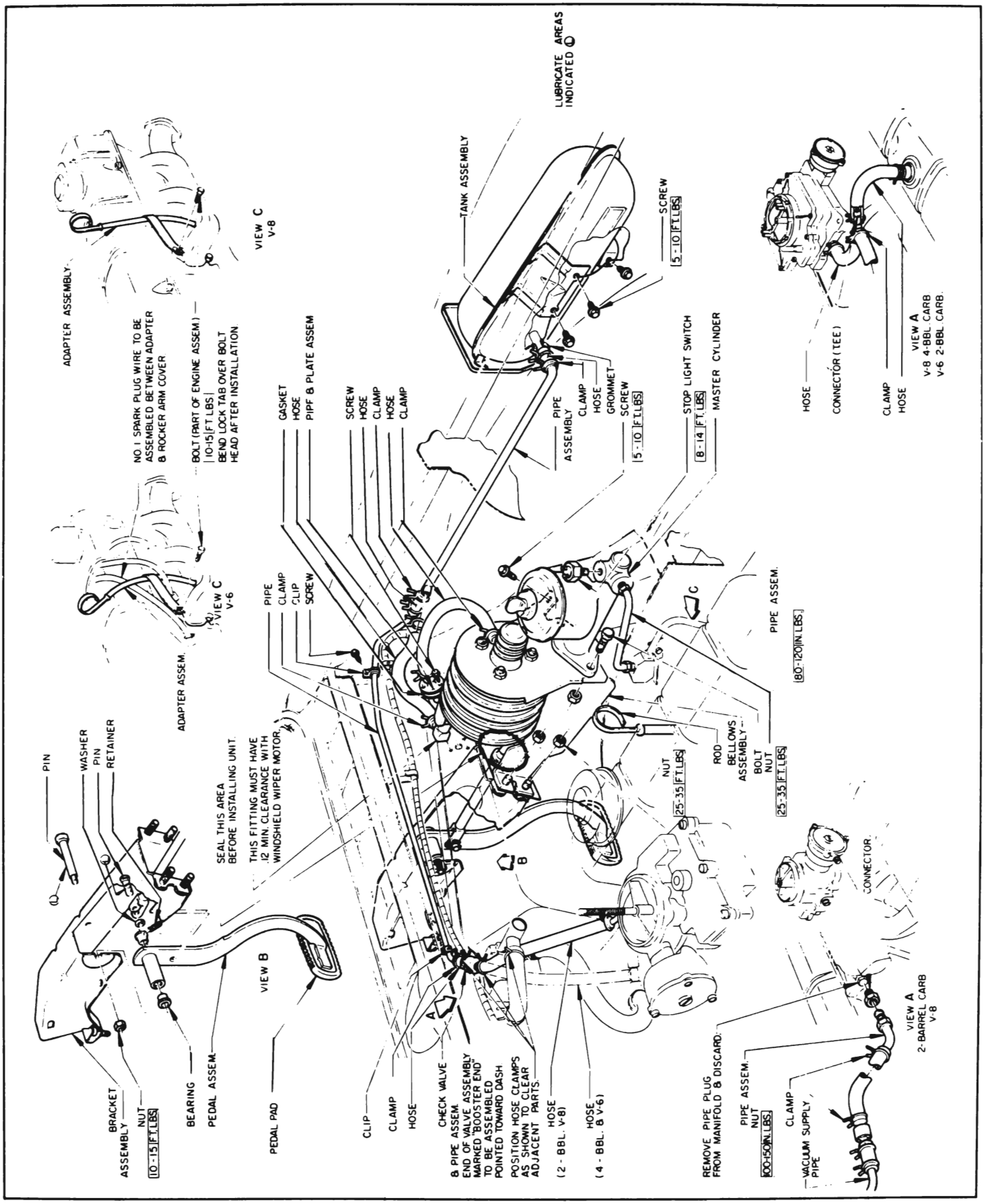

Figure 9-17A—Power Brake Installation

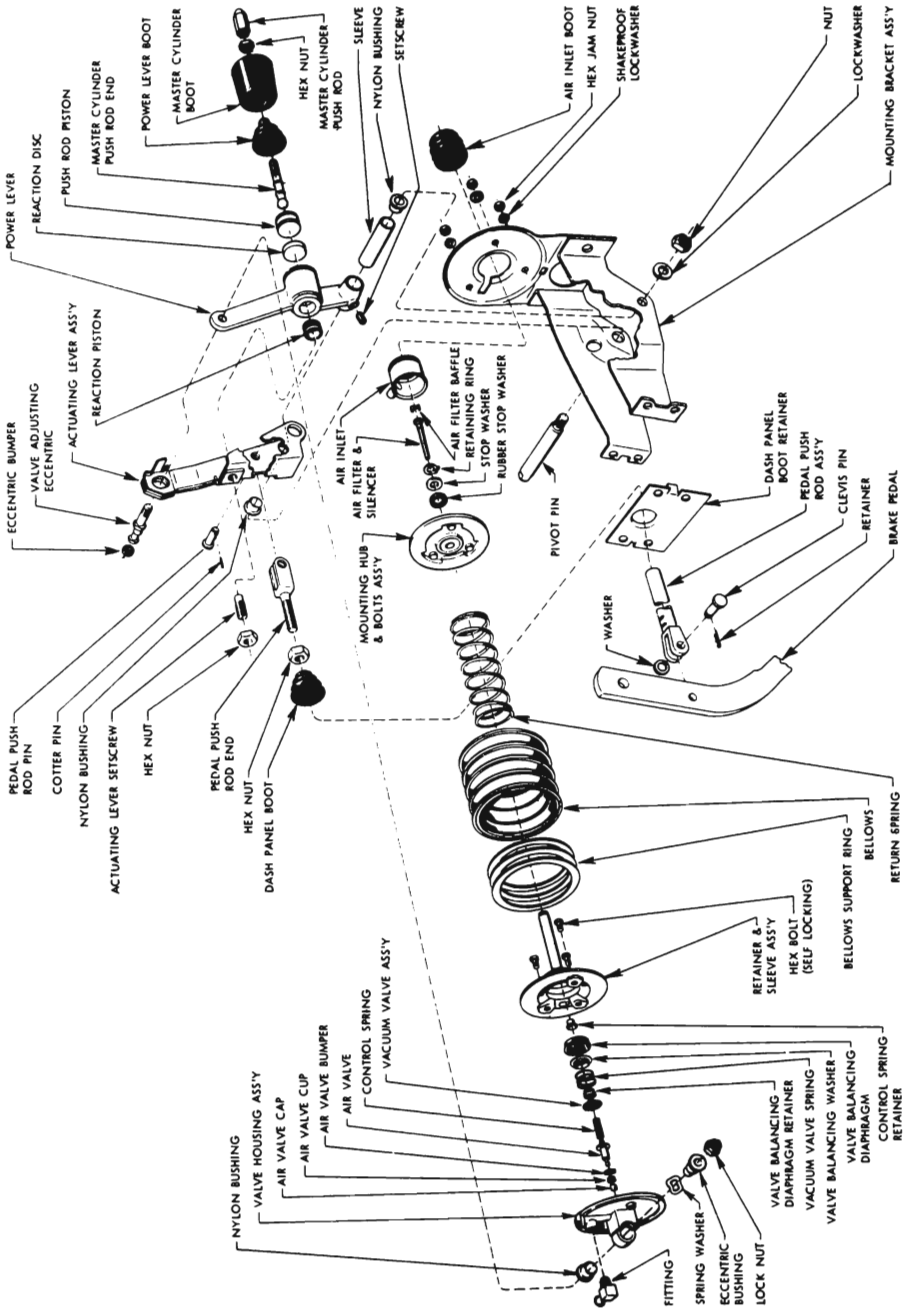

Figure 9-18—Power Brake - Exploded View

The result of an applying movement of the brake pedal by the operator is shown in Figure 9-16. The actuating lever is moving in an "applying" direction and its trigger is applying pressure to the air valve button. The air valve, which at "unapplied" was held open by the air valve spring, has now closed. Continued movement has opened the vacuum valve which, by its spring, has been held in closed position. This permits vacuum to be applied to the bellows, evacuating a controlled amount of air from it (the amount of evacuation depending on the amount of pedal effort) and causing it to contract. In this way, because it is mechanically connected to the power lever, it moves the power lever which, with the actuating lever, moves the push rod into the master cylinder, thereby applying the brakes.

As fluid pressure increases in the master cylinder, a reaction force is transmitted through the push rod to the reaction disc and reaction piston to apply a pressure on the actuating lever through the reaction adjusting screw. This reaction force moves the "trigger" away from the air valve button to close off the vacuum port. The reaction force is proportional to the fluid pressure in the hydraulic system and balances the force exerted on the actuating lever, providing the driver with brake "feel."

When pedal pressure is held (at any stage of brake application or release), both the air and vacuum valves immediately close and the unit becomes poised. This is shown in Figure 9-17. The operator is imposing only a "holding" pressure on the pedal. And the air and vacuum valves are responding by also remaining in a "holding" position -- both are closed. Thus, a status quo is maintained in the bellows. While the preceding reduction of air pressure is maintained, no further evacuation can occur. The power unit holds the brake system at the same degree of application as the operator's pressure on the pedal. The fluid pressure applied by the master cylinder continues, as at all other times, to be proportional to the foot pressure applied by the operator.

