

SECTION E**BENDIX TANDEM POWER BRAKE UNIT****4L-4N-4R SERIES****CONTENTS**

Division	Subject	Page No.
I	TROUBLE DIAGNOSIS: Tandem Power Brake Unit Trouble Diagnosis	50-88
II	DESCRIPTION AND OPERATION: Description of Tandem Power Brake Unit Operation of Tandem Power Brake Unit	50-89 50-90
III	ADJUSTMENTS AND MINOR SERVICE: (Not Applicable)	
IV	REMOVAL AND INSTALLATION: Removal and Installation of Tandem Power Brake Unit	50-93
V	OVERHAUL AND MAJOR SERVICE: Disassembly of Tandem Power Brake Unit Cleaning and Inspecting Tandem Power Brake Unit Reassembly of Tandem Power Brake Unit Gauging of Tandem Power Brake Unit	50-94 50-96 50-97 50-99
VI	SPECIFICATIONS: Tandem Power Brake Unit Specifications	50-99

DIVISION I**TROUBLE DIAGNOSIS****50-44 TANDEM POWER BRAKE UNIT TROUBLE
DIAGNOSIS**

See Section C, Paragraph 50-26, for Trouble
Diagnosis.

DIVISION II

DESCRIPTION AND OPERATION

50-45 DESCRIPTION OF TANDEM POWER BRAKE UNIT

The Bendix Tandem Diaphragm Master-Vac is a vacuum unit for power braking. The unit uses engine manifold vacuum and atmospheric pressure for its power.

The Master-Vac is composed of two (2) major assemblies: 1) the vacuum power section and 2) the dual system master cylinder. See Figure 50-125.

The vacuum power section is contained in a front shell and a rear shell. These two shells are held together by a twist-lock method with tabs on the edge of the front

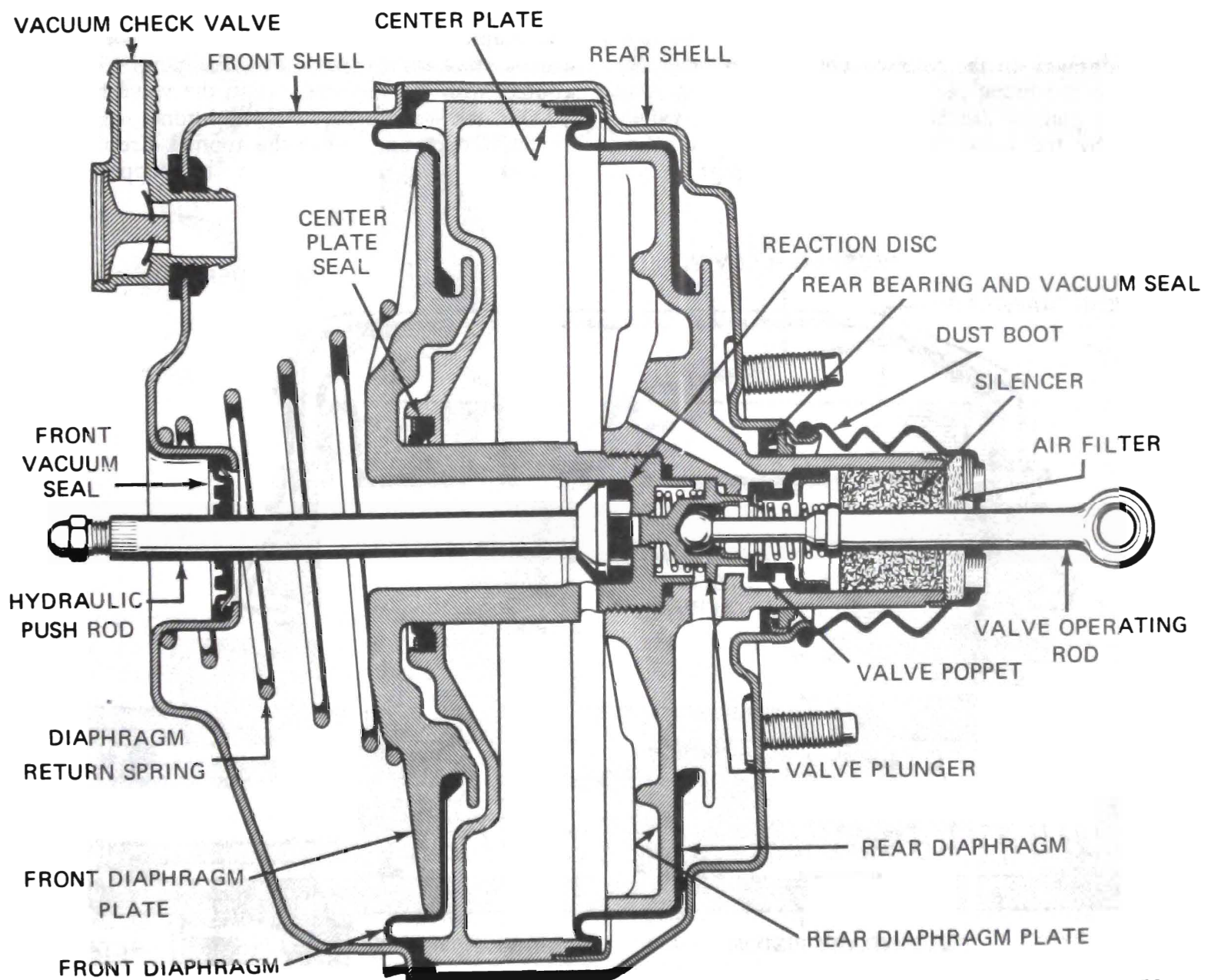
shell engaged by lanced areas on the edge of the rear shell.

A vacuum check valve is inserted in an opening in the front shell, and the hydraulic push rod projects through a vacuum seal that is seated in the recessed area of the front shell.

A dust boot covers the diaphragm plate hub that projects through the rear shell with the valve rod inserted through a hole in the end of the boot.

Two moving diaphragms and diaphragm plates (front and rear) and a stationary center plate are housed inside the shells. Also included are two diaphragms and a diaphragm return spring. A reaction disc is assembled in the front diaphragm plate hub at the end of the hydraulic push rod.

The control valve consists of a valve operating rod,



50-750

Figure 50-125

valve plunger, poppet, poppet retainer, valve return spring and a valve rod spring. A silencer is assembled in the rear diaphragm plate hub and an air filter fits inside the dust boot.

The master cylinder is similar to those previously used, except for the capacity of the fluid reservoirs. The cylinder bore contains a primary and a secondary piston assembly. A stop screw is installed in the fluid inlet port in the bottom of the front reservoir. See Figure 50-126.

50-46 OPERATION OF TANDEM POWER BRAKE UNIT

A. Released Position

With the engine running and the brakes released, vacuum from the intake manifold is admitted through the vacuum check valve to the front (left) vacuum chamber and, through a port in the hub of the front plate, to the vacuum chamber to the front (left) of the rear diaphragm. In the released position (no pressure applied to the brake pedal), the valve operating rod and valve plunger are held to the rear in the valve housing by the valve return spring to CLOSE the atmospheric port and OPEN the vacuum port. With

the valve in this position, the chambers to the rear of both the front and rear diaphragm are open to vacuum through the portings in the hub of the valve housing (rear plate) and around the edge of the center plate. The vacuum power diaphragms are then balanced or suspended in vacuum, since vacuum is present on both sides of both diaphragms. The vacuum diaphragm and plate return spring is then free to return the diaphragm and plate assembly with the hydraulic push rod to the fully released position. With the hydraulic push rod in the released position, the hydraulic compensating ports in the master cylinder are open and permit fluid to return from the wheel cylinders to the separate fluid reservoirs or to enter either system from its reservoir to compensate for expansion or loss of fluid in either system. See Figure 50 127.

