POWER BRAKES—BENDIX

GENERAL DESCRIPTION

The Bendix power brake unit can be identified by the die-cast hydraulic cylinder and pressed steel filler cap (Fig. 5-17). The Moraine power brake unit can be identified by the cast iron master cylinder and cast iron filler cap (Fig. 5-39).

The Bendix power brake is a combined vacuum and hydraulic unit for power braking, utilizing engine intake manifold vacuum, and atmospheric pressure for its operation (Fig. 5-12). It is a self-contained unit requiring no external rods or levers exposed to dirt or moisture. This power brake unit replaces the master cylinder only. Other parts of the brake system are the same as with standard brakes. Two external line connections to the power brake are necessary. One is a vacuum connection to the carburetor (and vacuum reservoir). The other is a hydraulic connection into the hydraulic brake system.

The power brake system provides reduced pedal travel compared to the conventional brake system. The reduced pedal travel lowers the height of the pedal down to approximately that of the accelerator pedal, permitting the driver to shift his toe from one pedal to the other without lifting his heel from the floor. Lighter pedal pressures are also obtained for normal stops.

Design of the power brake is such that, in case of engine failure and consequent loss of engine vacuum, several applications of the brakes can be made utilizing vacuum supply in the vacuum reservoir. In case of complete loss of vacuum, the brakes can be applied manually in the conventional manner. More effort for manual application is required, however, due to the lack of power assist.

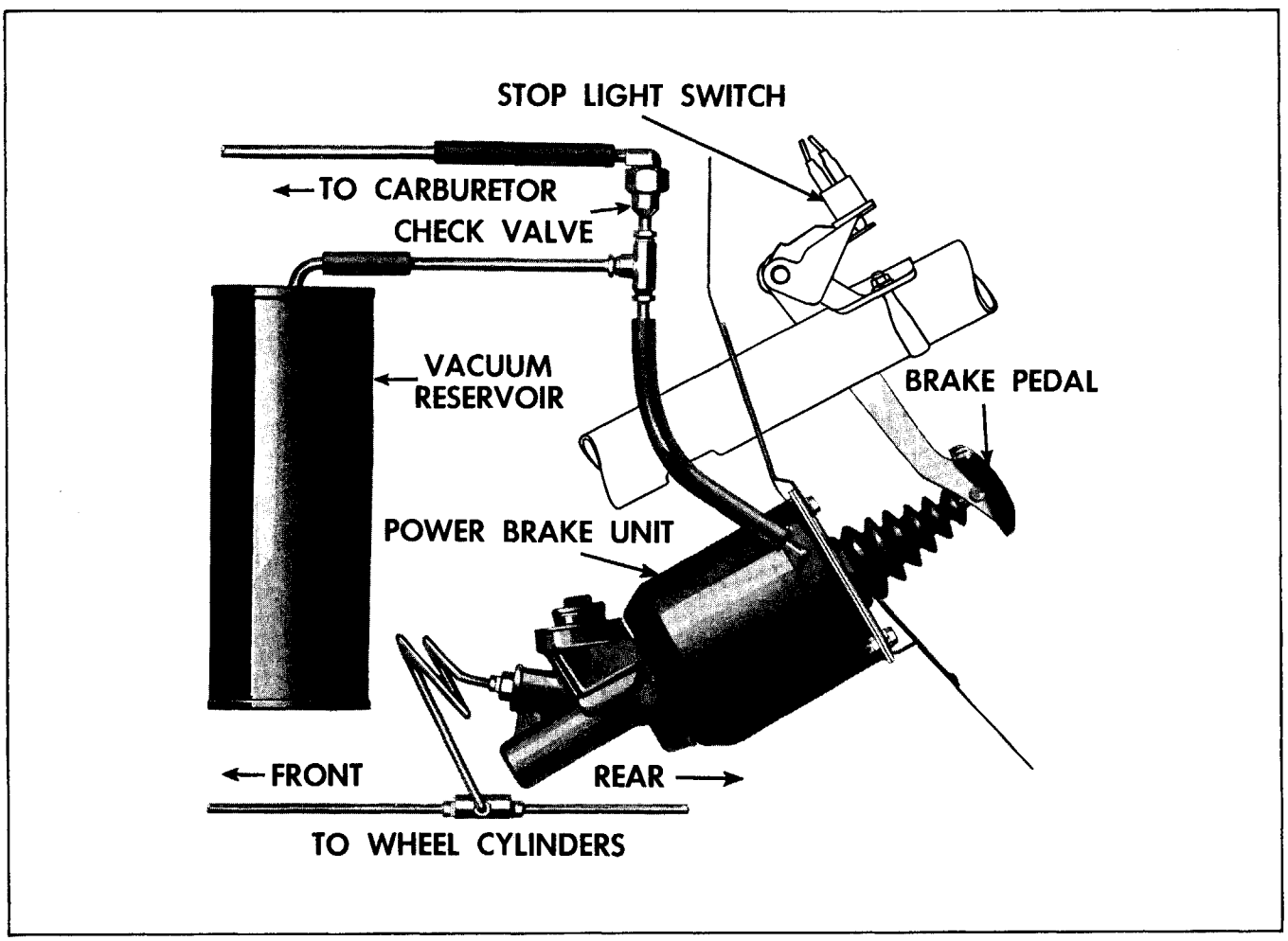

Fig. 5-12 Power Brake Schematic

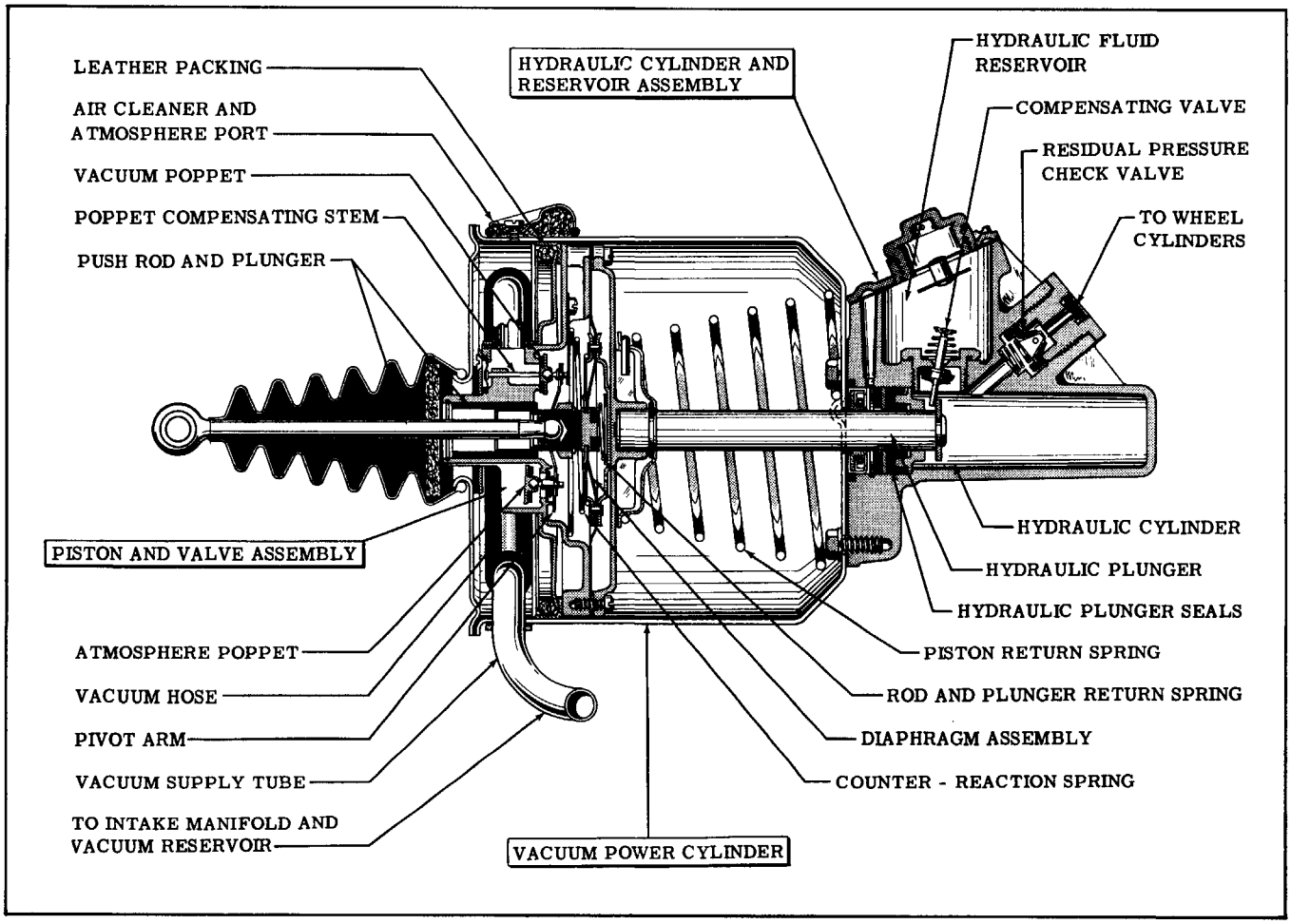

Fig. 5-13 Cross Section of Power Brake

CONSTRUCTION

The Bendix power brake assembly (Fig. 5-13) consists of three operating units, which are: hydraulic cylinder and reservoir assembly, vacuum power cylinder, and piston and valve assembly.