When the brakes are in the fully applied position and the power unit is delivering its maximum assist, any additional pedal pressure applied by the operator results in a still greater increase of pressure to the master cylinder through the combination of the actuating lever and power lever acting as one through the eccentric, fully compressing the rubber collar.

The full assist of the power unit is maintained during this increase. When the foot pressure of the operator is released, the unit correspondingly releases its pressure on the brake system. Here, with the trigger moving away from the air valve button, the vacuum valve is closed by spring tension while, in the same movement, the air valve is opened. Atmosphere is thereby permitted to enter the bellows, causing it to expand. At any point during release, as well as during application, the operator may assume a "holding" position, and the unit will immediately become poised. On complete release, of course, the entry of atmosphere allows the return spring to expand the bellows to its full length and again assume an unapplied position.

9-17 REMOVAL AND INSTALLATION OF BRAKE UNIT

a. Removal

1. Remove the stop light switch wires.

2. Disconnect hydraulic line. Plug or tape line to prevent dirt from entering the hydraulic system.

3. Disconnect the vacuum hoses from the top of the bellows unit.

4. Disconnect the air supply hose from the unit.

5. Disconnect the pedal push rod from the brake pedal.

6. Remove the nuts which attach the mounting bracket to the cowl and the self-tapping screw holding the tab to the frame rail.

b. Installation

1. Replace the nuts which attach the mounting bracket to the cowl. Torque to 25 ft. lbs. Install the self-tapping screw holding the tab to the frame rail.

2. Connect the pedal push rod to the brake pedal.

3. Connect the vacuum hose to the top of the bellows unit.

4. Connect air supply hose to the unit.

5. Connect hydraulic line.

6. Install stop light switch wires.

7. Bleed hydraulic system.

9-18 DISASSEMBLY OF POWER BRAKE UNIT

1. Clean the outside of the power brake unit. Remove the filler cap and empty the brake fluid from the master cylinder reservoir.