B. Applied Position

As the brakes are applied by the driver, the valve operating rod and valve plunger move to the front in the diaphragm and plate assembly to compress the valve return spring and bring the poppet valve into contact with the vacuum seat in the valve housing to CLOSE the vacuum port. Any additional movement of the valve operating rod in the applied direction moves the valve plunger away from the poppet valve to

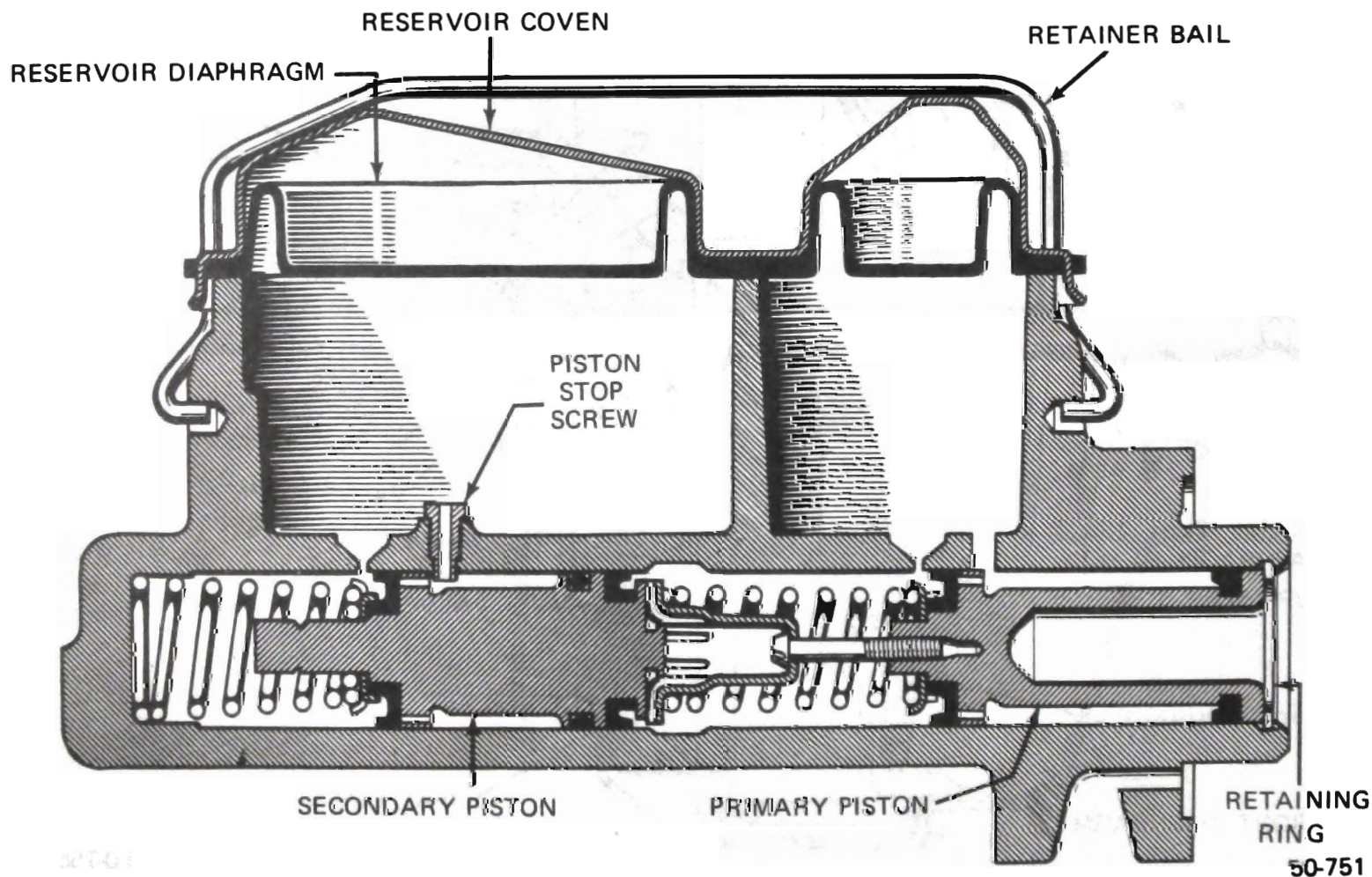


Figure 50-126 Cross Section - Master Cylinder

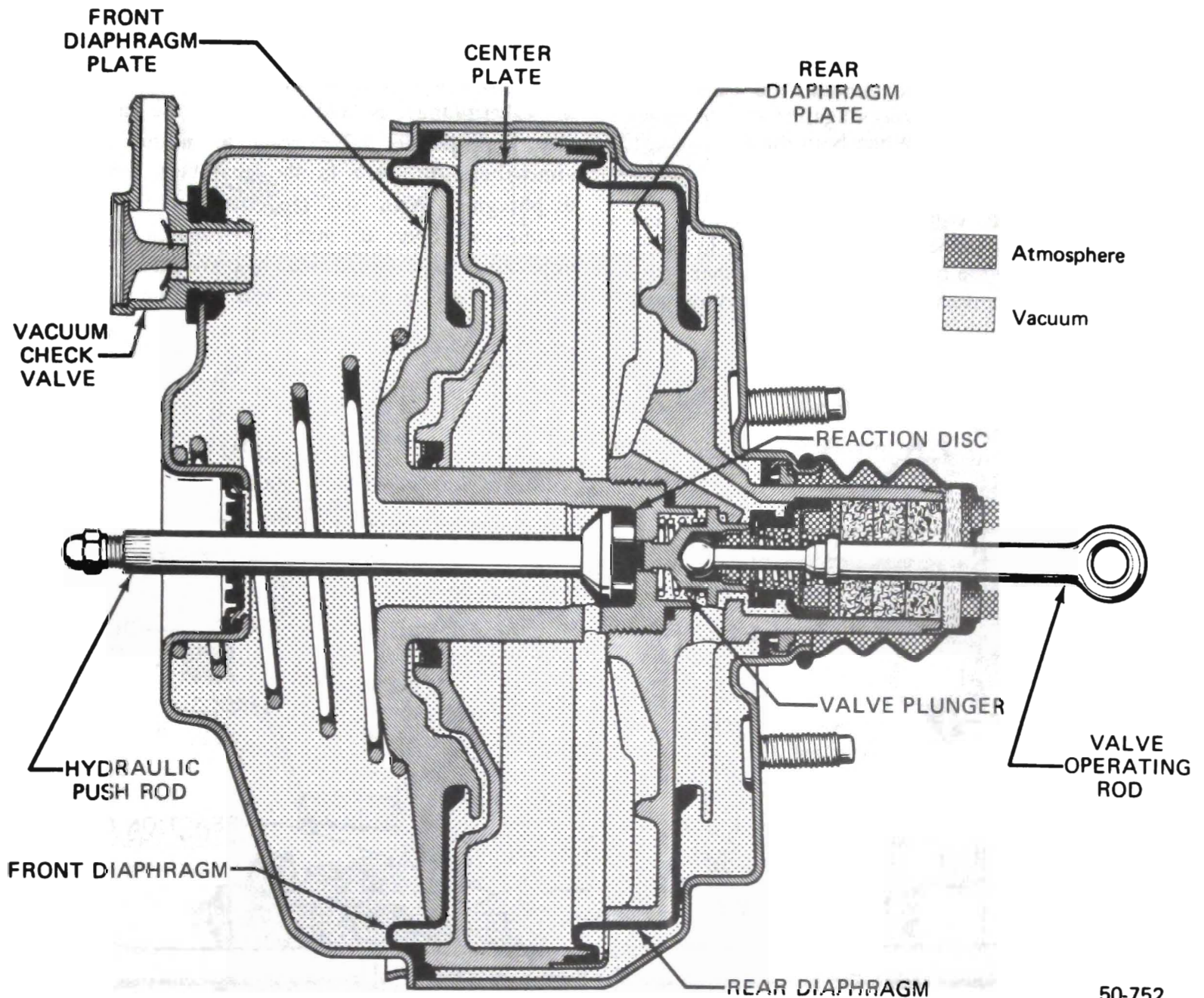


Figure 50-127 Released Position

OPEN the atmospheric port and admit atmosphere through the air filter, poppet and passages to the pressure chambers at the rear of both the front and rear diaphragms. With vacuum on the front and atmospheric pressure on the rear side of both diaphragms, a force is developed to move the vacuum power diaphragm and plate assembly, hydraulic push rod and hydraulic pistons to the front. This movement closes the compensating ports in the master cylinder and forces brake fluid under pressure through the outlet ports and brake tubes into the brake wheel cylinders. As hydraulic pressure is obtained, the front hydraulic piston "floats", providing equal line pressure to both systems. As this pressure increases in the brake systems, a counterforce (to the rear), acting through the hydraulic push rod and rubber reaction disc, sets up a reaction force against the hub of the diaphragm

plate and the face of the valve plunger. The rubber disc distributes this pressure between the plate and plunger in proportion to their respective contact areas. The pressure acting against the valve plunger and operating rod tends to move the valve plunger slightly to the rear in relation to the hub of the diaphragm plate to close the atmospheric port on the valve poppet. Since part of the counterforce (to the rear) reacts through the valve plunger and operating rod against the driver's foot, a "feel" of braking effort is provided, which is always in direct proportion to the hydraulic pressure developed within the brake systems. Full power application has been attained with full atmospheric pressure admitted to the pressure chambers (to the rear) of both diaphragms and with constant vacuum to the front. Any increase in hydraulic pressure to the brakes beyond this point