The piston and valve assembly is connected to the brake pedal by a push rod and plunger. The piston operates inside the vacuum cylinder moving the hydraulic plunger into the hydraulic cylinder. A piston return spring is provided in the vacuum cylinder to return the piston and hydraulic plunger to their released positions.

The end of the vacuum cylinder is attached rigidly by screws to the hydraulic cylinder and fluid reservoir casting. On the outside of the vacuum cylinder is a vacuum supply tube, and an air cleaner and atmosphere port. Attached to the hydraulic cylinder assembly is a fluid reservoir cover and a hydraulic port fitting incorporating a residual pressure check valve. A fluid compensating valve is located between the fluid reservoir and the hydraulic cylinder. Vacuum and hydraulic seals are provided in the bore of the hydraulic cylinder to seal around the hydraulic plunger.

The piston is connected to the vacuum supply tube by a flexible vacuum hose. The piston contains a push rod and plunger, a diaphragm assembly, counter-reaction spring, a vacuum poppet and poppet compensating stem, and an atmosphere poppet. The poppets are actuated by the push rod plunger through the pivot arm. The push rod and plunger return spring is located inside the diaphragm assembly. The spring returns the push rod and plunger to its released position in the piston. A leather packing is located at the outside diameter of the piston to provide a seal between the piston and the vacuum cylinder.

PRINCIPLES OF OPERATION

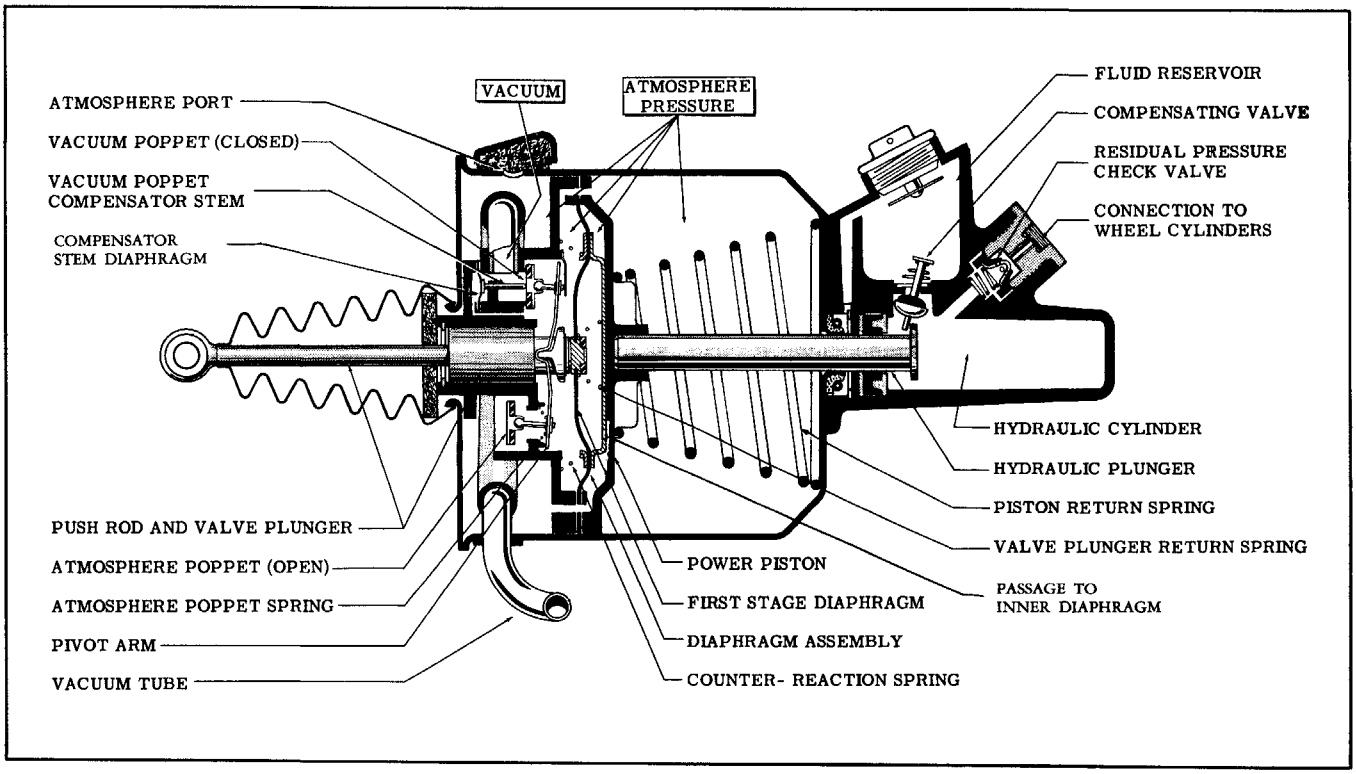

Fig. 5-14 Power Brake in Released Position

RELEASED POSITION (FIG. 5-14)

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 a vacuum reservoir. From the vacuum tube, vacuum is transmitted into the unit through a flexible hose which is attached to the power piston at the left of the vacuum poppet.

Atmosphere, after passing through air cleaner and atmosphere port, enters the power brake cylinder chamber at the left side of the power piston. From the left side of the piston, atmosphere is communicated through the open atmosphere poppet to the left side of the diaphragm assembly and through the passage in the piston, shown at the top of the diaphragm, to the cylinder chamber at the right of the piston. A small passage in the piston admits atmosphere from the left side of the diaphragm assembly to the left side of the vacuum poppet compensator stem diaphragm. As there is a vacuum on the right side of the compensator stem diaphragm, a slight force to the right is exerted on the vacuum poppet, partially balancing the force of atmospheric pressure against the right side of the vacuum poppet. Atmosphere also enters the passage shown at the bottom of the piston and is communicated to the right side of the diaphragm assembly. A small hole in the diaphragm plate admits atmosphere to the first stage (inner) diaphragm.

In the released position, both the power piston and the diaphragm assembly are balanced in atmospheric pressure. The piston is held to the left in its released position by the piston return spring; the push rod and valve plunger assembly is held in its leftward position in the piston by the valve plunger return spring.

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

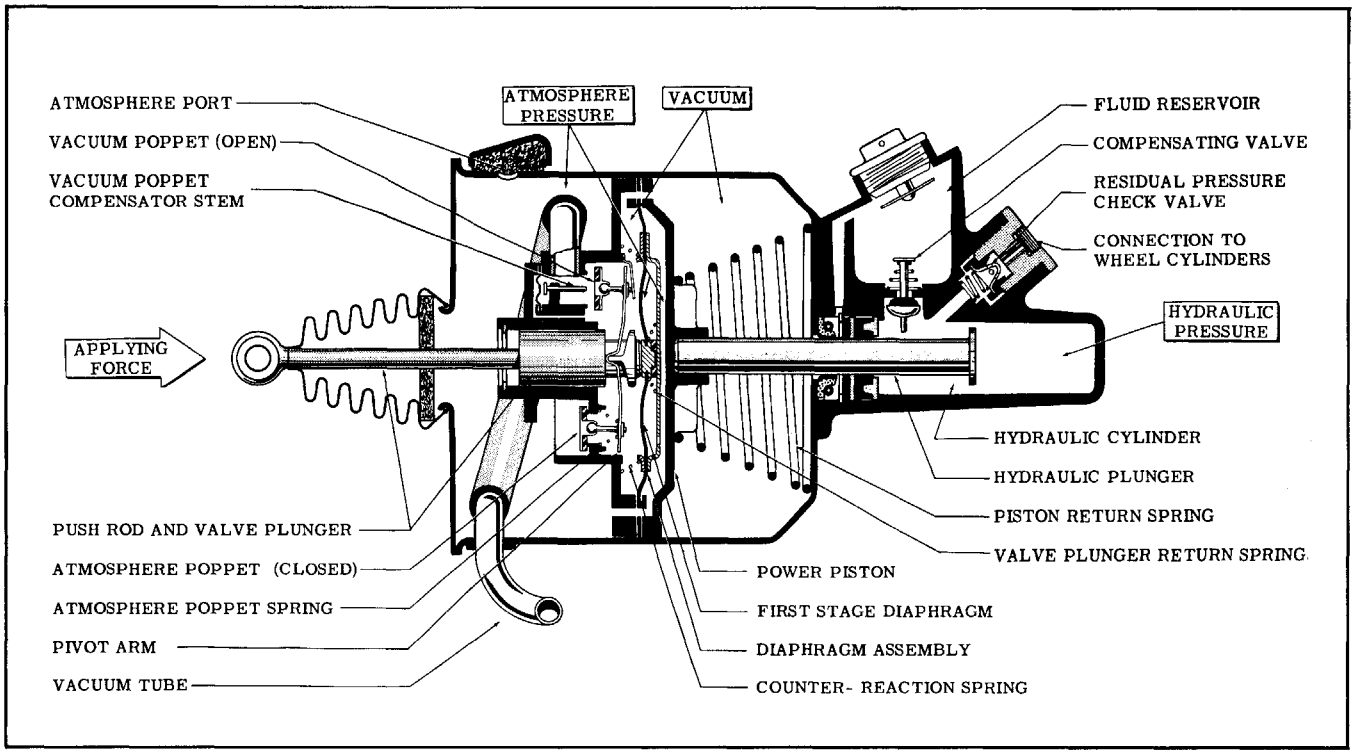

Fig. 5-15 Power Brake in Applying Position

APPLYING (FIG. 5–15)

As the brake pedal is applied by the driver, the push rod and valve plunger move to the right in the power piston allowing the pivot arm and atmosphere poppet spring to close the atmosphere poppet. After the atmosphere poppet closes, the pivot arm, which pivots freely on the push rod plunger, opens the vacuum poppet.