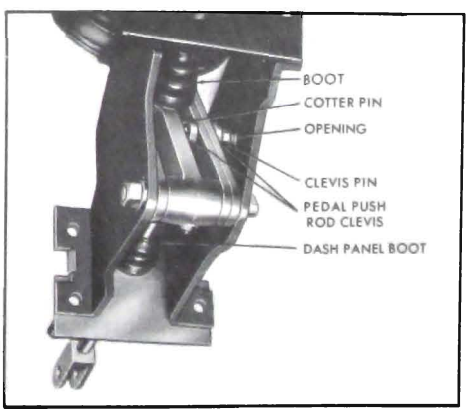

Figure 9-19—Power Lever Assembly

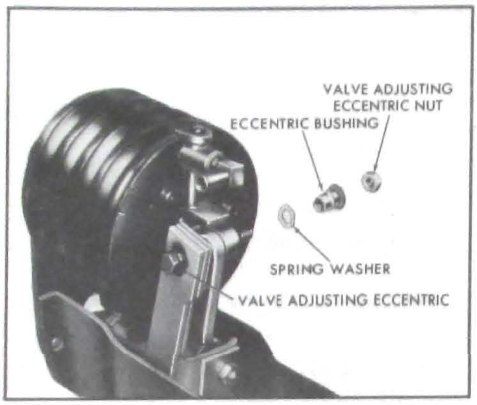

Figure 9-20—Removing Valve Actuating Eccentric

Figure 9-21—Removing Nylon Bushing

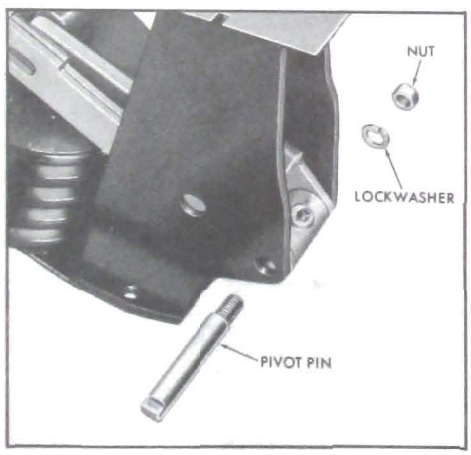

Figure 9-22—Removing Pivot Pin

2. Remove the master cylinder, boot and push rod assembly, leaving the boot in place on the power lever. NOTE: The master cylinder assembly is the same as the standard brake master cylinder except for the piston stop plate and should be so serviced.

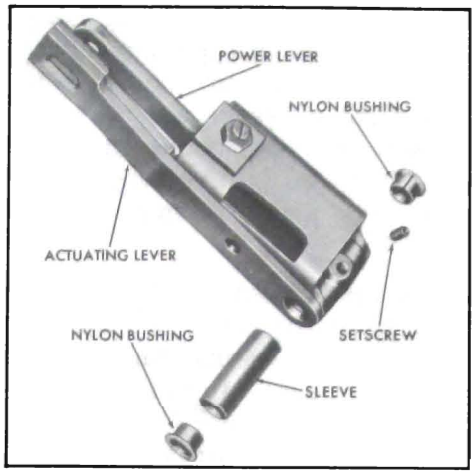

Figure 9-23—Removing Sleeve from Power Lever Assembly

NOTE: Do not disassemble push rod unless it is to be replaced.

3. Remove the nut from valve adjusting eccentric and remove the spring washer and bushing. Then remove the valve actuating eccentric from power lever; from eccentric remove and discard rubber eccentric or collar. Then remove nylon bushing from valve housing; discard nylon bushing.

4. Remove the pivot pin nut and lock washer and slide the pin out of the mounting bracket assembly. The power lever assembly, actuating lever assembly and the push rod assembly with dash panel boot may be removed as a unit.

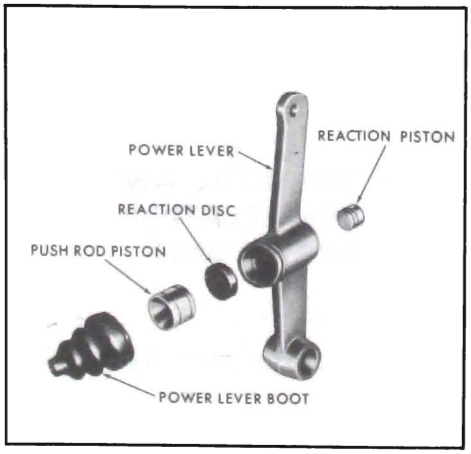

Figure 9-24—Disassembly of Power Lever

5. Remove the cotter pin from the pedal push rod to actuating lever clevis and retract the clevis pin. Remove the pedal push rod assembly, the boot retainer, and dash panel boot and discard the boot. NOTE: Do not disassembly push rod unless it is to be replaced.

6. Remove and discard the nylon bushings in the power lever sleeve and remove the sleeve set screw. Push the sleeve out of the power lever assembly and separate the power lever assembly and the actuating lever.

7. Remove the power lever boot, push rod piston, reaction disc and the reaction piston from the power lever. Discard the boot and reaction disc.

CAUTION: Care must be taken to avoid damage to finish of bore and/or pistons.

NOTE: The reaction adjusting screw and lock nut should not be removed, unless the actuating lever is to be replaced.

9-19 DISASSEMBLY OF POWER UNIT

1. Remove the three attaching nuts and lock washers and remove the mounting bracket assembly from the power unit (Figure 9-25).

2. Remove air inlet housing and boot from mounting bracket assembly. Discard boot.

3. Carefully clamp power unit in a vise having padded jaws as shown in Figure 9-26.

Remove air filter baffle from sleeve of retainer and sleeve assembly by pushing down and sideways to unhook, then lift out air filter with baffle. Figure 9-26.

4. While holding mounting hub and bellows down against return spring, remove retaining ring, steel stop washer and rubber stop