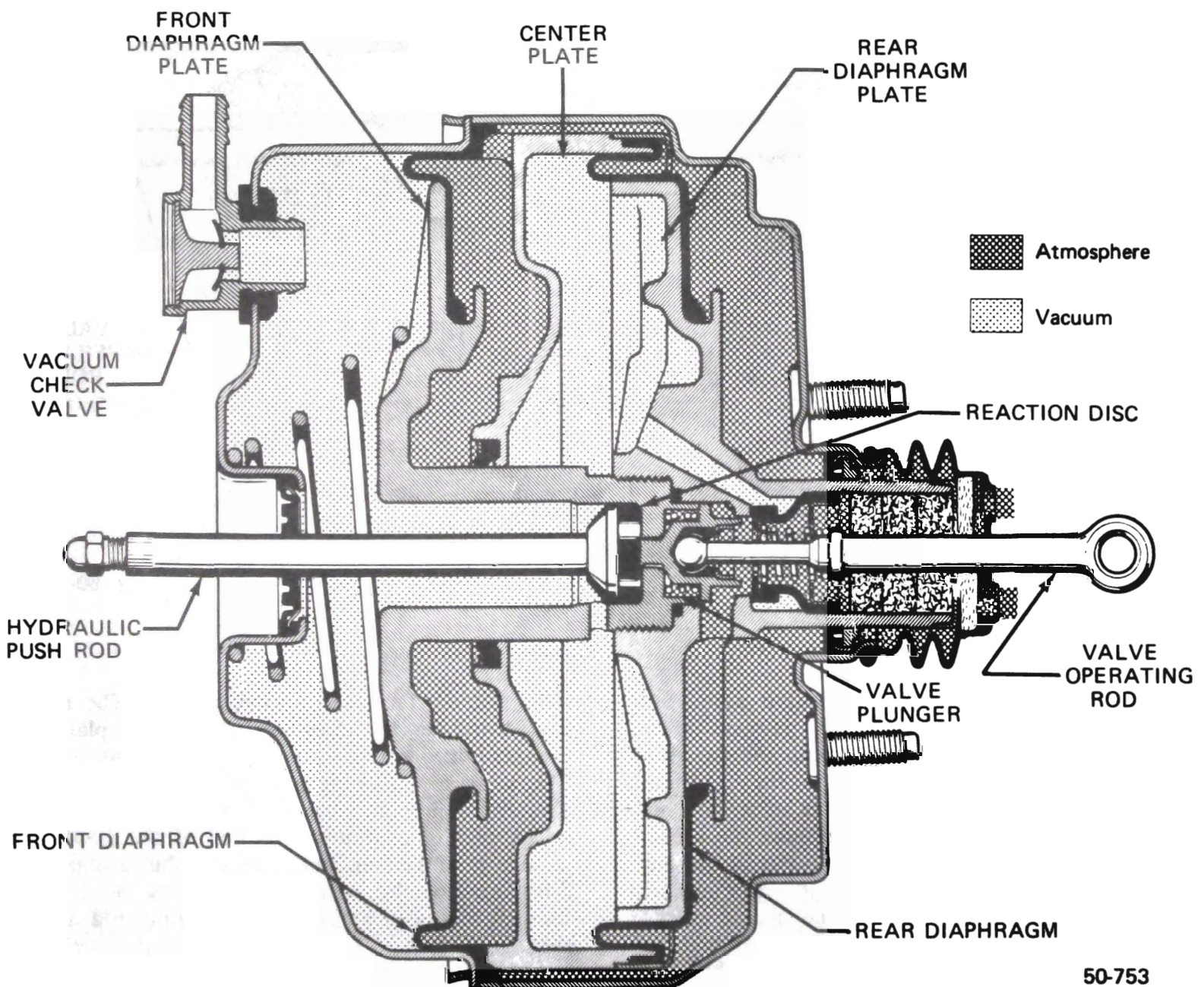
must be supplied by physical effort of the driver. See Figure 50-128.

C. Holding Position

During applications of the brakes, the "reaction" against the valve plunger works against the driver to close the atmospheric port. When both the atmospheric and vacuum ports are closed, the brake unit is in the holding position. In this position, the degree of braking application will be held until either the atmospheric port is reopened by an increase in pedal pressure to increase the brake application further or by a decrease in pedal pressure to reopen the vacuum port

and decrease the brake application.

Whenever the pressure applied to the brake pedal is held constant, the valve returns to its holding position. However, when the fully applied position is reached, the valve plunger is held away from the valve poppet (the atmospheric valve seat) to admit maximum atmospheric pressure to the chambers behind both diaphragms. With the chambers in front of the diaphragms open to manifold vacuum, full power application is attained which is referred to as the "runout" point of the power unit. See Figure 50-129.



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Figure 50-128 Applied Position

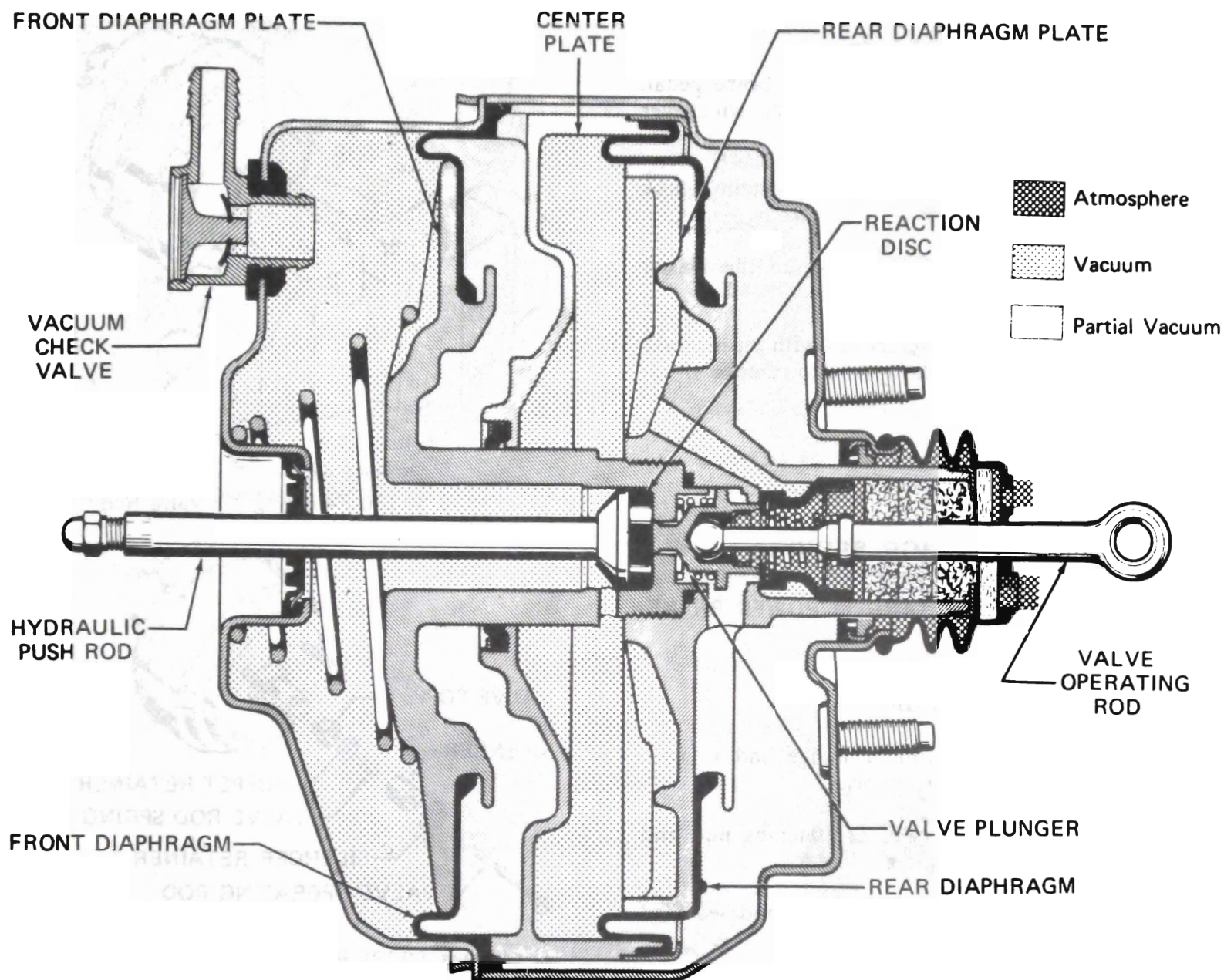


Figure 50-129 Holding Position

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DIVISION IV REMOVAL AND INSTALLATION

50-47 TANDEM POWER BRAKE UNIT REMOVAL AND INSTALLATION

A. Removal

1. Disconnect the vacuum hose from the vacuum check valve in the front shell of the power section.
2. Disconnect the hydraulic brake tubes at the master cylinder outlet ports. Plug the outlet ports and the tubes to prevent loss of fluid and to keep out dirt.
3. Disconnect the valve operating rod from the brake pedal inside the car.
4. Disconnect the stoplight switch wires or disconnect

the battery, so that the stoplights are not on during the time the power brake is removed.