The "pre-loading" of the vacuum poppet (in the released position) by the vacuum poppet compensator stem reduces the force required to lift the poppet from its seat. Smoothness in the initial application of the power brake is thereby obtained.

With the vacuum poppet open, vacuum is communicated to the left side of the diaphragm assembly and to the right side of the power piston.

With atmospheric pressure on the left side of the power piston and vacuum on the right side, a pressure differential exists which causes the power piston to move to the right. As the power piston moves to the right, the piston return spring is compressed and the hydraulic plunger moves to the right in the hydraulic cylinder.

Initial movement of the plunger allows the compensating valve to seat, trapping fluid in the hydraulic cylinder. Fluid under pressure is forced past the residual pressure check valve and through the lines to the wheel cylinders.

When the brake pedal is depressed and the plunger moves to the right, a reactionary, or opposing force, is provided by the valve plunger return spring (first stage diaphragm) and differences in pressure on the sides of the diaphragm (vacuum on left side and atmospheric pressure on the right side). This reactionary force results in 40% of the load being provided by the driver while 60% is done by the power brake unit.

Initial reactionary force is provided by the valve plunger return spring. When the plunger has moved far enough to the right to open the vacuum poppet, vacuum is communicated to the left side of the diaphragm, the reactionary force is a combination of valve plunger return spring force and pressure differential across the diaphragm.

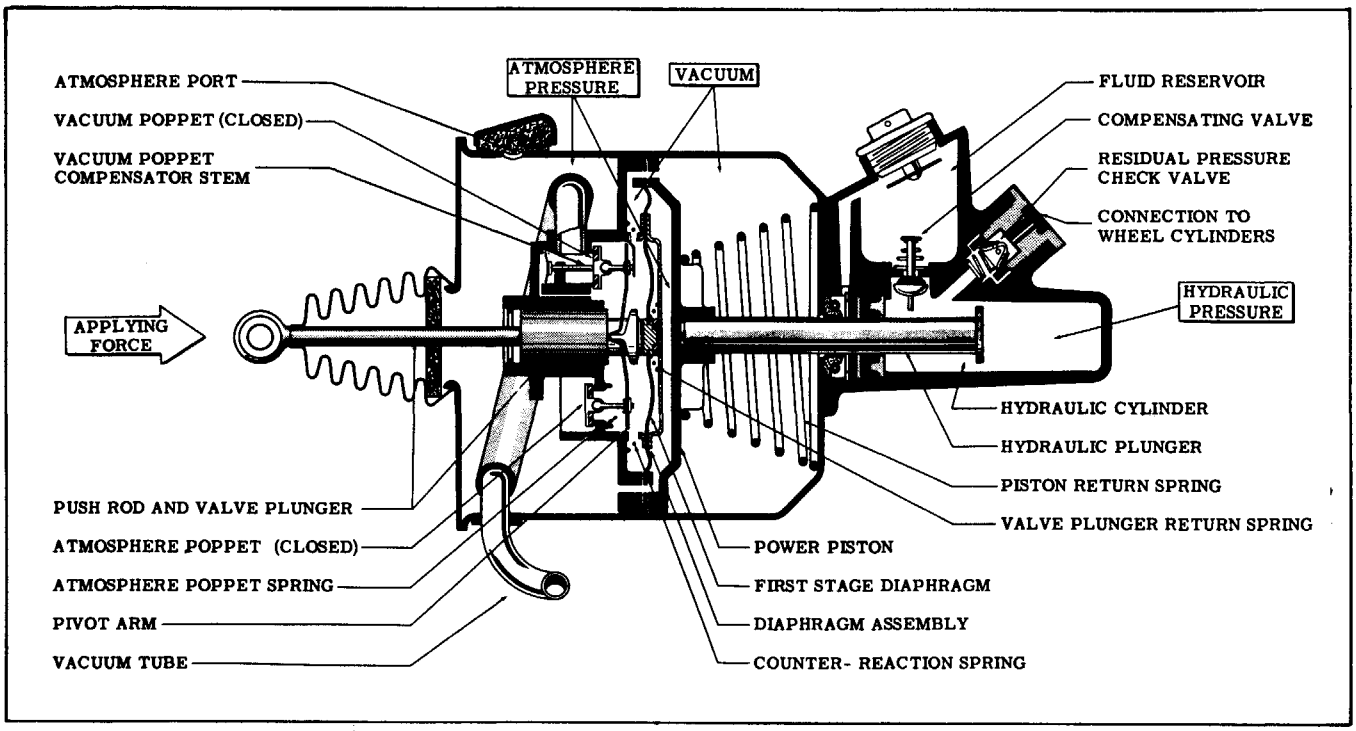

Fig. 5-16 Power Brake in Holding Position

HOLDING POSITION (FIG. 5-16)

After the degree of braking desired is obtained, no increase in force on the pedal is exerted by the driver. The push rod and plunger then stop moving to the right. The power piston, however, continues to move to the right due to the difference in pressure on the sides of the piston (vacuum poppet open, atmosphere poppet closed). The motion of the piston to the right (rod and plunger stationary) is transmitted to the pivot arm, which moves to close the vacuum poppet.

With both poppets closed, the forces on both sides of the piston become equal, the piston stops moving and the unit is in holding position. The degree of vacuum at the right side of the piston and at the left side of the diaphragm assembly is sufficient to give the required degree of reactionary force and to hold the power piston in the position which gives the selected braking action. An increase in the applying force on the push rod by the driver will move the rod and plunger to the right in the piston, opening the vacuum poppet causing the power piston to move to the right, thereby causing an increase in hydraulic pressure. A decrease in force on the push rod will let the plunger move left, opening the atmosphere poppet causing power piston to move left, thereby causing a decrease in hydraulic pressure.

FULLY APPLIED POSITION (FIG. 5-15)

When the power brake is fully applied, the vacuum poppet is held completely open by the push rod plunger. Full manifold vacuum is transmitted to the right side of the power piston with full atmospheric force on the left side of the piston. Any additional hydraulic output pressure is obtained from the addition of force on the brake pedal by the driver without any additional power assist from the power unit.

RELEASING (FIG. 5-14)

To release the brakes, the driver removes brake pedal force on the push rod and plunger allowing the reactionary force to move the plunger back to its leftward position in the power piston. This allows the vacuum poppet to close and causes the plunger pivot arm to open the atmosphere poppet completely. Atmospheric pressure is again communicated to both sides of the diaphragm assembly and to the right side of the power piston. The piston and diaphragm assembly are again balanced in atmospheric pressure allowing the return spring and fluid pressure in the hydraulic cylinder to return the piston to its released position. Fluid in the lines returns past the residual pressure check valve to the hydraulic cylinder. When the piston reaches the released position, the washer on the hydraulic plunger tilts the compensating valve, opening the hydraulic cylinder to the fluid reservoir.

NO POWER CONDITION

If it should be necessary to use the brakes at a time when the engine is not running and there is no reserve vacuum left in the system, the brakes can be applied in the same manner as in a conventional system. However, as there will be *no* power assist from the unit, *more physical effort* must be exerted by the driver for any degree of braking desired. In the "no power" case, the push rod and plunger move to the right in the power piston until solid contact is made with the piston plate. The return spring is then compressed; the piston and hydraulic plunger are moved to the right and the plunger displaces fluid from the hydraulic cylinder as described before.

PERIODIC SERVICE

Each time the car is in the service department the brake pedal height should be observed. Brakes should be adjusted any time the pedal pad to floor clearance is less than 1" with brakes applied and engine running.

The power brake piston packing is lubricated at the time of original assembly and needs no further lubrication. CAUTION: Do not lubricate push rod and valve plunger.

ADJUSTMENTS ON CAR

There are no special brake adjustments required on Pontiac cars equipped with power brakes. Any time the brake pedal goes to within 1" from floor (floor mat to underside of pedal pad) brakes should be adjusted as outlined under "Adjustments on Car", page 5–3.

The following inspections must be made on cars with power brakes at the time the brakes are adjusted.

1. Check for possible vacuum leaks at carburetor, vacuum check valve, vacuum reservoir, and vacuum power cylinder.

2. Check fluid level in hydraulic cylinder reservoir. Fluid level should be ½" from the top of filler plug opening.

3. Check condition of air cleaner hair and insert clean hair if necessary.

4. Check steering column pedal pivot bracket for loose screws. Check for free operation of brake pedal. If binding exists check for misalignment between pedal and vacuum cylinder push rod.

5. Check stop light switch for proper operation.

MINOR REPAIRS

BLEEDING BRAKES

Brakes should be bled in the same manner as standard brakes following the procedure on page 5–5.

STOP LIGHT SWITCH—REMOVE AND REPLACE

REMOVE

1. Disconnect wires from switch.

2. Remove cap screw which retains switch to left side of brake pedal pivot bracket.

3. Remove switch from end of pivot bracket shaft.

REPLACE

1. Position switch on end of pivot bracket shaft and loosely install cap screw.

2. Ensure that brake pedal is retracted (out) to its normal position, and position switch so that the distance between the striker plate and base of switch is not less than 11/32". NOTE: A size "S" drill can be used as a gauge.

3. Connect wires to stop light switch.

4. Start engine and check for proper operation of switch. Switch operation is satisfactory if stop lights go "on" when pedal has traveled approximately ½" from normal position.