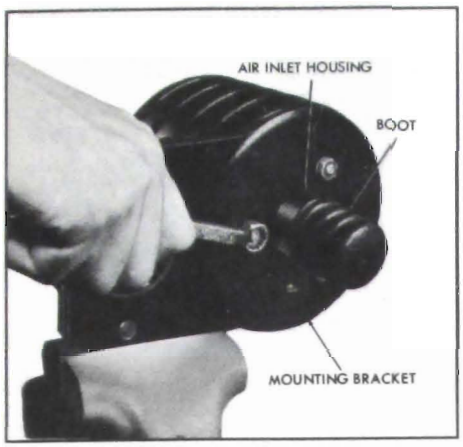

Figure 9-25—Removing Mounting Bracket Assembly

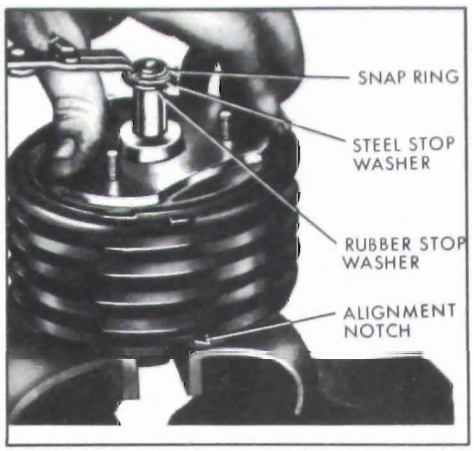

Figure 9-27—Removing Snap Ring

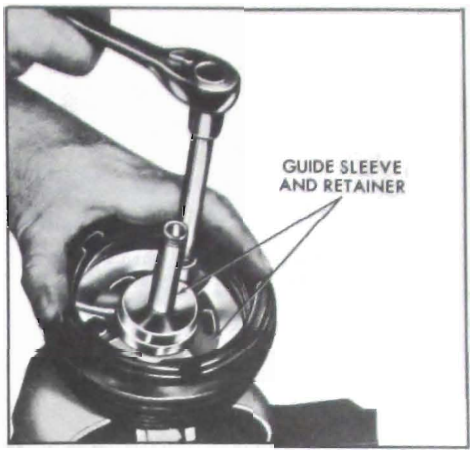

Figure 9-29—Removing Guide Sleeve Retainer

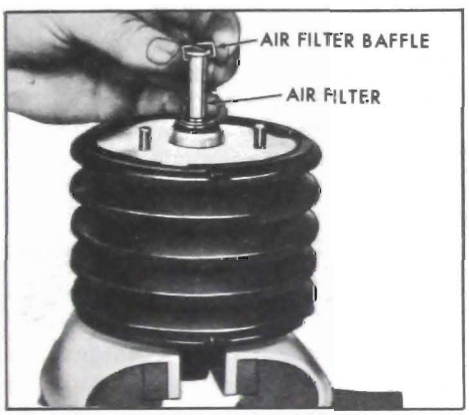

Figure 9-26—Removing Air Baffle

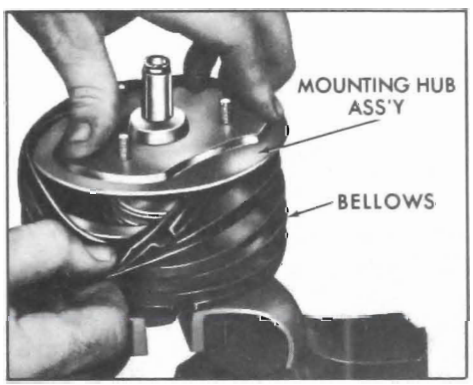

Figure 9-28—Removing Mounting Hub Assembly

washer from guide sleeve. CAUTION: Use care to avoid damaging retaining ring by opening too wide. Discard rubber stop washer. Figure 9-27.

5. Still holding the mounting hub down, remove lip of bellows from hub (Figure 9-28), then lift mounting hub assembly and return spring from power unit.

6. Remove three self-locking and sealing cap screws, then remove retainers and guide sleeve assembly with bellows from valve housing. Remove retainers and sleeve assembly from bellows. See Figure 9-29.

7. Remove air valve control spring, valve balancing diaphragm, vacuum valve spring, vacuum valve assembly and air valve assembly from valve housing. See Figure 9-30, taking steps in order F to A.

8. From the valve balancing diaphragm, remove the valve balancing washer and the valve balancing retainer. Discard the valve balancing diaphragm, vacuum valve assembly and air valve assembly.

9. Clean all metal parts (except the mounting hub assembly), including the air filter, in alcohol or other oil-free solvent and dry thoroughly with dry compressed air. NOTE: Mounting hub assembly contains a leather seal from which the lubricant must not be removed. If it is necessary to clean the mounting hub assembly, it should be wiped clean with a dry cloth only. Clean the rubber bellows, if necessary, by washing in a mild soap and water solution, after removing three support rings. Rinse in clean water and dry with compressed air. Inspect all parts for wear or damage. All worn or damaged parts must be replaced. If vacuum valve seat (in valve housing) is damaged, valve housing must be replaced. Replace all parts supplied in Repair Kit whether or not they show wear or damage.

9-20 REASSEMBLY OF POWER UNIT

1. Carefully clamp valve housing in padded jaw vise in such a position that alignment mark (see Figure 9-27) is clearly visible.

2. Refer to Figure 9-30, and reassemble air and vacuum valve. Follow steps in order A to F. Install new air valve assembly, then new vacuum valve assembly. Install vacuum valve spring. Assemble washer into new valve balancing diaphragm, then assemble diaphragm retainer to new valve balancing diaphragm, with small diameter of retainer toward diaphragm, then install this assembly as shown, retainer first, being sure that diaphragm retainer is centered in vacuum valve spring, and that center bead in retainer is pressed down snugly and evenly over neck or hub of vacuum valve assembly. Wipe