5. Remove the nuts and lockwashers that secure the power section to the engine compartment bulkhead and remove the power brake assembly from the car.

B. Installation

It may be desirable to fill the master cylinder reservoirs with brake fluid and to bench-bleed the master cylinder prior to installing in on the vehicle.

1. Secure the master cylinder to the power section with two (2) nuts and lockwashers. Be sure that the bail is aligned with the scribe marks on the shells.

2. Position the power section on the engine compartment bulkhead and secure it in place with four (4) nuts and lockwashers.

3. Attach the valve operating rod to the brake pedal. Connect the stoplight switch or the battery, whichever was disconnected.

4. Connect the vacuum hose to the vacuum check valve.

5. Connect the hydraulic brake tubes to the master cylinder outlet ports.

6. Fill the master cylinder reservoirs with clean brake fluid, and bleed the hydraulic system to remove all air from the system.

DIVISION V

OVERHAUL AND MAJOR SERVICE

50-48 DISASSEMBLY OF TANDEM POWER BRAKE UNIT

A. Disassembly of Overall Unit

1. Scribe across master cylinder flange and vacuum cylinder halves for correct assembly.

2. Remove two (2) master cylinder attaching nuts and lockwashers and remove master cylinder.

3. Carefully remove hydraulic push rod and seal and slide seal from rod.

4. Remove vacuum check valve and grommet, if required.

5. Remove dust boot and silencer from operating valve rod.

6. Remove dust guard retainer, dust guard and silencers from rear plate hub with an awl. Then, reinstall steel retainer on hub.

7. Squirt alcohol down operating valve rod to lubricate rubber grommet in the valve plunger.

8. Install end of air valve rod in vise, leaving just enough clearance to position two (2) open end wrenches between vise and retainer on hub of rear plate.

9. Using the wrench nearest the vise as a pry, force the valve plunger grommet off from the ball end of the rod. Do not damage plastic hub or allow vacuum cylinder to fall to the floor. See Figures 50-130 and 50-131.

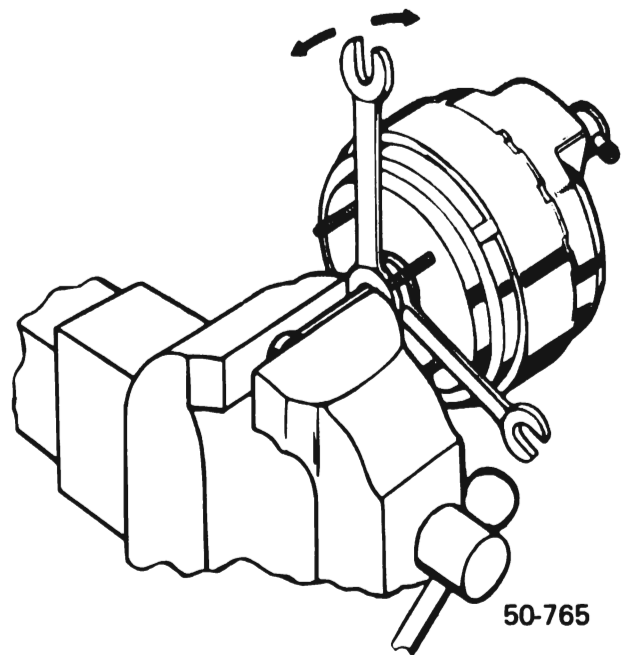


Figure 50-130 Removing Air Valve Rod

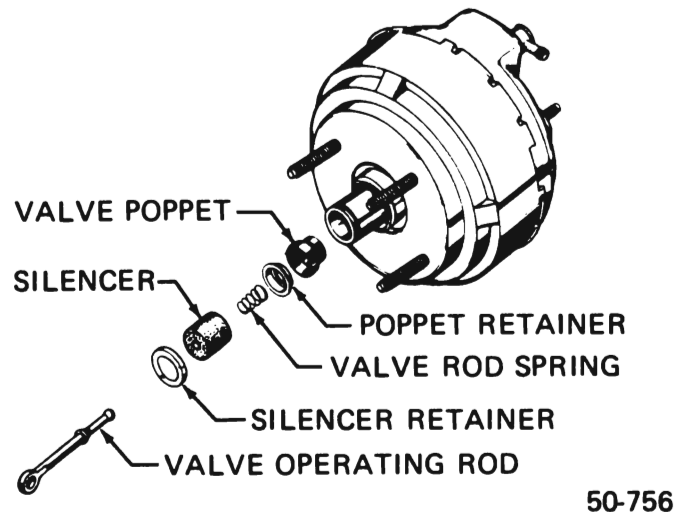


Figure 50-131 Removing Air Valve Rod

10. The edge of the front shell contains twelve (12) lances. Four (4) of these lances (one in each quadrant) are deeper than the other lances. The metal that forms the four (4) deep lances must be partially straightened so that the lances will clear the cutouts in the front shell. If the metal tabs that form the deep lances break during straightening, the shell must be replaced. See Figure 50-132.

11. Remove the hydraulic push rod and vacuum seal from the front shell.

12. Mount Tool J-23456 in a vise, and position the power section on the tool so that the four (4) studs on the rear shell fit into holes in the tool. See Figure 50-133.

13. Position the handle over the two (2) studs on the front shell and tighten the screw to apply a downward pressure on the front shell. Then, rotate the wrench and front shell counterclockwise until the lances in the edge of the rear shell are aligned with cutouts in the front shell. Considerable effort may be required to rotate the front shell.

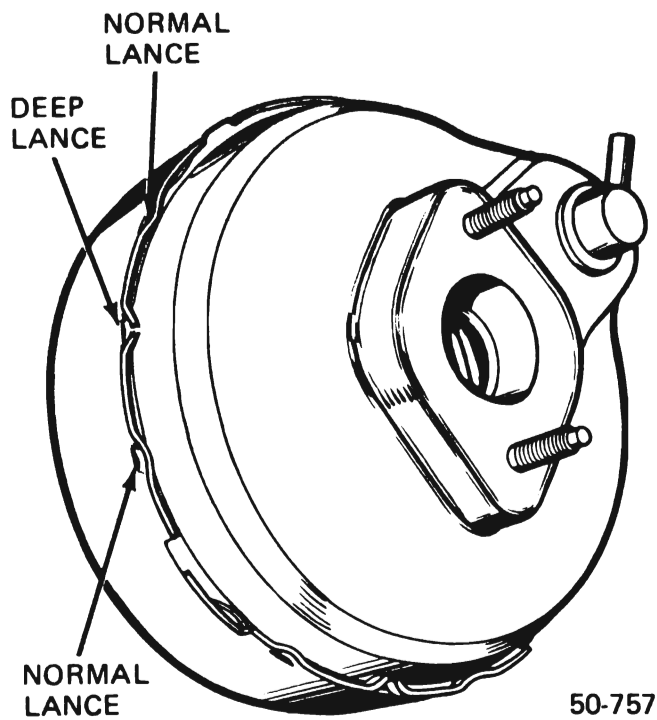


Figure 50-132 Lances in Front Shell

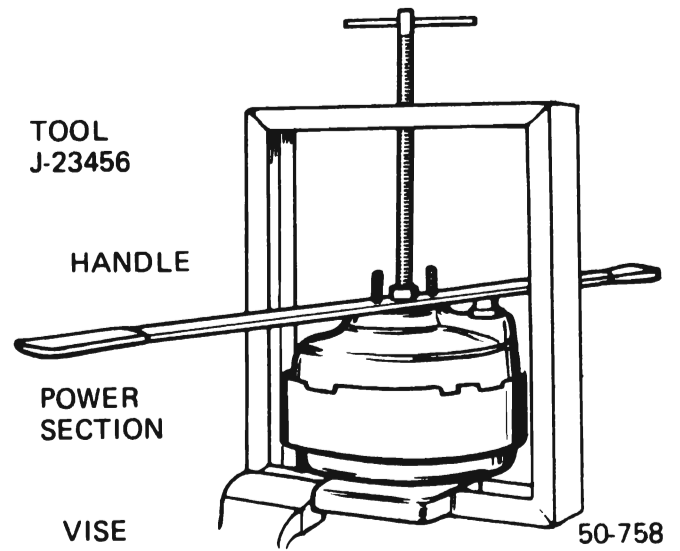


Figure 50-133 Unlocking Front and Rear Housings

14. Slowly release the screw of the tool to permit the two (2) shells to separate.

WARNING: The diaphragm return spring is compressed in the power section and expands as