REMOVAL OF POWER BRAKE UNIT

1. Disconnect vacuum hose from vacuum pipe leading to vacuum tee connector.

2. Raise car and remove engine side apron from left side.

3. Remove electrical cables from behind cable guide on reservoir cover of brake unit.

4. Remove coiled hydraulic pipe from outlet fitting on hydraulic cylinder and from tee connector.

5. Disconnect push rod from pedal.

6. Disconnect wires from stop light switch.

7. Remove nuts from U-bolt which retains pedal pivot bracket to steering column; remove pedal and pivot bracket (with stop light switch assembly attached).

8. Remove accelerator pedal.

9. Push rubber grommet up on steering column and move floor mat out of way.

10. Remove clutch pedal seal retainer (Synchro-Mesh equipped cars) and steering column seal retainer and remove seals.

11. On Hydra-Matic equipped cars, remove screws which retain mounting plate to floor pan and remove mounting plate with power brake unit attached. On Synchro-Mesh equipped cars, proceed as follows:

a. Remove screws which retain power brake unit to mounting plate. (Brake unit will rest on frame.)

b. Remove screws which retain mounting plate to floor pan and remove mounting plate, "jockeying" as necessary to clear clutch pedal.

c. Remove power brake unit. CAUTION: Do not support or carry brake unit by push rod since push rod may be pulled out of plunger.

12. Remove mounting plate from brake unit, if not previously removed, and remove vacuum hose from vacuum cylinder inlet tube.

DISASSEMBLY OF BENDIX POWER BRAKE UNIT

NOTE: Use extreme care in handling the natural rubber parts to prevent their coming into contact with mineral oil, grease, gasoline, or cleaning solvent.

1. Clean all dirt from the outside of the unit using care not to allow any of the cleaning solvent to enter the unit.

2. Mount unit in holding fixture J-5433 (Fig. 5-17). If holding fixture is not available, clamp hydraulic cylinder in vise.

3. Remove battery cable guide (Fig. 5-17).

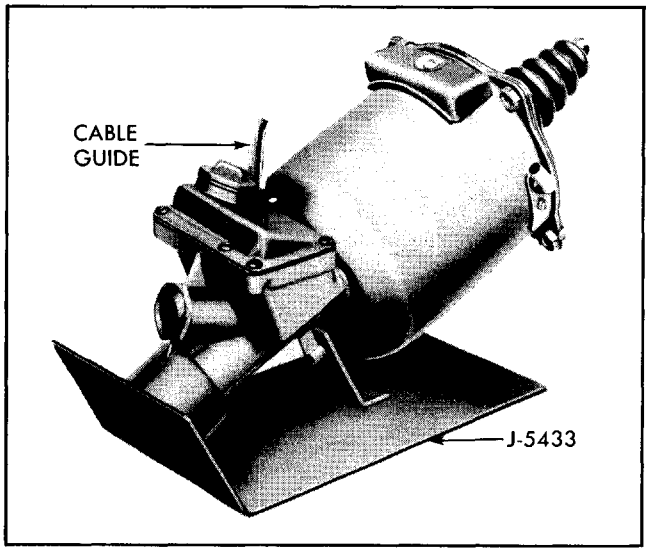

Fig. 5-17 Power Brake Unit in Holding Fixture

REMOVAL OF END PLATE AND AIR CLEANER (FIG. 5-18)

Remove rubber dust guard (1) from scallops at center of end plate (3). Remove rubber dust guard and felt (2) from push rod. Bend up two tabs on end plate and separate end plate and end plate gasket (4) from vacuum cylinder (6). Slide vacuum hose (5) off vacuum tube attached to vacuum cylinder. Remove air cleaner screw (11) and separate screw gasket (10), shell (9), hair (8) and rubber seals (7) from vacuum cylinder.

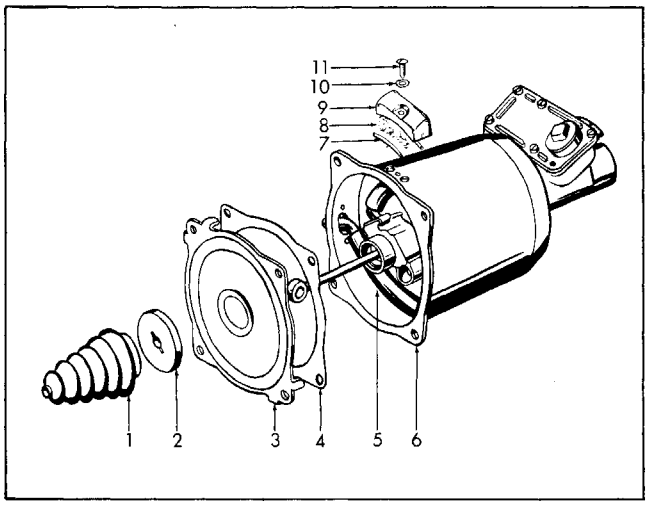

Fig. 5-18 Removal of End Plate and Air Cleaner

REMOVAL OF VACUUM TUBE AND PISTON ASSEMBLY (FIG. 5-19)

Remove two vacuum tube attaching screws (2), vacuum tube (3), and gasket (4). Inspect inner surface of vacuum cylinder under holes (5 and 7) for burring from attaching screws. Remove burrs to prevent damage to power piston assembly. Pull out piston assembly (1) from vacuum cylinder (6).

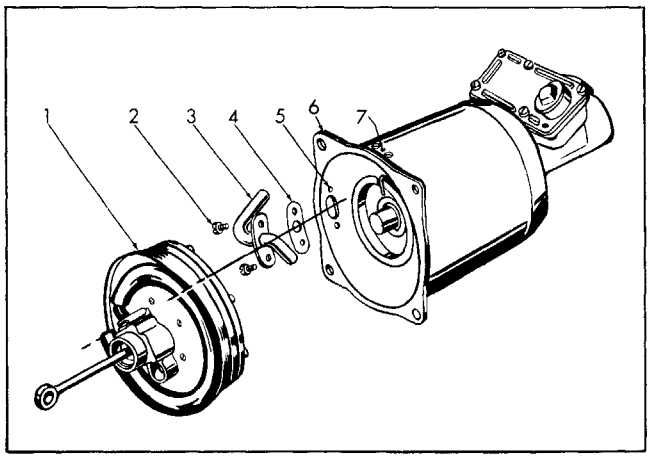

Fig. 5-19 Removal of Vacuum Tube and Piston Assembly

REMOVAL OF PISTON STOP, COMPENSATING STEM AND VACUUM HOSE (FIG. 5-20)

Remove vacuum hose (9) from piston tube (7). Remove tube screw (6) and separate tube and rubber seal (8) from piston assembly (10). Visually inspect condition of rubber stop (1). If there is no evidence of wear or damage, remove screws (2) and remove steel stop washer (3) with rubber stop attached. (If rubber stop warrants replacing, separate stop from steel washer before removing steel washer.) Remove compensating stem diaphragm (4) and compensating stem (5).

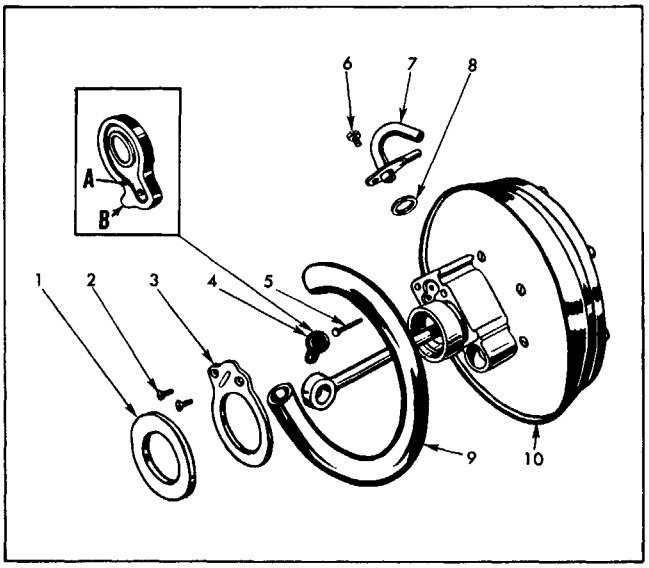

Fig. 5-20 Removal or Replacement of Piston Stop, Compensating Stem, and Vacuum Hose

REMOVAL OF PISTON RETURN SPRING (FIG. 5-21)

Push in on spring retainer plate (2) sufficient to release "C" washer (1), then slide "C" washer out of groove in hydraulic plunger (4). Remove retainer plate (2) and piston return spring (3).

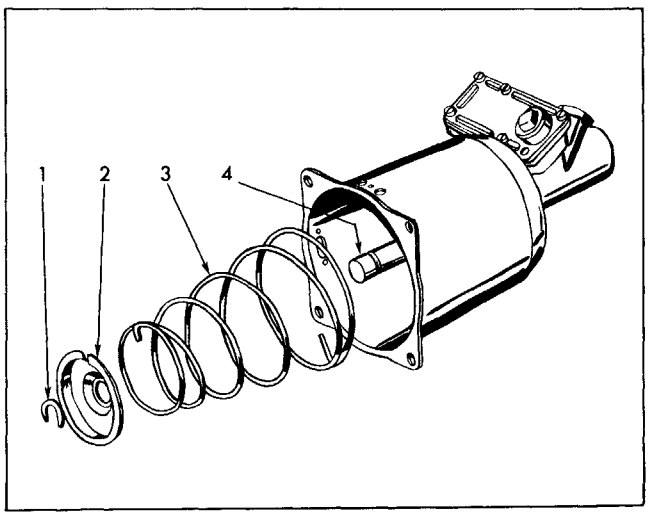

Fig. 5-21 Removal or Replacement of Piston Return Spring

REMOVAL OF VACUUM CYLINDER FROM HYDRAULIC CYLINDER ASSEMBLY (FIG. 5-22)

Scribe alignment marks across vacuum cylinder (2) and hydraulic cylinder assembly (7). Using 7/16" socket wrench with extension, remove three vacuum cylinder attaching screws (1). Separate vacuum cylinder gasket (3), and rubber ring seal (4) from hydraulic cylinder. Push hydraulic plunger (6) into hydraulic cylinder and remove leather seal (5) from hydraulic cylinder.