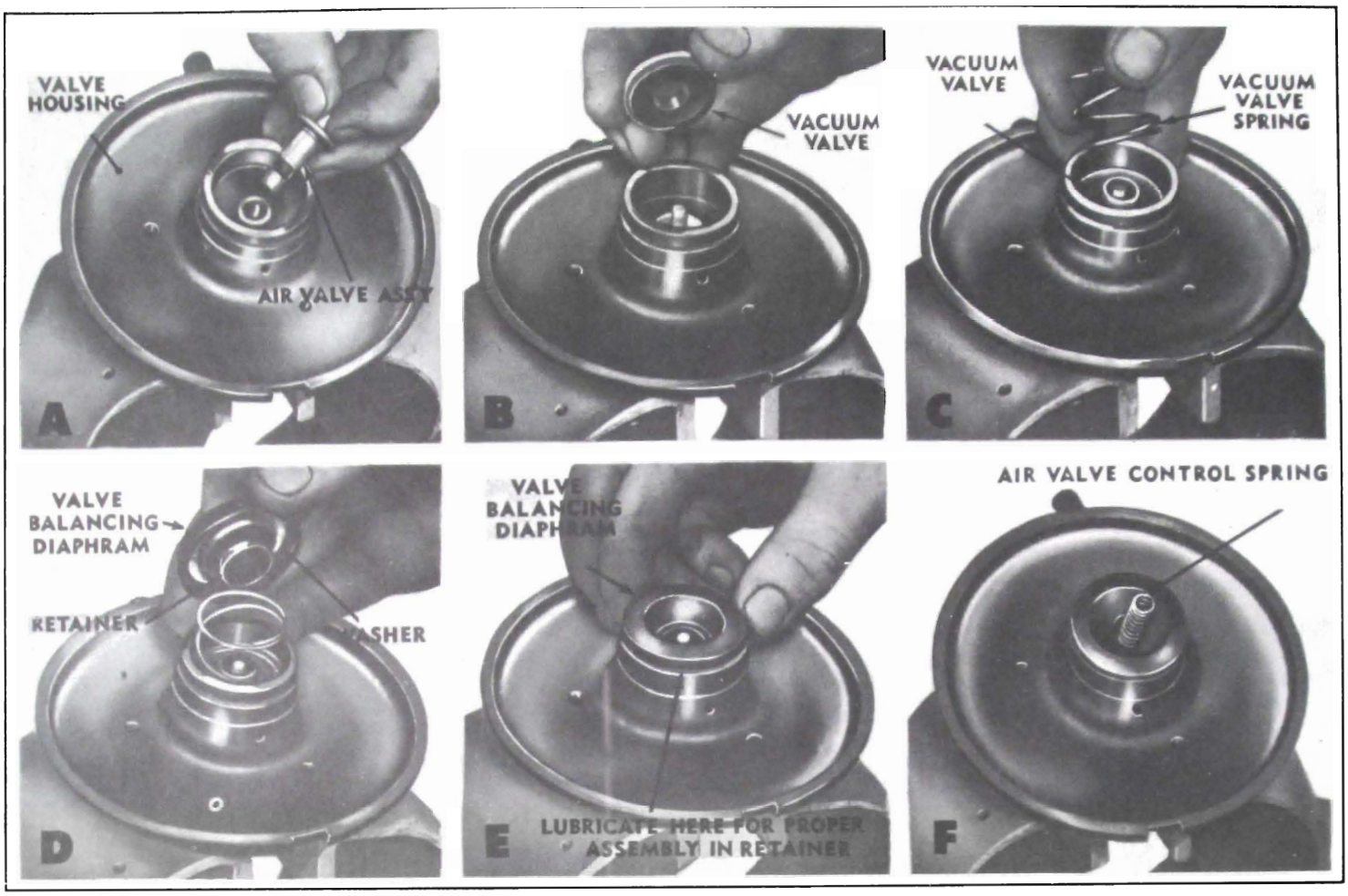

Figure 9-30—Valve Control Assembly

some Lubriplate around outside diameter of valve balancing diaphragm. Insert the air valve control spring.

WARNING: DO NOT APPLY BRAKE FLUID TO THE RUBBER PARTS OF THIS UNIT.

3. If a new bellows is to be installed, remove three support rings from old bellows and insert them into convolutions of new bellows, then assemble either end of bellows over retainers and guide sleeve assembly as in Figure 9-31. Be sure that the three bosses in the retainer are aligned with the three recesses in the bellows, and that guide sleeve projects into (not out of) bellows.

4. Carefully place the assembled bellows and guide sleeves and retainers assembly over the valve balancing diaphragm, using a twisting motion, then position on the valve housing. Start the three self-locking and sealing cap screws. Do not use lock washers. Check alignment marks to be sure of correct positioning, then tighten the three self-locking and sealing cap screws evenly to 85-115 inch-pounds torque. Figure 9-32.

5. Sight down guide sleeve to be

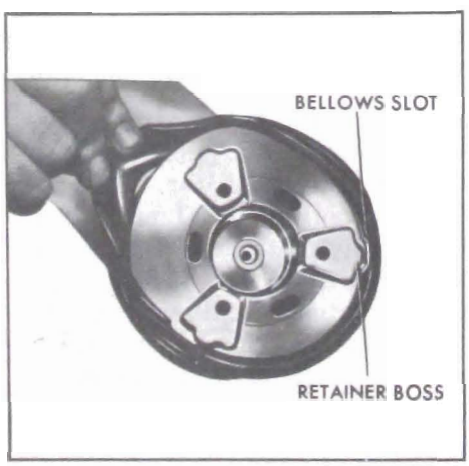

Figure 9-31—Reassembly of Retainer

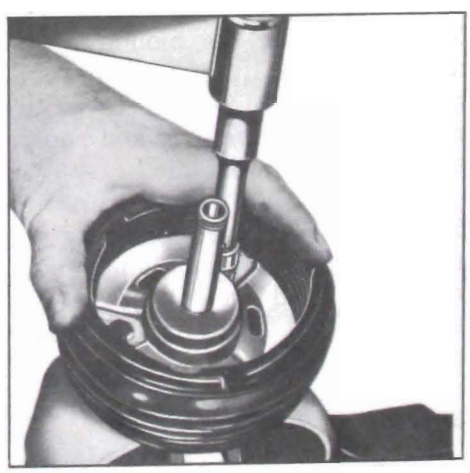

Figure 9-32—Installing Guide Sleeve Retainer

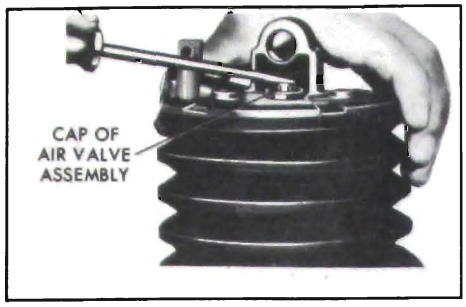

Figure 9-33—Testing Air Valve Operation

sure air valve control spring is squarely in retainer.

6. Remove unit from vise, invert and test air valve operation as shown in Figure 9-33. Using the flat of a screwdriver, press air valve button inward. Two definite stages of movement should be felt. In the first stage, only the air valve control spring is being compressed; in the second stage, the resistance of the vacuum valve spring is added. The step from stage one to stage two can be felt if the valves have been correctly assembled. When pressure is released, the valve should snap back readily.

7. Lubricate guide sleeve and inside diameter of leather seal in mounting hub with Lubriplate. Replace unit in vise as before and position return spring around guide sleeve and retainer assembly, being sure that it is evenly placed around hub of retainer. Slide mounting hub assembly with threaded studs facing up, over guide sleeve. Hold mounting hub assembly down against return spring and assemble flange of bellows evenly over outside edge of mounting hub assembly.

8. Still holding mounting hub assembly down against return spring, place new rubber stop washer, then steel stop washer, over guide sleeve. Install retaining ring, being sure it is seated properly in its groove. Refer to Figure 9-27.