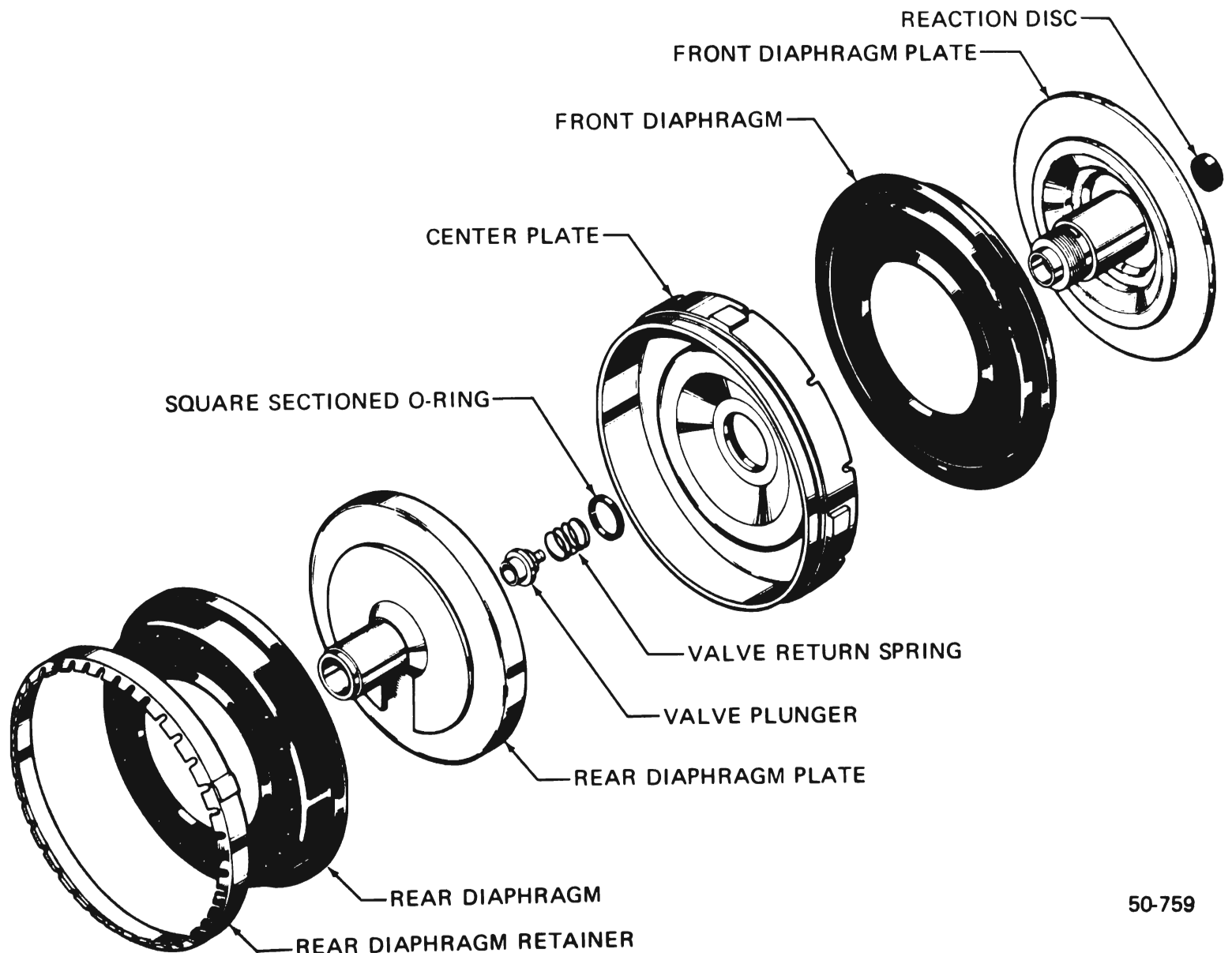


Figure 50-134 Diaphragm and Plates

the pressure on the shells is removed. If the shells do not separate when the screw has been turned slightly to reduce the pressure, tap the shells with a rubber hammer to break the bond.

15. Continue to release the screw until diaphragm spring tension has been removed.

16. Remove the front shell and return spring.

17. Work edges of front diaphragm from under lances of rear housing and remove complete vacuum assembly from rear housing, using care not to damage rear housing seal. Bosses on center plate must be aligned with cutouts in rear housing to remove the assembly.

18. Wet the rear diaphragm retainer with alcohol and remove the retainer using fingers only.

19. Clamp Tool J-22839 in a vise. Place the diaphragm and plate assembly on the tool with the tool seated in the hex opening in the front plate.

20. Twist the rear diaphragm plate counterclockwise, using hand leverage on the outer edge of the plate.

21. After the two (2) plates have been loosened, remove the plates from Tool J-22839 and place on a bench with the front plate down. Unscrew the rear plate completely and carefully lift it off the front plate hub, grasping the valve plunger and valve return spring as the parts are separated. See Figure 50-134.

22. Remove the square sectioned O-ring from the shoulder of the front diaphragm plate hub.

23. Remove the reaction disc from inside the front diaphragm plate hub. Carefully slide the center plate off the hub of the front plate. 24. Remove the diaphragms from the plates.

25. If rear housing seal requires replacement, use a blunt punch or 1-1/4" socket to drive seal from housing. See Figures 50-135 and 50-136.

26. For disassembly of master cylinder, proceed as follows:

a. Remove the reservoir cover and diaphragm and drain the fluid from the reservoirs.

b. Remove the stop screw from the bottom of the front reservoir.

c. Remove the retaining ring from the groove near the end of the cylinder bore.

d. Then, remove the primary and secondary piston assemblies from the bore.



Figure 50-135 Removing Rear Seal

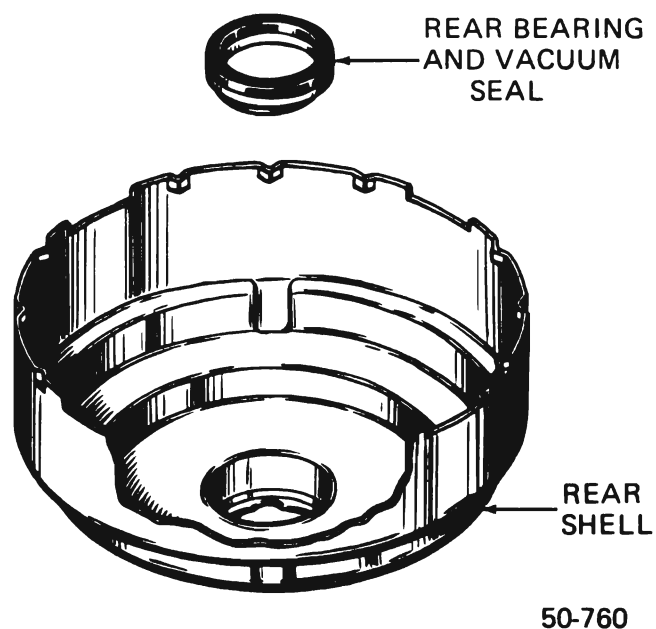


Figure 50-136 Rear Bearing and Rear Shell

e. Disassemble the secondary piston assembly, as illustrated in Figure 50-137.

50-49 CLEANING AND INSPECTING TANDEM POWER BRAKE UNIT

A. Power Section

All parts to be reused should be washed in alcohol or brake fluid. Dry the parts with compressed air and place them on clean paper or lintfree cloth.

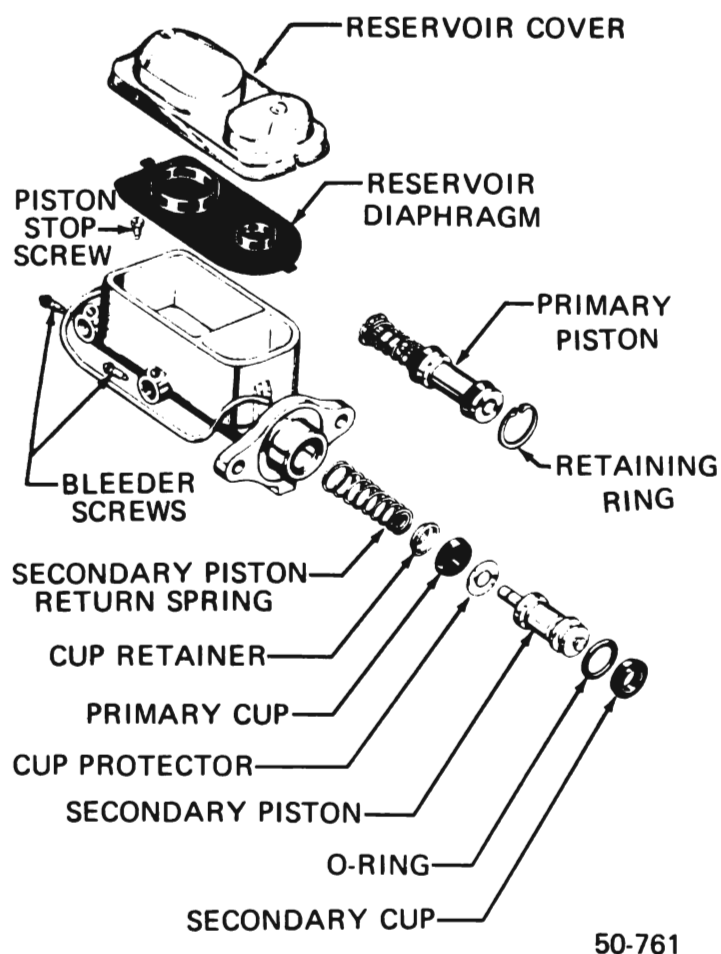


Figure 50-137 Exploded View - Master Cylinder

Small rust spots inside the shells may be removed with crocus cloth or fine emery cloth. Be sure to clean thoroughly after using any abrasive.