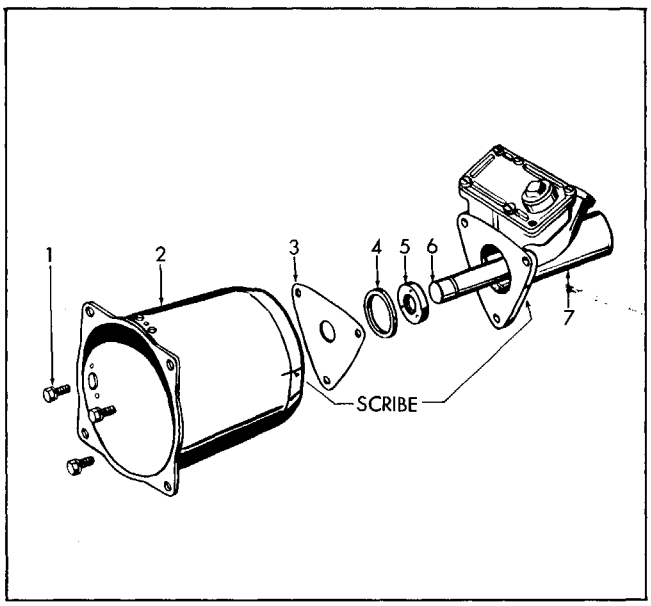

Fig. 5-22 Removal of Vacuum Cylinder from Hydraulic Cylinder

REMOVAL OF FLUID RESERVOIR COVER, COMPENSATING VALVE, AND HYDRAULIC PLUNGER (FIG. 5-23)

Scribe alignment marks across hydraulic cylinder casting and reservoir cover; then remove five cover attaching screws (11), cover (10) and gasket (9). From cover remove filler cap (13) and gasket (12). With 1 1/8" thin walled socket wrench, remove compensating valve assembly (8). Using Truarc snap ring pliers, remove retainer ring (1). (If ring is of Spirolox type, use sharp pointed tool to pry end of ring out of groove.) Pull hydraulic plunger (6) out of hydraulic cylinder and remove steel washer (2), Spauldite guide washer (3), rubber hydraulic cup (4) and cup retainer (5) from plunger.

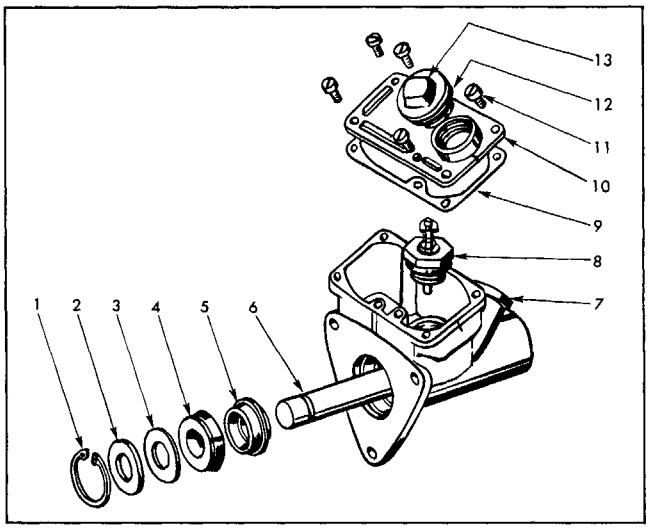

Fig. 5-23 Removal or Replacement of Reservoir Cover, Compensating Valve, and Hydraulic Plunger

REMOVAL OF RESIDUAL CHECK VALVE (FIG. 5-24)

Remove hydraulic outlet fitting (1), residual check valve cup and retainer (3) and check valve spring (4) from hydraulic cylinder (5). From outlet fitting (1) remove rubber seal (2).

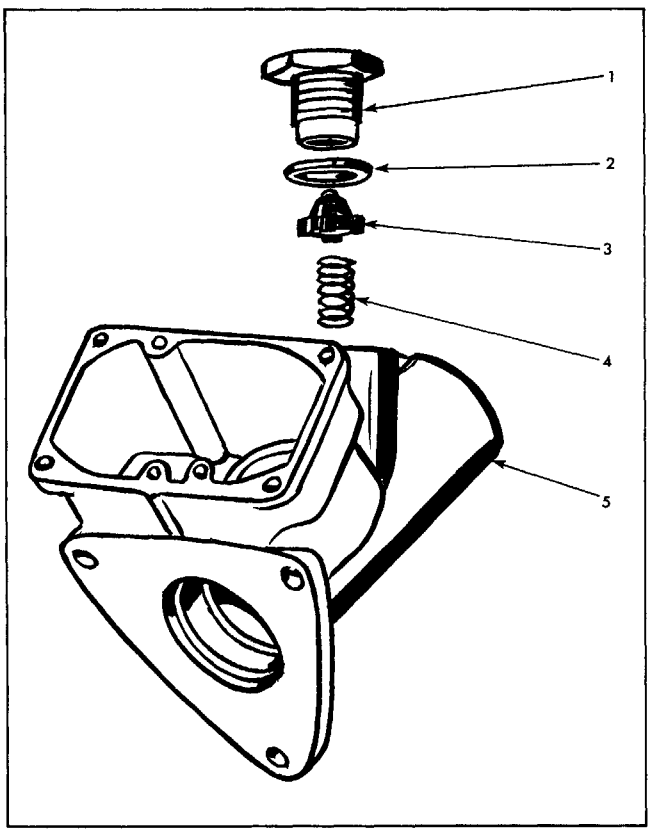

Fig. 5-24 Removal or Replacement of Residual Check Valve

DISASSEMBLY OF COMPENSATING VALVE (FIG. 5-25)

Clamp compensating valve fitting (3) in vise; spread open and remove spring retainer (1), then remove spring (2) and valve stem and poppet (5). Remove rubber seal (4) from fitting.

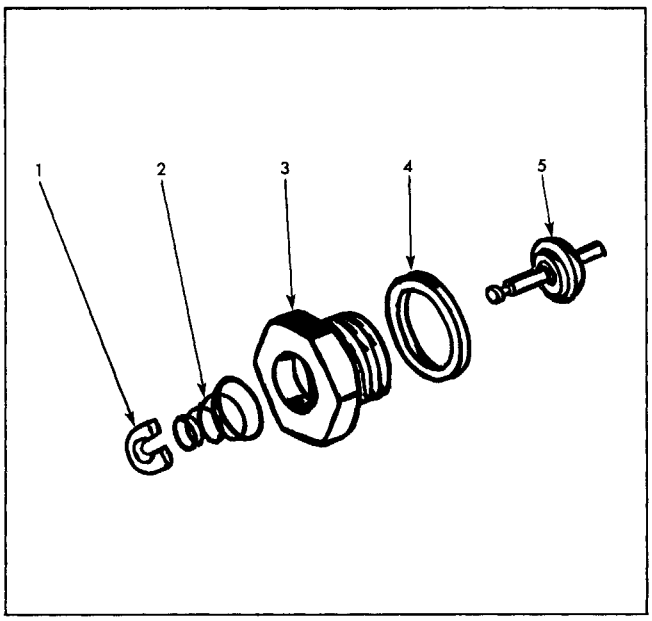

Fig. 5-25 Dissassembly or Assembly of Compensating Valve

REMOVAL OF FRONT PISTON PLATE, DIAPHRAGM, PUSH ROD AND PLUNGER, AND POPPETS (FIG. 5-26)

Hold rear piston plate assembly (6) in vise using care not to damage surface at vacuum tube port. Loosen five piston plate screws (1), and separate front piston plate (2), gasket (3), diaphragm assembly (4), and counter-reaction spring (5) from rear piston plate assembly. Remove vacuum poppet spring screw (7), spring (8) from rear piston plate (18). Using pliers, remove atmosphere poppet retaining clip (14). Break clip if necessary to remove from poppet stem. Separate atmosphere poppet spring (16) and atmosphere poppet (19) from piston plate. Remove push rod and plunger, and vacuum poppet assembly from piston plate. From groove in bore of piston plate, remove plunger stop ring (20). Using sharp tool under end of Spirolox ring (9) remove ring from groove at end of plunger (17). Separate pivot washer (10) and pivot arm (12) from plunger. Remove clip (11) and separate vacuum poppet (13) from pivot arm. From recess around plunger remove flat rubber seal (15).