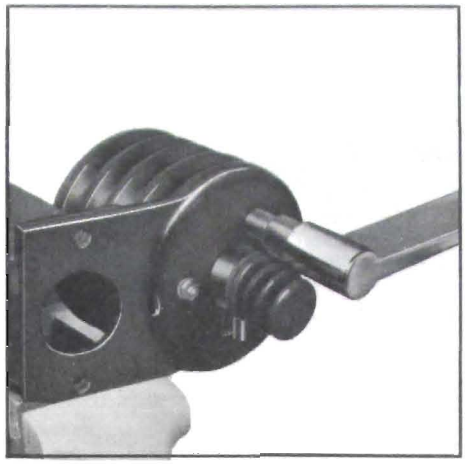

Figure 9-34—Positioning Mounting Bracket

9. Assemble air filter baffle to air filter, then install this assembly into guide sleeve. See Figure 9-26. Air filter baffles clips over end of guide sleeve and into the same groove with and above the retaining ring.

10. Assemble air inlet housing and boot to mounting bracket assembly, being sure the air supply tube stays in alignment with the clearance slot in the mounting bracket.

11. Position mounting bracket on mounting hub with threaded studs projecting through holes in mounting bracket and start three lock washers and nuts. Align slot in mounting bracket with tab on bellows and tighten three nuts to 85-115 inch-pounds torque. Figure 9-34.

9-21 REASSEMBLY OF POWER BRAKE UNIT

1. Check actuating lever trigger position as shown in Figure 9-37. Drill rod, when clamped as shown, must be perpendicular to flat side of actuating lever and tight against side of slot. Notch drill rod if required to maintain squareness. Measure the trigger position as shown in Figure 9-35. Micrometer reading should be 0.950 inches plus or minus 0.005 inches.

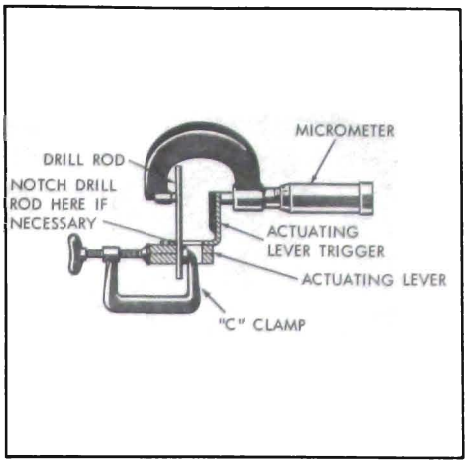

Figure 9-35—Checking Lever Trigger Position

If the micrometer reading is not within these limits, bend the trigger to the correct position or replace the actuating lever.

2. Reassemble the new reaction disc, push rod piston, new boot and reaction lever.

3. Install new sleeve bushings.

NOTE: If reaction adjusting screw has been moved, see "Adjustments."

4. Install the dash panel boot over the non-adjustable end of the push rod, put the push rod through the hole in the boot retainer and assemble the boot to the retainer. Attach the adjustable clevis end to the actuating lever with the clevis pin and a new cotter pin.

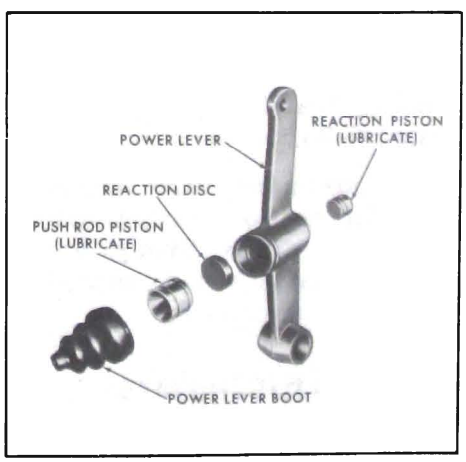

Figure 9-36—Reassembling Power Lever Assembly

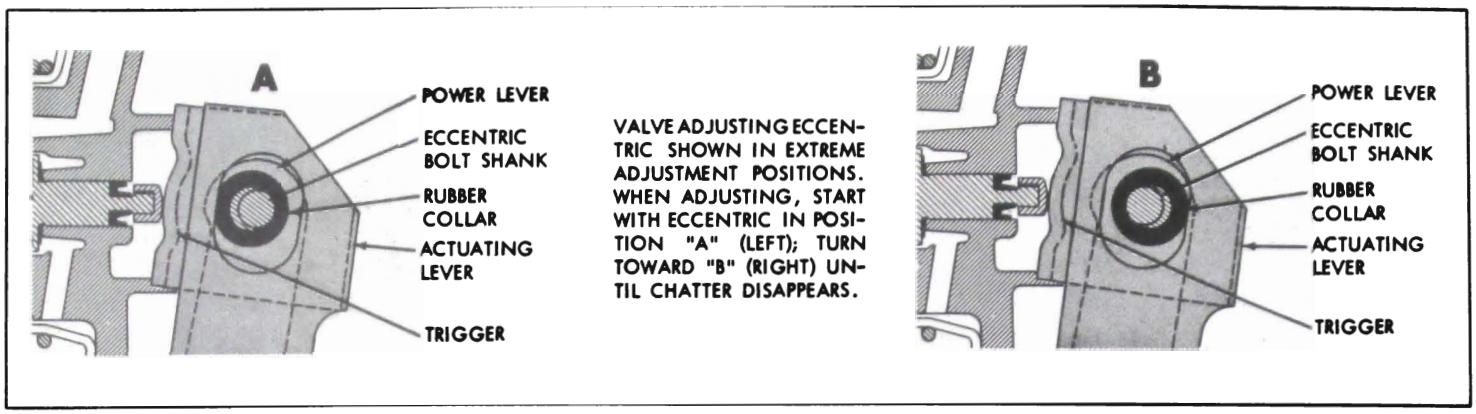

Figure 9-37—Valve Adjusting Eccentric

5. Attach the boot retainer to the mounting bracket.

6. Install nylon bushing in valve housing, and lubricate with Lubriplate. Refer to exploded view, Figure 9-18.

7. Assemble new rubber collar under hex head of eccentric. This can be done most easily by starting the collar under one side of the hex, then forcing it over the hex with thumb pressure. These two parts make the assembly.

8. Assemble power unit to power lever and actuating lever assembly, by installing valve adjusting eccentric bolt. In doing this, be sure that end of actuating lever trigger does not strike side of air valve button. When assembled, curve of trigger rest against the end of air valve button.