Inspect all parts and replace any that are damaged or show excessive wear.

B. Master Cylinder

Clean all master cylinder parts to be reused in alcohol or brake fluid. Crocus cloth or a cylinder hone may be used to remove pitted, scored or corroded areas from the cylinder bore. Be sure to clean thoroughly after using any abrasive in the bore.

All rubber parts should be replaced whenever the master cylinder is disassembled. Other parts should be inspected and replaced if they are damaged or show excessive wear.

50-50 REASSEMBLY OF TANDEM POWER BRAKE UNIT

1. Reassemble master cylinder as follows:

a. Dip the secondary piston parts in clean brake fluid and assemble the parts on the piston as shown in Figure 50-137. The large O-ring goes in the second

groove from the end of the piston, and the secondary cup (cup with large inside diameter) goes in the rear groove with the lip of the cup toward the large end of the piston.

b. The primary cup (cup with small inside diameter) goes on the nose of the piston with the lip of the cup toward the nose end of the piston.

c. Dip the secondary and primary piston assemblies in clean brake fluid, and coat the cylinder bore in clean brake fluid.

d. Guide the secondary piston assembly, spring end first, into the cylinder bore. Use a dull scribe to ease the cups into the bore, and be careful to avoid damaging the cups.

e. Insert the primary piston assembly in the same manner.

f. Hold the primary piston in the bore and assemble the retaining ring in the groove near the end of the bore.

g. Assemble the piston stop screw in the threaded port in the bottom of the front reservoir.

h. Assemble the diaphragm and cover on the reservoirs.

2. If the rear bearing and seal were removed, press new bearing and seal into this cavity in the rear shell using Tool J-22677. See Figure 50-138. The flat rubber surface of the seal should be $5/16$ " below the flat, inside surface of the rear shell.

3. Install reaction disc in hub of front plate with small tip toward hole. Use rounded rod to seat disc.

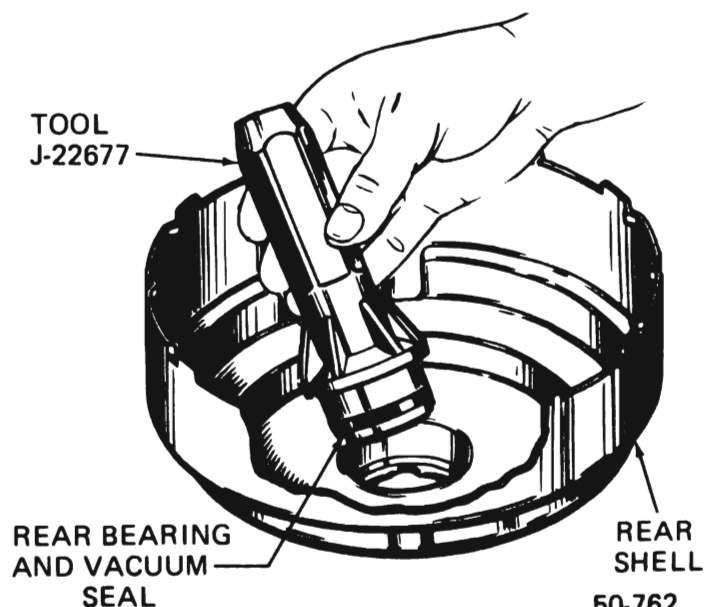


Figure 50-138 Installing Rear Bearing and Vacuum Seal

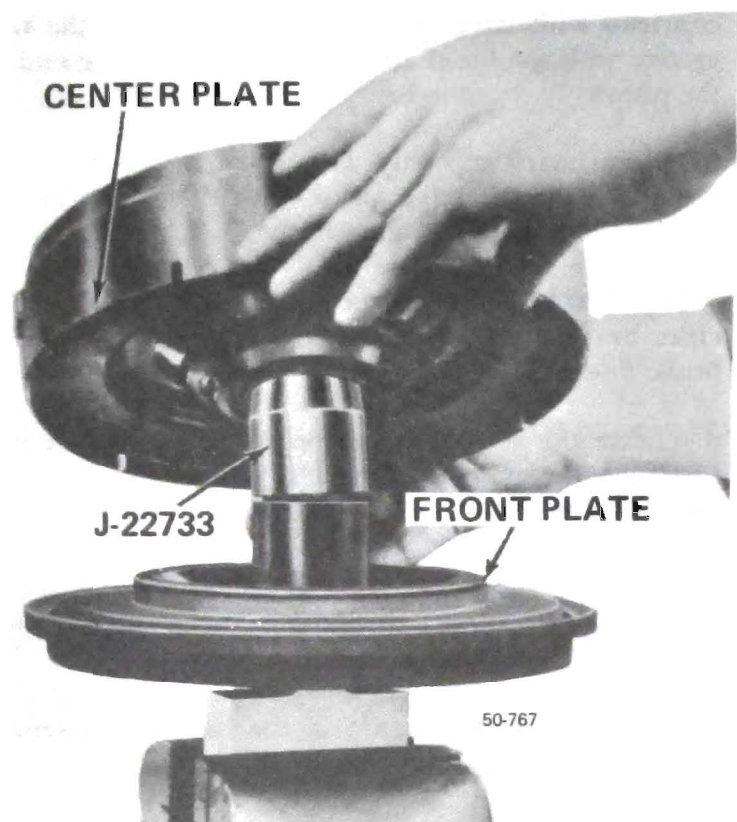


Figure 50-139 Seal Protector Tool J-22733



Figure 50-140 Installing Air Valve Plunger

4. Mount Tool J-22839 in vise.

5. Install front diaphragm on front plate. Long fold of diaphragm must be facing down.

6. Install Tool J-22733 over threads on front plate hub. See Figure 50-139.

7. Apply a light film of special seal lubricant to front plate hub and to seal in center plate, then guide center plate, seal first, onto the front plate hub, being careful not to damage center plate seal.

8. Apply special seal lubricant lightly to front and rear bearing surfaces of air valve plunger, being careful not to apply lubricant to rubber grommet inside plunger. Install vacuum seal O-ring on shoulder of front plate hub and valve plunger return spring and plunger in base of front plate hub. See Figure 50-140.

9. Set rear plate over hub of front plate and, using hands only, screw plate on hub, making sure that valve and spring are properly aligned. Hand torque plates to 150 in.lbs. Check travel of valve plunger with index finger.

10. Assemble rear diaphragm to rear plate and place lip of diaphragm in groove in rear plate. Install diaphragm retainer over rear diaphragm and lip of center plate. Using fingers, press retainer until it seats on shoulder of center plate. See Figure 50-141.

11. Apply talcum powder to inside wall of rear housing and special seal lubricant to the scalloped cutouts of front housing and to seal in rear housing; assemble diaphragm and plate assembly into rear housing by carefully guiding rear plate hub through seal in rear housing. Bosses on center plate must be aligned between lances in rear housing for reassembly. Work outer rim of front diaphragm into rear housing with screwdriver blade so that it is under lances in housing.