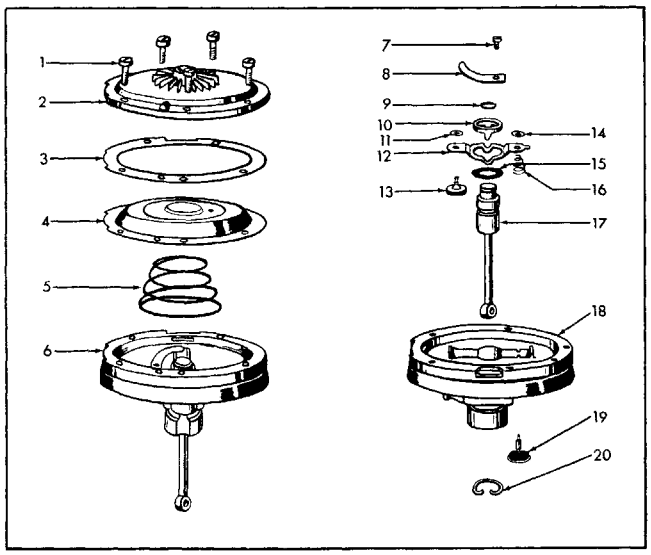

Fig. 5-26 Removal of Front Piston Plate, Diaphragm, Push Rod and Plunger, and Poppets

REMOVAL OF PACKING AND PLATES FROM REAR PISTON PLATE (FIG. 5-27)

Place rear piston plate (7) on bench, with packing and plates facing upward. Remove six retainer plate attaching screws (1), retainer plate (2), ring (3), wicking (4), piston packing plate (5), and leather piston packing (6).

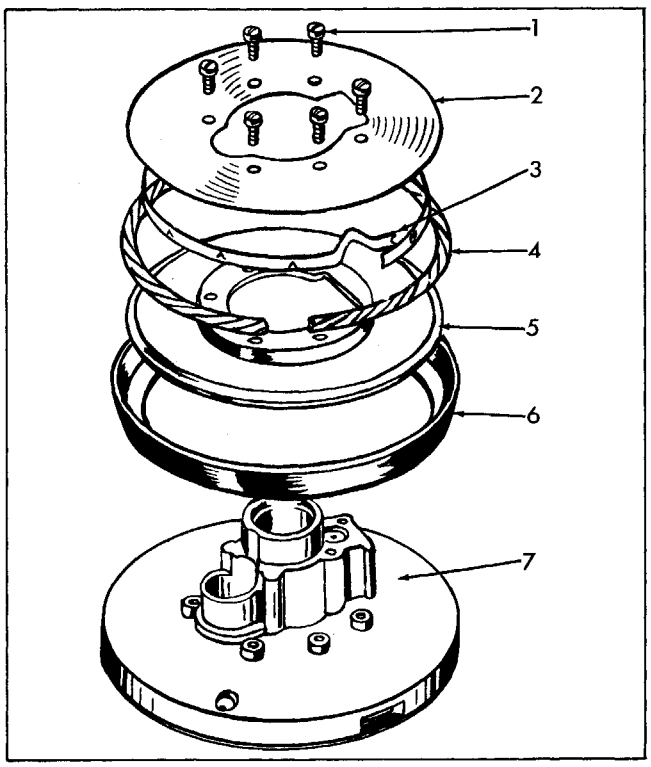

Fig. 5-27 Removal of Packing and Plates from Rear Piston Plate

CLEANING AND INSPECTION

CLEANING

Thoroughly wash all parts in alcohol or a commercial cleaning fluid. *Use only alcohol* on rubber parts or parts containing rubber. Use air hose to blow dirt and cleaning fluid out of recesses and internal passages. Remove rust or corrosion from bore of vacuum cylinder shell with fine emery cloth.

It is *important* that all cleaned parts be placed on clean paper or cloth to prevent the possibility of dirt being assembled into the power brake.

INSPECTION

Inspect all parts for wear or damage and replace as necessary. Particular attention should be given to the following items.

VACUUM CYLINDER SHELL

Inspect shell for scores, pits, dents or nicks, or damaged threads in nuts or in mounting flanges.

HYDRAULIC CYLINDER CASTING

Examine the bore down one inch from the open end. For the hydraulic cup to seal properly, this portion of the bore must be free from scores, deep scratches and corrosion. The sealing surfaces at the reservoir cover, compensating port, and hydraulic outlet port must be free of scoring, pitting, dents and nicked edges. Also check casting for cracks and damaged threads.

HYDRAULIC PORT FITTING

The surface at the small end of the fitting must be free of scoring or corrosion which might prevent sealing with the rubber cup of the residual check valve.

COMPENSATING PORT FITTING

Inspect surface around port opening, inside threaded end of fitting, for scoring or corrosion which might prevent proper seating of the compensating valve.

VALVE SUPPLY TUBE

Make sure the tube braze is secure and the tube plate is not distorted.

PISTON PLATES

Examine plates for cracks and damaged threads. Inspect plunger bore in the rear piston plate and poppet seats for scratches and nicks. *Do not* attempt to refinish bore. Replace with new plate if necessary.

HYDRAULIC PLUNGER AND WASHER ASSEMBLY

Inspect polished surface for scores, pits, or dents. *Do not* attempt to refinish plunger surface; replace with new assembly if necessary.

PUSH ROD AND PLUNGER ASSEMBLY

Rod must pivot freely in plunger without any noticeable end play. Inspect plunger for scores, pits, or dents on outside diameter of polished surfaces. *Do not* attempt to refinish plunger surface; replace with new assembly if necessary.

VACUUM CYLINDER END PLATE

Examine end plate for distortion.

ASSEMBLY OF BENDIX POWER BRAKE UNIT

ASSEMBLY OF COMPENSATING VALVE (FIG. 5-25)

Insert stem of valve poppet assembly (5) through hole in threaded end of fitting (3). Assemble large coil of poppet spring (2) to fitting over stem of poppet. Hold poppet on seat, compress spring, and insert "C" washer retainer (1) in groove at end of stem. Crimp ends of "C" washer together to retain in place. Coat rubber seal (4) with brake fluid and assemble over threads of fitting.

REPLACEMENT OF RESIDUAL CHECK VALVE (FIG. 5-24)

Coat rubber seal (2) with brake fluid and place over threads of hydraulic outlet fitting (1). Hold outlet fitting in inverted position, and insert cone end of cup and retainer assembly (3) into end of fitting. Center check valve spring (4) in recess of rubber cup. Hold hydraulic cylinder casting (5) upside down and thread outlet fitting into hydraulic cylinder.

REPLACEMENT OF HYDRAULIC PLUNGER, COMPENSATING VALVE, AND FLUID RESERVOIR COVER (FIG. 5-23)

Hold hydraulic cylinder in vise and tighten outlet fitting (7) to 50 lb. ft. torque. Insert washer end of plunger (6) into hydraulic cylinder. Place cup retainer (5) on plunger so that the smaller inside diameter of retainer is toward plunger washer. Coat hydraulic cup (4) with brake fluid and place over plunger; lip on cup must be toward cup retainer. Place Spauldite guide washer (3) against cup. Place steel washer against guide washer. Slide all parts into bore of hydraulic cylinder. CAUTION: Use care so as not to cut hydraulic cup (4) when placing cup on plunger (6) and when inserting cup lip into bore of hydraulic cylinder. It will be necessary to use a small screwdriver or similar tool having a smooth edge to start lip into bore.

Press parts into cylinder bore and insert snap ring (1) using snap ring pliers J-4245. Be sure snap ring is engaged in recess. Push in on hydraulic plunger and then install compensating valve assembly (8) into hydraulic cylinder. Pull back on plunger to be *sure* plunger washer tilts compensator valve. Tighten fitting to 15 lb. ft. torque. Place cover gasket (9) on reservoir of hydraulic cylinder. Align cover (10) scribe marks and replace all cover screws (11), with exception of the rearmost screw on right hand side. Replace filler cap gasket (12) and screw filler cap (13) into cover.

ASSEMBLY OF VACUUM CYLINDER TO HYDRAULIC CYLINDER ASSEMBLY (FIG. 5-28)

Pull out hydraulic plunger (6), place Hydraulic Plunger Seal Installer J-5405 over end of plunger, and assemble leather seal (5) over seal tool with lip of seal toward hydraulic cylinder (7). Press seal into recess of hydraulic cylinder and then remove tool J-5405 from plunger. Place rubber seal (4) into hydraulic cylinder recess around leather seal. Align vacuum cylinder (2) to hydraulic cylinder, and with gasket (3) in place, insert three cap screws (and lock-washers) (1). Tighten screws to 6 lb. ft. torque.

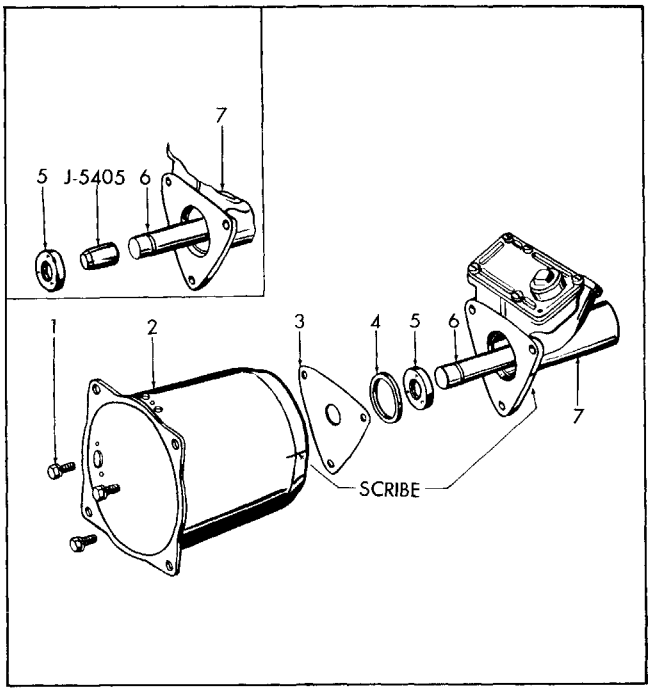

Fig. 5-28 Assembly of Vacuum Cylinder to Hydraulic Cylinder

REPLACEMENT OF PISTON RETURN SPRING (FIG. 5-21)

Place larger end of vacuum piston return spring (3) in vacuum cylinder making certain hook on spring is between a screw head and a raised projection on end of cylinder. Assemble retainer plate (2) over end of spring, aligning notch with hook on spring. Compress spring, and with retainer plate over end of plunger (4), insert "C" washer (1) into groove of plunger.