9. Install the spring washer over the spherical bushing, slide the assembly over the valve adjusting eccentric bolt and into the valve housing, then install the nut. (See Figure 9-20.)

10. Tighten the valve adjusting eccentric nut to the point that the eccentric bolt is firmly locked to the power lever but can still be turned for adjustment.

9-22 ADJUSTMENTS

a. Valve Operation

Valve adjustment must be made without master cylinder installed.

1. Mount unit assembly on the car or clamp in vise.

2. Be sure that master cylinder push rod is removed, so that cut-in of unit can be checked without interference.

3. Be sure that vacuum supply hose is attached to power unit, then apply vacuum.

NOTE: If a shut-off valve is used in the vacuum line, the unit should never be applied with the shut-off valve closed; an application against a closed or blocked vacuum line may expand the bellows, causing dislocation of the bellows support plate.

4. Turn the valve adjusting eccentric until the unit chatters when the pedal is depressed in a sharp and rapid applying movement. Then turn the eccentric until the chatter disappears. Do not turn the eccentric more than necessary or the unit cut-in will be excessively high. (See Figure 9-37.)

5. After completing the valve adjusting eccentric adjustment, tighten the eccentric nut to 180-220 inch-pounds torque. Then check the adjustment again, after the nut is tightened.

b. Push Rod Adjustment

This adjustment is necessary if any of the master cylinder parts, power lever parts or the push rod itself has been changed.

1. With the master cylinder removed from the unit, locate the master cylinder push rod in the push rod piston. Push on the rod to seat the reaction disc in the power lever, then hold the rod in with a light pressure.

2. Adjust the push rod length to the .096/.116 dimension (see Figure 9-38).

3. Tighten lock nut and recheck the adjustment.

4. With the boot installed on the master cylinder, attach the master cylinder to the mounting brackets, using 25 foot pounds torque on the nuts. Care must be taken when installing the master cylinder boot to be sure it does not wrinkle and that the reaction piston stays

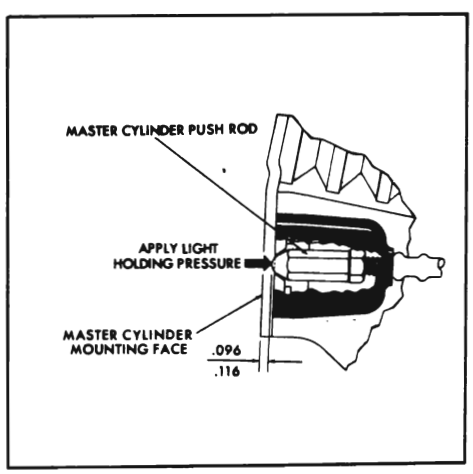

Figure 9-38—Push Rod Adjustment

properly located in the power lever.

NOTE: If the push rod adjustment is too long, it may force the master cylinder piston forward, closing off the compensating port and causing locked brakes. If this adjustment is too short, a "clunk" may be noticeable on operation of the unit.

c. Master Cylinder

1. Remove the master cylinder filler cap and check the master cylinder at the compensator port for bubbles or spurt on application of the unit, which indicates that the push rod is properly adjusted. Check fluid level. Add fluid to correct level if needed and reinstall master cylinder filler cap.

d. Reaction Adjusting Screw

This adjustment must be made only if the adjustment has been changed or the actuating lever or reaction piston has been replaced.

1. Recommended Method

(a) Disconnect the hydraulic line to the brakes. Connect a gauge to the master cylinder.

(b) Apply a 30 pound load perpendicular to the pedal pad (Figure 9-40). The hydraulic gauge reading should be 340 to 350 PSI Adjust the reaction adjusting screw to obtain this, with the final adjustment being made by turning the screw in. Tighten the adjusting screw lock nut and recheck the setting.

2. Alternate Method

If gauges are not available, a setting can be made as follows:

(a) With the unit completely assembled, and the valve adjusting eccentric adjusted, turn the reaction adjusting screw in until the rear of the reaction piston skirt is flush with the back face of the power lever.

NOTE: A light rearward pressure on the master cylinder push rod will maintain contact between the reaction adjusting screw and the reaction piston.

(b) Back off the screw 1-2/3 turns and lock in place with the jam nut.

(c) After installation of the unit in the vehicle and completion of all other adjustments, apply a load of 70 pounds or more at the pedal. The rear of the reaction piston skirt should then be flush or exposed not more than .010 inch.

e. Pedal Height Adjustment

The pedal push rod is adjustable in the clevis at the unit end. It should be adjusted to provide a pedal height of (4-1/4) inches. (See Figure 9-40.)

9-23 SERVICE DIAGNOSIS AND CORRECTIONS

The Power Brake Unit is a pedal-assist type, so that all of the brake system components, from the master cylinder to the wheels, are a conventional hydraulic brake system.

Should the power unit become inoperative, the conventional hydraulic brake can be applied, although a greater pedal effort will be required for a given application.

First, check the complete brake system in the normal way.

If brake service is required, do not remove the power unit until you are sure that the trouble is in the power unit and not in another part of the system. With the engine stopped, apply the brakes several times to eliminate all vacuum from the system. Then, with the power unit not operating, check the hydraulic brake system for loss of pedal, and for fading or spongy pedal. The brake system can be checked in the same way as if there were no power unit. The brakes can be bled in same way. The same corrective measures can be taken as with any conventional hydraulic brake system. If, with the hydraulic part of the brake system in good working order, the brakes still do not operate properly, proceed to check the operation of the power unit as follows:

NOTE: The adjustments described in the following paragraphs may be made on the car, unless it is necessary to remove the power unit from the car for replacement or servicing other than simple adjustment.

To determine whether the power unit is operating, stop the engine and depress the brake pedal several times to eliminate all vacuum from the system. Then apply the brakes, and while maintaining light pressure on the brake pedal, start the engine. If the unit is operating, the brake pedal will move forward very slightly when engine vacuum power is added to the foot pressure on the pedal. If the unit is not operating, there will be no pedal action.

Complaint: Hard pedal; power unit not operating.

If the foregoing test shows that the power unit is not operating, this condition may be due to one of the following causes:

Cause: Blocked, kinked or leaking vacuum line.