12. Install rear housing in Tool J-23456.

13. Install diaphragm return spring in rear housing.

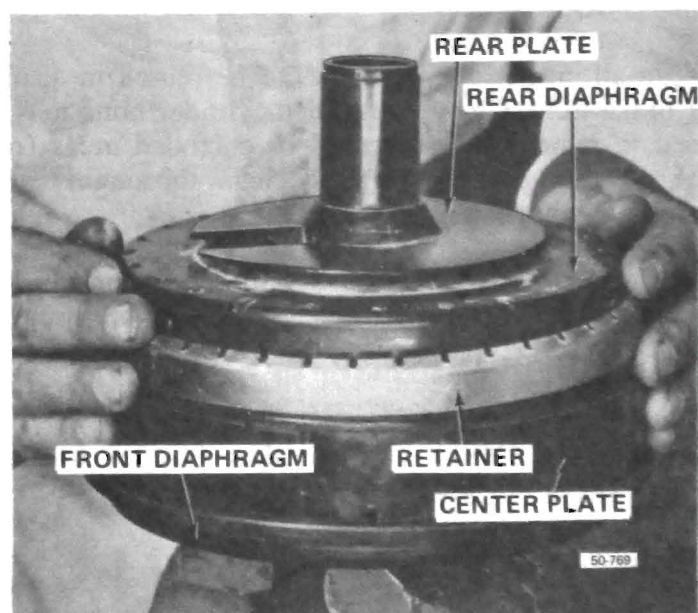


Figure 50-141 Installing Rear Diaphragm Retainer

14. Place front housing over rear housing and align scribe marks.

15. Tighten until diaphragm edge is fully compressed and tangs on front housing against slots on rear housing.

16. Rotate bar clockwise until housings are locked together. Remove from tool.

17. Wet poppet valve with alcohol and assemble in rear plate hub, small end first; wet poppet retainer with alcohol and assemble with shoulder inside poppet. Assemble retainer, filters, silencer over ridge on rod and return spring over ball end of operating valve rod. Wet grommet in valve plunger with alcohol and guide air valve rod into valve plunger. Tap end of operating valve rod with plastic hammer to lock ball in grommet. Press filters and silencers into hub and install retainer on hub.

18. Assemble silencer in dust boot, wet dust boot opening with alcohol and assemble over operating valve rod and over flange of rear housing.

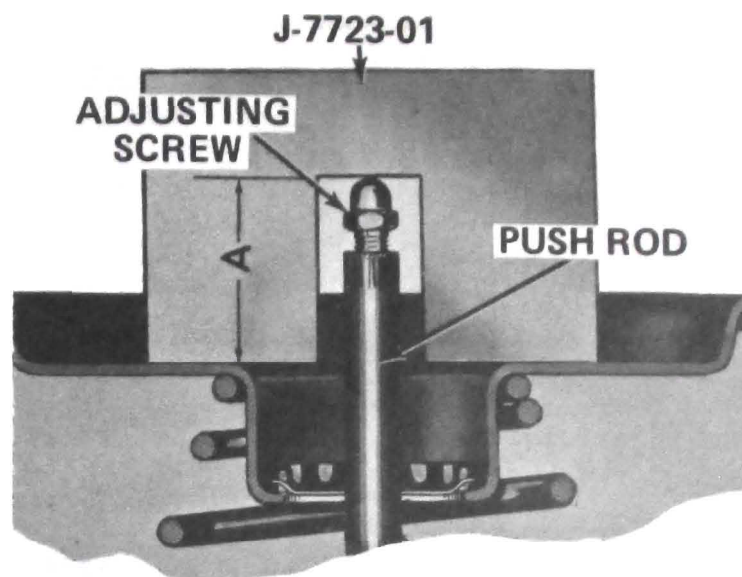
19. Install check valve and grommet, if removed.

20. Apply special seal lubricant to piston end of hydraulic push rod and insert in cavity in front plate. Twist rod to eliminate air bubbles at reaction disc. Assemble seal over push rod and press into recess in front housing.

21. Check push rod adjustment with Tool J-7723-01 (tool cutout should be 1.195"-1.200"). If adjustment is correct, attach master cylinder to vacuum cylinder.

50-51 GAUGING TANDEM POWER BRAKE UNIT

The self-locking screw is set to correct dimension at time of original assembly of power unit. Under normal service, no further adjustment should be needed, provided push rod assembly remains in original unit.



50-770

Figure 50-142 Push Rod Adjustment

If, however, push rod is transferred to another unit or new push rod is used, adjustment will be necessary. To adjust push rod, hold serrated end of push rod with pliers and turn adjusting screw in to shorten or out to lengthen push rod. Measure push rod height with push rod installed in unit, using Tool J-7723-01. See Figure 50-142.

DIVISION VI

SPECIFICATIONS

50-52 POWER BRAKE SPECIFICATIONS

Specifications for the Bendix Tandem Hydraulic Master Cylinder and Power Brake Unit are the same as listed for the drum brake unit. See Section A for "Master Cylinder" or Section D for "Power Brake Unit".

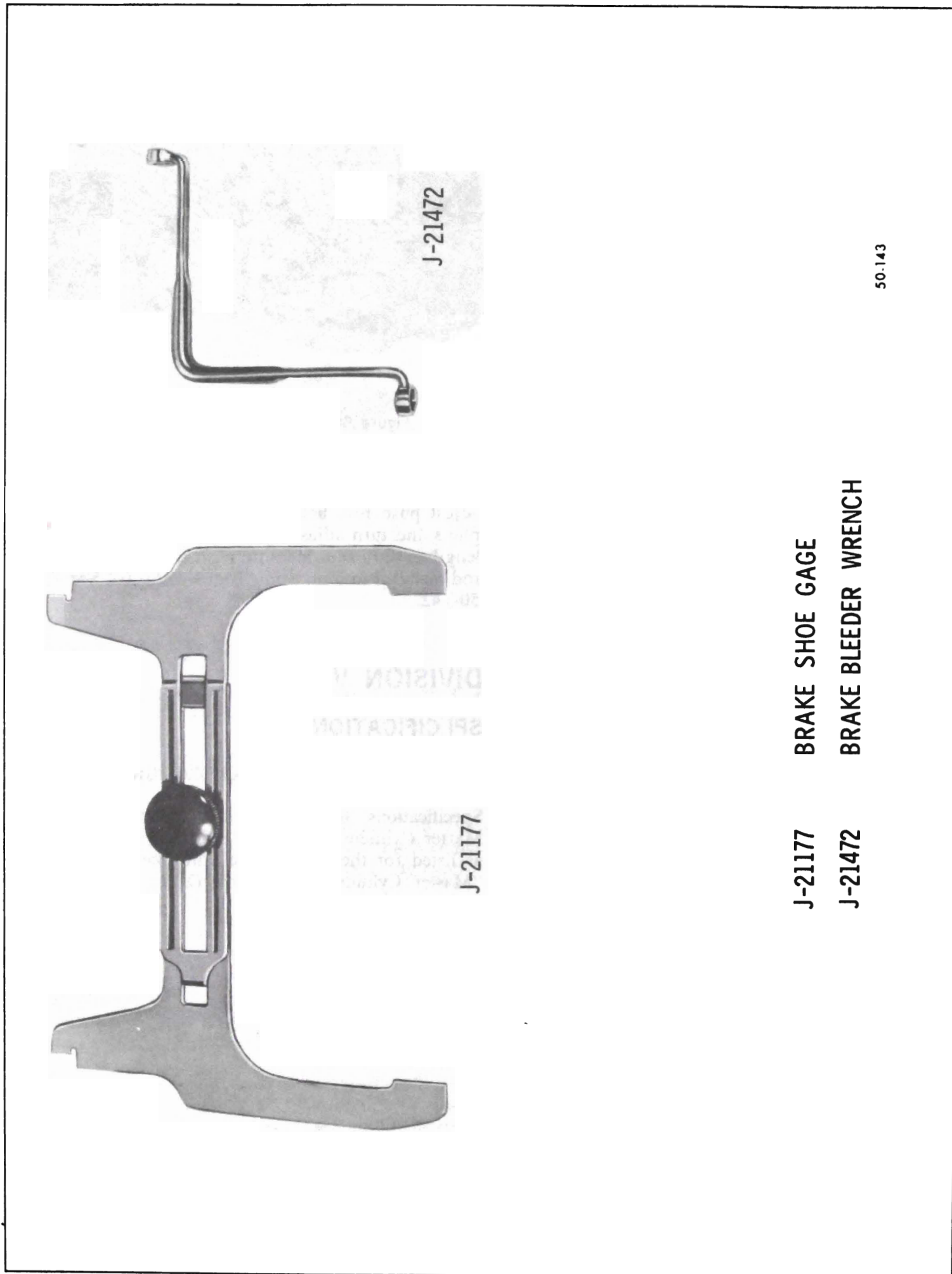
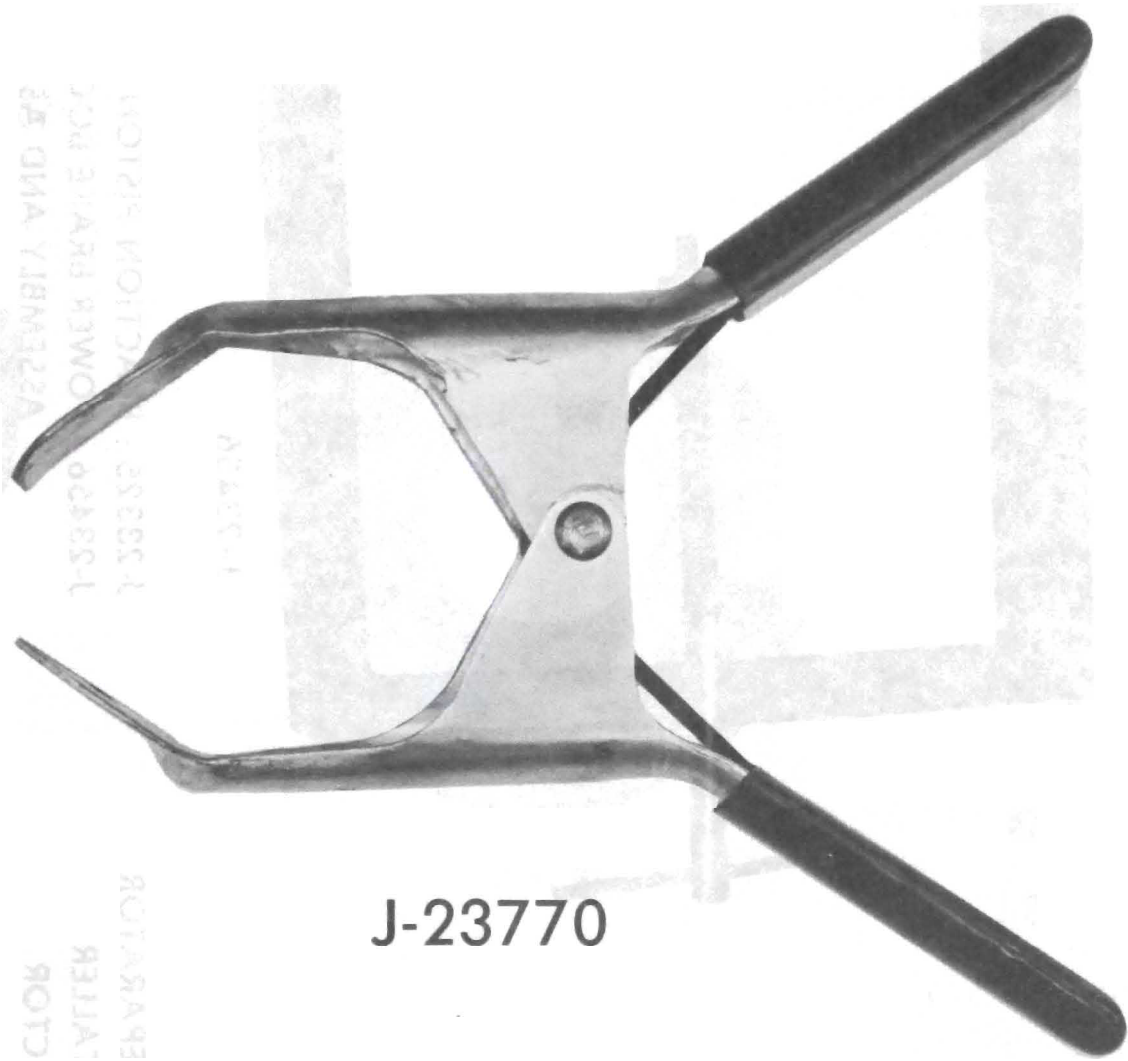