REPLACEMENT OF PUSH ROD AND PLUNGER, POPPETS, DIAPHRAGM, AND FRONT PISTON PLATE (FIG. 5-29)

Place stem of vacuum poppet (14) in hole at rounded end of pivot arm (13) and install two retaining clips (12) ensuring that clips are pushed down against pivot arm. A piece of bar stock with $\frac{1}{8}$" hole in end or piece of brake pipe with flared end facilitates installation. Place rubber seal (19) in recess of push rod plunger (20) with lip of seal toward push rod.

Coat plunger with Lubriplate, place into bore of rear piston (15), and engage snap ring (21) in recess in bore of piston plate. Place pivot arm vacuum poppet sub-assembly over end of plunger, insert pivot washer (11), and engage Spirolox ring (10) into groove at end of plunger. (Engage end of ring in groove and then "screw" into place.) Place vacuum poppet spring (9) into recess of piston plate (15) and with end of spring over end of vacuum poppet stem, insert screw (8). Place atmosphere poppet spring (17) between pivot arm and piston plate with large coil of spring towards atmosphere port. From opposite side of piston plate, place atmosphere poppet (18) so that stem passes through plate, spring, and hole in pivot arm. Install retainer clips (16) on stem of poppet in same manner as before. A length of round rod with a flat end can be used to back up atmosphere poppet when installing clips.

Clamp rear piston plate assembly (7) in vise and screw Guide Pin Set J-5404 in place. Place large end of counter-reaction spring (5) in piston plate. Place diaphragm (4) over guide pin so that by-pass holes and notches in diaphragm and plate are aligned. NOTE: When by-pass holes and notches are aligned, the correct side of the diaphragm will be toward the piston plate.

Move diaphragm downward until it seats on the spring. When properly seated, the flange of the metal ring will be within the counter-reaction spring. Place gasket (3) and front piston plate (2) over guide pins, making sure by-pass holes and notches are properly aligned.

Apply force on front piston plate to compress counter-reaction spring until front piston plate rests on rear piston plate. Loosely install two screws (1). Remove guide pins, one at a time, and install remaining three screws. Tighten all screws evenly.

REPLACEMENT OF PACKING AND PLATES IN REAR PISTON PLATE (FIG. 5-30)

Place piston assembly (7) flat on work bench inside of Piston Assembly Ring J-5406. Place leather packing (6) against piston with lip up. Place packing plate (5) inside leather packing, with beveled edge of plate down against packing, so that "cutouts" and holes in plate are aligned with piston. Coil wicking (4) inside lip of leather packing. Cut wicking to required size. Remove wicking and dip it in vacuum cylinder oil; let excess drip off and reinstall wicking.

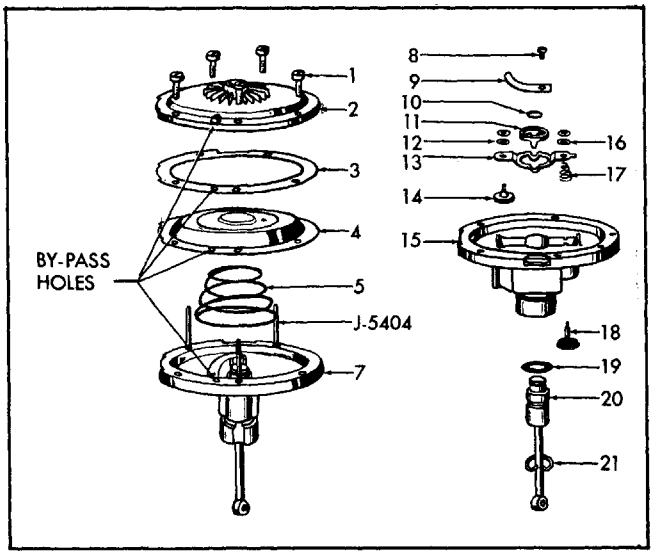

Fig. 5-29 Replacement of Push Rod and Plunger, Poppets, Diaphragm, and Front Piston Plate

Coil expander ring (3) inside wicking with barbs pointing upward into wicking. Engage notch at loop end of ring with hook at opposite end. Replace and align wicking retainer plate (2). Replace six screws (1) and tighten evenly.

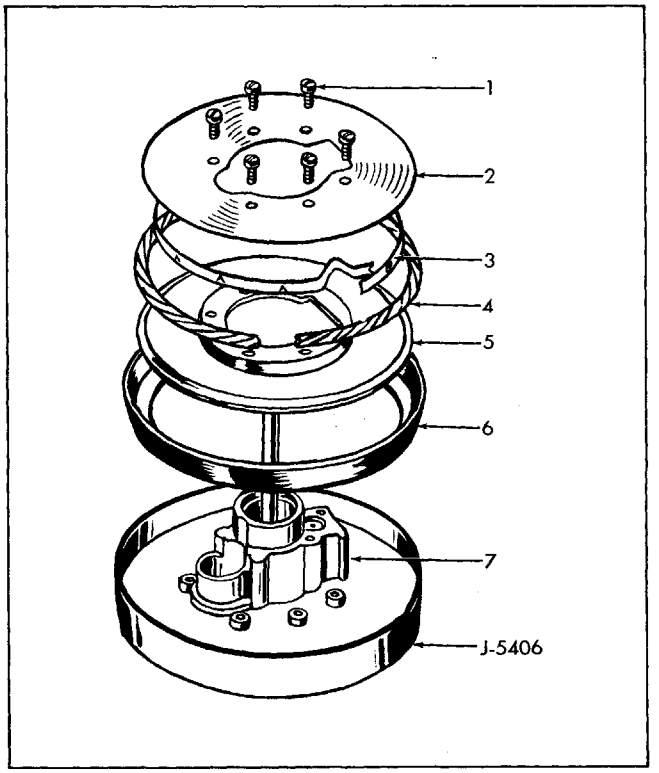

Fig. 5-30 Replacement of Packing and Plate in Rear Piston Plate

REPLACEMENT OF COMPENSATING STEM, PISTON STOP, AND VACUUM HOSE (FIG. 5-20)

Place vacuum poppet compensating stem (5) into hole in recess in hub of piston plate (10). Place compensating stem diaphragm (4) in recess with "by-pass" slot "A" of diaphragm outward and tab "B" aligned as shown. Place steel stop washer (3) over push rod, align washer with hub of piston; replace two screws (2) and tighten securely. Soften coating of rubber stop (1) (if stop was removed) with gasoline and cement to steel washer (3). Position rubber seal (8) in recess of piston, hook plate of tube (7) to piston plate and replace screw (6). Tighten screw securely. Attach vacuum hose (9) to tube (7) and coil hose around hub of piston.

REPLACEMENT OF PISTON AND VACUUM TUBE (FIG. 5-31)

Apply thin film of vacuum cylinder oil to bore of vacuum cylinder (8) and to lip of leather packing (6). Position piston into cylinder so that free end of vacuum hose (1) is in line with center of hole (5). Push piston into cylinder, adjusting position slightly until hook (7) seats between two web sections of front piston plate. Move piston 20°-25° in both directions in cylinder and stroke piston against spring several times by hand, to allow piston to find its normal operating position. Check location of end of hose (1) with respect to center of hole (5) in cylinder. Install tube (3) and gasket (4) and replace two screws (2). Slide end of hose (1) onto vacuum tube approximately 5/8". Operate piston by hand through its full stroke several times to make certain that the hose does not rub against the cylinder or piston. Should interference occur, remove and rotate piston to a new "web" position where interference does not occur.

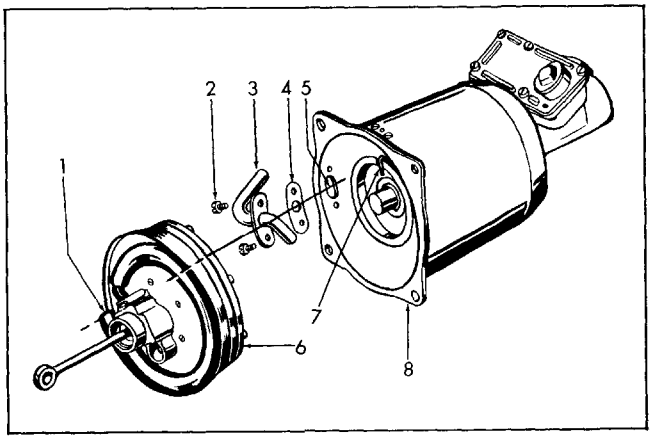

Fig. 5-31 Replacement of Piston and Vacuum Tube

REPLACEMENT OF AIR CLEANER AND END PLATE (FIG. 5-32)

Place two rubber seals (6) on bottom edges of air cleaner shell (8). Place hair (7) in shell. Replace screw (10) and gasket (9) and attach air cleaner shell to vacuum cylinder (5). Be sure hair is under shell; a small steel scale or similar tool can be used to push hair under ends of shell. Align end plate gasket (4) and end plate (3) and place against vacuum cylinder. Bend over two tabs of end plate to secure plate to cylinder. Install rod guard felt (2) in large end of rubber rod guard (1). Dip small end of rubber guard in brake fluid and place guard and felt over push rod. Attach lip of rubber guard to scallops at center of end plate (3).