Remedy: Remove the vacuum hose from the power unit, and with engine running, check the vacuum source. Be sure that

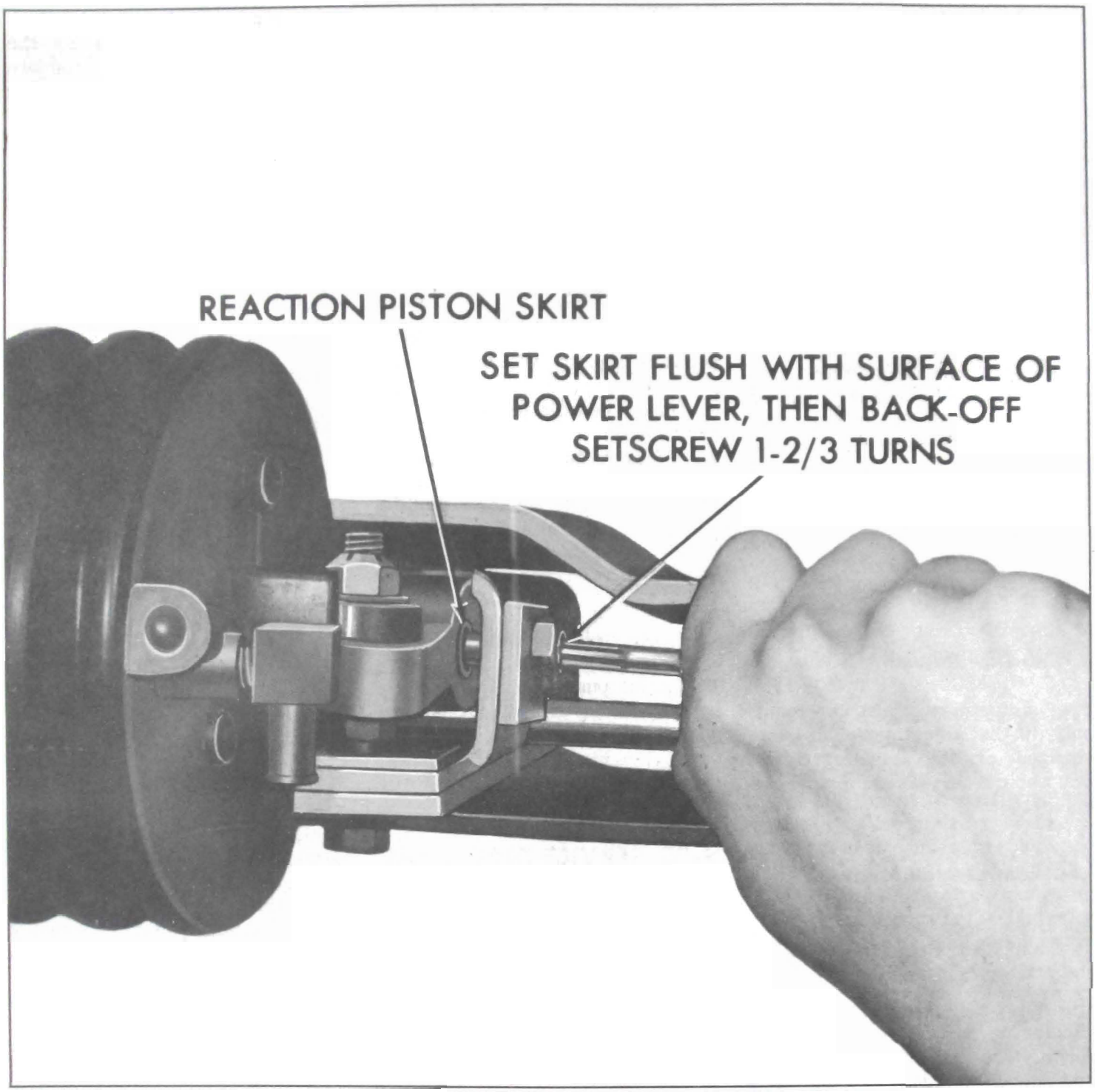

Figure 9-39—Reaction Screw Adjustment

check valve is operating properly, and that hose is not blocked, kinked, broken, or loosely connected. Check the following points:

1. Routing of vacuum hose.
2. Kinks in hose which could cut off the vacuum supply.

Cause: Vacuum leaks in unit.

Remedy: With engine running, and brake pedal in applied position, listen at unit for a hissing sound indicating a vacuum leak. Locate and correct. Look for a hole in the bellows.

Cause: Valve adjusting eccentric out of adjustment.

Remedy: This adjustment must be made with master

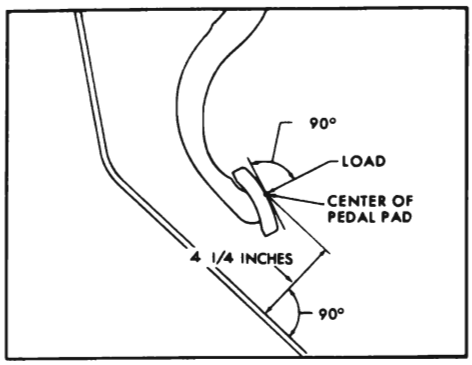

Figure 9-40—Pedal Height

cylinder and push rod removed.

NOTE: If valve eccentric adjustment does not correct trouble, check actuating lever trigger for bent condition. See paragraph 9-20.

Complaint: Pedal chatters on brake application.

Cause: Improper adjustment of valve adjusting eccentric.

Remedy: Adjust correctly the valve adjusting eccentric as described above.

Cause: Improper adjustment of push rod.

Remedy: Adjust the push rod.

Cause: Air in hydraulic brake line.

Remedy: Bleed the hydraulic brakes.

Complaint: Slow return of brake pedal.

Cause: Clogged air filter.

Remedy: Remove air inlet housing boot, collapse unit by hand and remove air filter and air filter baffle. Clean filter with alcohol and dry thoroughly with dry compressed air. If filter is badly clogged or damaged, replace it.

Cause: Improper adjustment of master cylinder push rod.

Remedy: Correctly adjust push rod.

NOTE: If push rod is difficult to adjust, check the position of the master cylinder boot and the alignment of the master cylinder. If the boot is binding or if the master cylinder is not securely mounted, causing misalignment, correct the condition, then proceed with push rod adjustment.