Figure 50-143 Special Tools

Figure 50-90--Special Tools - Brake Shoe Replacement



J-23770 DISC BRAKE METERING VALVE PIN DEPRESSOR

Figure 50-144 Special Tools - Single Piston

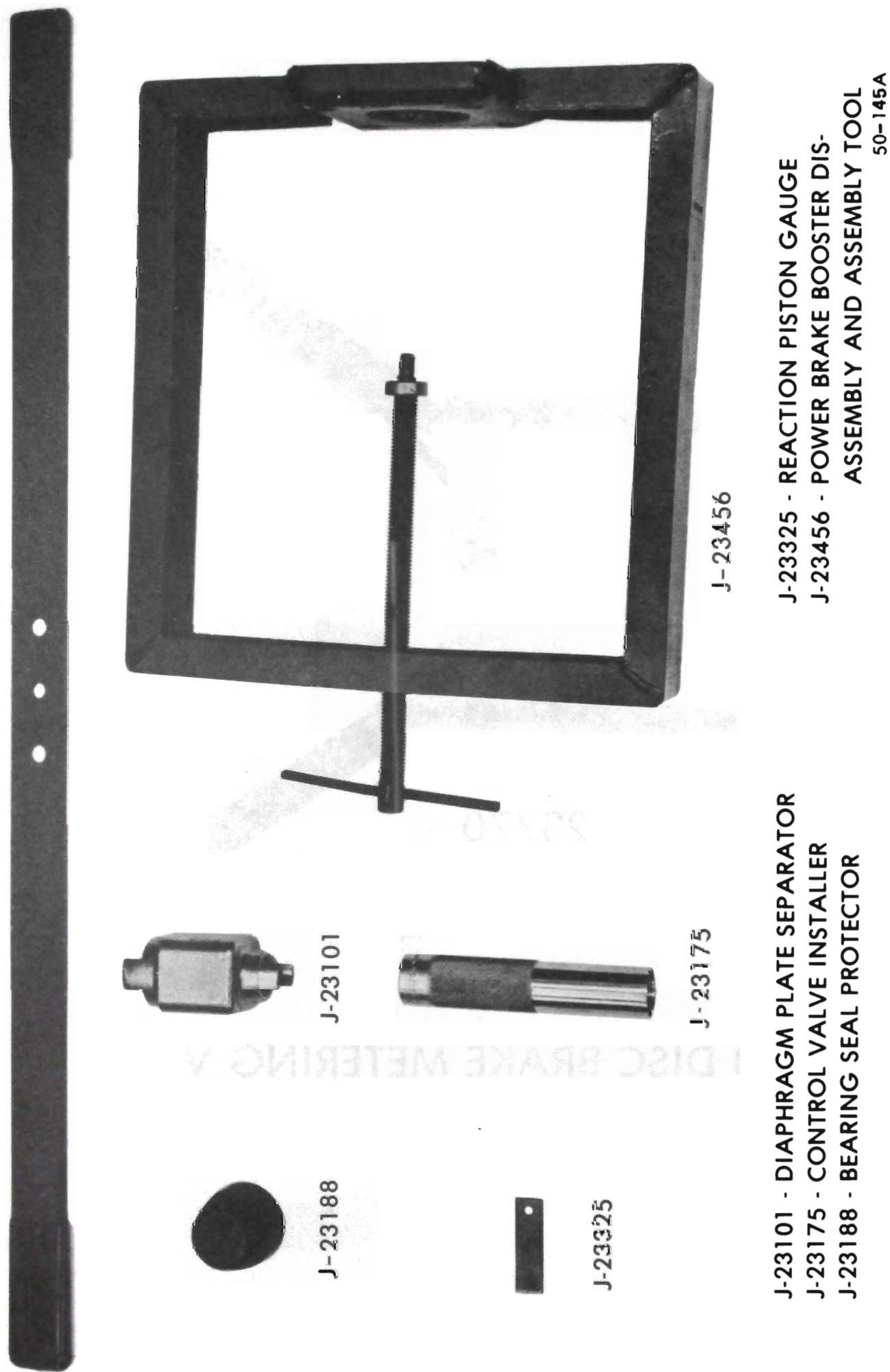


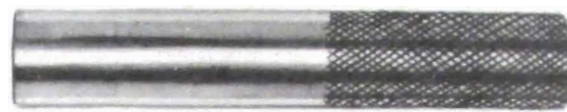
Figure 50-145 Special Tools - Tandem Power Brake Unit



J 22647



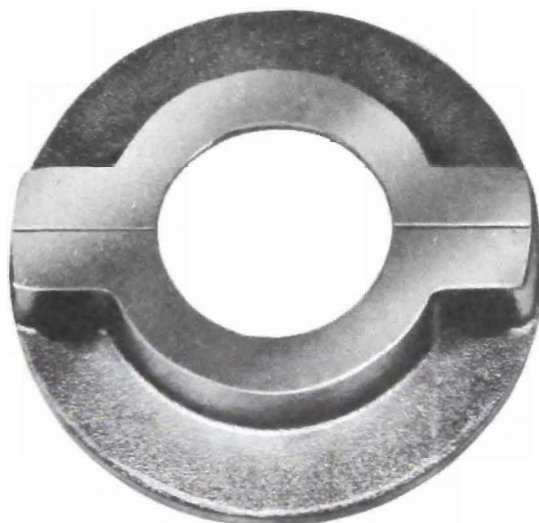
J 21524



J 21601-01



J 4880



J 9746



J 21472

- J 4880 - SNAP RING PLIERS
- J22647 - POWER BRAKE PUSH ROD HEIGHT GAGE
- J 9746 - REAR PINION BEARING REMOVER
- J 21472 - BRAKE BLEEDER WRENCH
- J 21524 - POWER PISTON REMOVER AND INSTALLER
- J 21601-01 - POWER BRAKE RETAINER INSTALLER

50.94A

Figure 50-146 Special Tools - Power Brake Unit