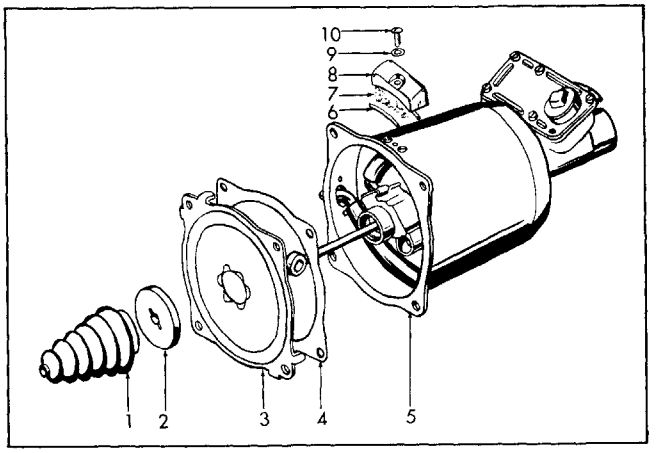

Fig. 5-32 Replacement of Air Cleaner and End Plate

INSTALLATION OF POWER BRAKE UNIT

NOTE: Installation procedure for Hydra-Matic equipped cars differs from that for Synchro-Mesh equipped cars. Each procedure is outlined below.

PROCEDURE FOR HYDRA-MATIC EQUIPPED CARS

1. Install battery cable guide (Fig. 5-17) on reservoir cover and tighten all cover attaching screws evenly. Install vacuum hose on tube at side of cylinder and install mounting plate.

2. Place mounting plate, with brake unit attached, in position and install screws which retain mounting plate to floor pan.

3. Replace steering column seal and seal retainer.

4. Replace brake pedal pivot bracket (with pedal and stop light switch attached). NOTE: The brake pedal pivot bracket has a tang which must fit in a hole in the steering column.

5. Install push rod in pedal, fastening pin with hairpin retainer. Attach anti-rattle spring around push rod and connect to hole in brake pedal (Fig. 5-33).

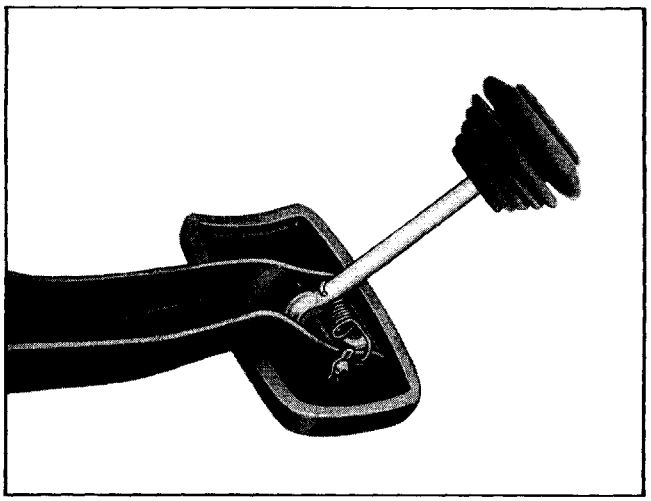

Fig. 5-33 Correct Assembly of Brake Pedal to Push Rod

6. Pull rubber boot back from vacuum cylinder so that push rod can be observed where it enters vacuum cylinder. There should be approximately 1/8" clearance between push rod and bore of plunger at top or 12 o'clock position with brake pedal released (Fig. 5-34). If improper clearance is noted, loosen brake pedal pivot bracket and shift slightly to obtain clearance. NOTE: If clearance cannot be obtained, check for bent push rod or bent mounting plate.

7. Connect stop light switch wires and check for proper operation.

8. Connect hydraulic pipe and vacuum hose. Place battery cable behind cable guide.

9. Fill hydraulic cylinder with recommended brake fluid (page 5-12) and bleed brakes as outlined on page 5-5. CAUTION: Use only recommended brake fluid (page 5-12) to insure satisfactory brake performance.

PROCEDURE FOR SYNCHRO-MESH EQUIPPED CARS

1. Install battery cable guide on reservoir (Fig. 5-17) and tighten all screws evenly. Install vacuum hose on tube at side of cylinder.

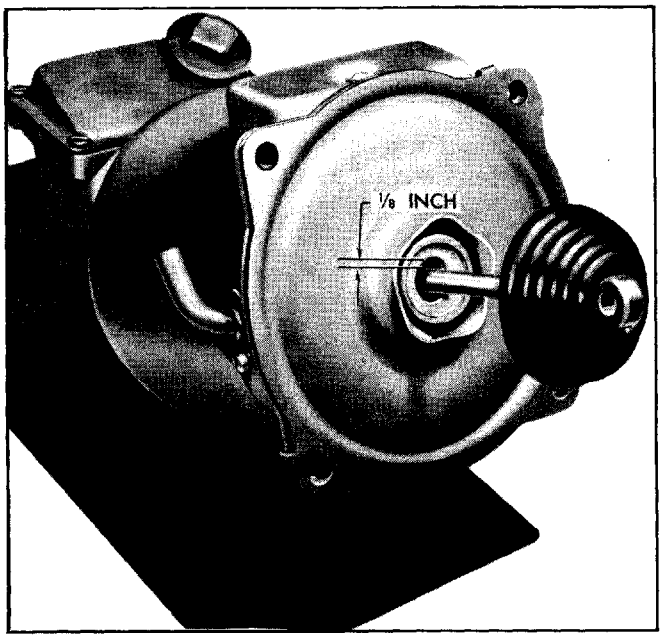

Fig. 5-34 Clearance Between Push Rod and Plunger

2. With aid of an assistant to support and align brake unit from underside of car or under hood, position brake unit in car.

3. Place mounting plate over clutch pedal, position against floor pan, and install retaining screws.

4. Align brake unit with mounting plate and install retaining screws.

5. Replace clutch pedal and steering column seals and seal retainers. Complete installation as outlined in steps 4 through 9 of above procedure.

DIAGNOSIS AND TESTING—BENDIX POWER BRAKES

SYSTEM TESTS

Road test brakes by making a brake application at about 20 MPH to determine if vehicle stops evenly and quickly. If pedal has a spongy feel when applying the brakes, air may be present in the hydraulic system. Bleed system as described on page 5-5.

When engine is stopped and transmission is in neutral, apply brakes several times to remove all vacuum in the system. Depress brake pedal, hold

light foot pressure on pedal and start engine. If the vacuum system is operating, pedal will tend to fall away under foot pressure, and less pressure will be required to hold pedal in applied position. If no action is felt, vacuum system is not functioning.

Stop engine and again remove all vacuum in system. Depress brake pedal and hold foot pressure on pedal. If pedal gradually falls away under foot pressure, the hydraulic system is leaking.

If the brake pedal travels to within 1″ of the toeboard, brake shoes require adjustment or relining.

TROUBLE DIAGNOSIS

The same types of brake troubles are encountered with power brakes as with standard brakes. Before checking power brake system for source of trouble refer to trouble diagnosis of standard brakes on page 5–8.

After these possible causes have been eliminated check for cause as outlined below.

HARD PEDAL

a. Vacuum failure due to
   1. Faulty vacuum check valve.
   2. Collapsed vacuum hose.
   3. Plugged vacuum hose or fittings.
   4. Leaking vacuum reservoir, or vacuum hose and pipe connections.

b. Bound up pedal mechanism.

c. Glazed linings.

d. Grease, brake fluid, or water on linings.

e. Power brake unit trouble due to
   1. Vacuum hose on piston loose or restricted.
   2. Vacuum leak in unit between piston plates, past leather piston packing, between vacuum cylinder and hydraulic cylinder, or around hydraulic plunger seal.
   3. Restricted air cleaner.
   4. Jammed push rod and valve plunger.
   5. Broken counter-reaction spring.
   6. Leak past atmosphere poppet.

GRABBY OR SEVERE BRAKES

a. Grease or brake fluid on linings.

b. Scored drums.

c. Anchor pins loose.

d. Power brake unit trouble due to
   1. Vacuum leak in reaction diaphragm.
   2. Sticking push rod and valve plunger.
   3. Faulty pivot arm and vacuum poppet action.
   4. Restricted diaphragm passage.

PEDAL GOES TO FLOOR (OR ALMOST TO FLOOR)

a. Brakes require adjustment.

b. Air in hydraulic system.

c. Hydraulic leak in lines or at wheel cylinders.

d. Fluid reservoir needs replenishing.

e. Cracked drums or broken linings.

f. Power brake hydraulic leakage at
   1. Compensating valve.
   2. Hydraulic plunger seal.
   3. Compensating seals or outlet fitting seals.

BRAKES FAIL TO RELEASE (OR SLOW RELEASE)

a. Anchor pins loose.

b. Bound up brake pedal linkage.

c. Brakes improperly adjusted.

d. Power brake unit troubles due to
   1. Faulty residual check valve.
   2. Excessive hydraulic plunger seal friction.
   3. Faulty compensating valve.
   4. Excessive piston packing friction.
   5. Restricted air passage in piston plate.
   6. Restricted air cleaner.
   7. Sticky push rod and valve plunger.
   8. Broken piston return spring.

TORQUE SPECIFICATIONS

BENDIX POWER BRAKE UNIT

	Lb. Ft.
Vacuum Cylinder to Hydraulic Cylinder Bolt	6
Compensating Port Fitting	15
Hydraulic Outlet Fitting	50