BENDIX HYDRO-BOOST

Chevrolet
Dodge
GMC
Plymouth

NOTE – *The Bendix Hydro-Boost is standard on some models and optional on others. See the BRAKE APPLICATION tables at the beginning of this section.*

DESCRIPTION

System utilizes power steering pump fluid pressure to operate booster. Assembly contains an open center spool valve which controls pump pressure magnitude during braking, a lever mechanism to control position of valve, and a boost piston to provide force necessary to operate master cylinder. Unit also has a reserve system which stores sufficient fluid under pressure to provide at least two braking applications in case fluid flow from power steering pump is not available. Brakes can also be applied manually if reserve system is depleted.

OPERATION

RELEASED POSITION (NO BRAKING)

In this position, spool valve return spring holds spool valve open. In open position, spool valve provides unrestricted fluid flow between power steering pump and power steering gear. Fluid pressure is blocked from entering boost pressure chamber by lands on spool valve. As fluid pressure increases with steering demand, it has no effect on boost pressure chamber. Boost pressure chamber is vented through spool valve, to pump return port, and back to power steering pump.

BRAKING POSITION

As brake pedal is depressed, it moves pedal rod and initiates movement of spool valve. This closes fluid return port to pump from boost chamber, and admits fluid into boost chamber from pressure port. Additional valve movement restricts flow between pump and steering gear, causing pump to increase fluid pressure to maintain flow rate to steering gear. As fluid pressure increases in boost chamber, it forces piston forward actuating master cylinder piston, resulting in brake application. If fluid pressure is required for steering while braking, pump pressure will rise and spool valve will shift in an open direction allowing more fluid to flow to steering gear.

RESERVE SYSTEM

1) System consists of a charging valve, accumulator valve, and a spring loaded accumulator. Accumulator is integral with booster unit. System is open to pressure port of booster unit. Charging valve has an orfice and ball check. Fluid from pump passes through orfice in valve, and if pressure exceeds pressure in accumulator, it unseats ball check valve and enters accumulator. Ball check valve prevents reverse flow when accumulator pressure is greater.

2) Accumulator valve is a poppet type valve held closed by pressure stored in accumulator. An actuator on spool valve sleeve opens accumulator valve when a stop with no pump pressure is made that requires use of reserve pressure. Fluid pressure can also enter accumulator from boost chamber through accumulator valve, when boost chamber pressure exceeds accumulator pressure. A pressure relief valve vents accumulator to pump return port when pressure in accumulator exceeds approximately 1600 psi.

ADJUSTMENT

BRAKE PEDAL

Chevrolet & GMC – 1) Make adjustment in linkage until pedal travel is as specified. Pedal travel is distance pedal moves toward floor from a fully released position. Pump pedal a minimum of 3 times with engine off before making measurement.

2) Specified pedal travel is 3½" on all models except four-wheel disc brake models. Pedal travel is 6" on all four-wheel disc brake models.

NOTE – *Pedal adjustment procedure for Chrysler Corp. vehicles was not available from manufacturer.*

TESTING

NOTE – *Hydroboost cannot cause noisy brakes, fading brake pedal, or pulling brakes. If one of these conditions exists, other components of brake system are at fault.*

PRELIMINARY CHECKS

Check fluid levels in master cylinder and power steering pump. Check belt tension and adjust if necessary. With engine off, depress brake pedal several times to eliminate all accumulator reserve from system. Hold brake pedal depressed and start engine. If unit is operating correctly, brake pedal will fall slightly then push back against drivers foot, remaining at about the same position. If booster is not operating correctly, use the following tests.

NOTE – *If problem cannot be found in preliminary steps or tests, check areas of brake system that might cause condition. See Hydraulic Brake Trouble Shooting in this Section.*

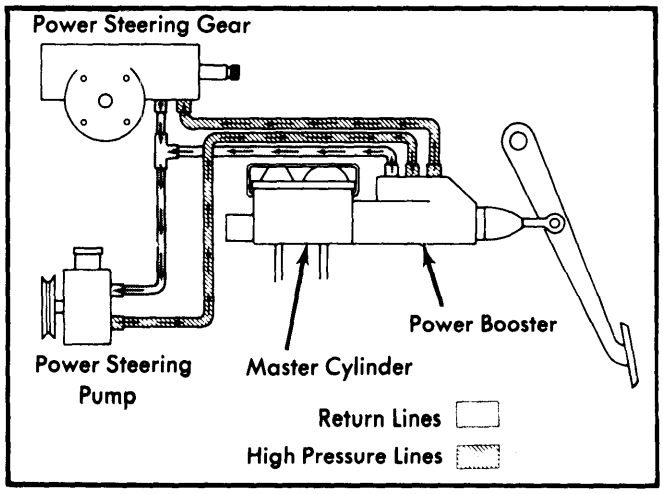

Fig. 1 Hydro-Boost Fluid Flow Chart

BENDIX HYDRO-BOOST (Cont.)

HYDRO-BOOST DIAGNOSIS

NORMAL OPERATING CHARACTERISTICS

Brake pedal application of the Hydro-Boost system differs in some respects from a vacuum type power brake system in the following manner:

1) As pedal is depressed, a slight power steering pump noise may be heard until booster run-out.

2) Application of pedal through run-out may not necessarily be smooth due to internal ratio change. It is possible to push the pedal past run-out because the pedal ratio is higher. The pedal becomes hard at the end of vacuum booster runout.

3) On the first full application of the brake pedal, a slight hissing sound may be heard. The hiss is the accumulator charging and the noise should go away in a short period of time.

4) As the brake pedal is depressed hard, a slight kick-back of pedal may be felt.

5) If the vehicle is started with the pedal depressed, the pedal will fall away slightly then return to approximately the same position.

CONDITION

NO BOOST – HARD PEDAL

Preliminary Check – With engine stopped, depress brake pedal several times. This will eliminate all accumulator reserve from system. Hold the brake pedal depressed with medium pressure (25-35 lbs.) and start engine. If the unit is operating correctly, the brake pedal will fall slightly, then push back against driver's foot, remaining at about the same position. If the booster is not operating correctly, the trouble may be one of the following causes:

POSSIBLE CAUSE	CORRECTION
1) Loose or broken power steering pump belt.	1) Tighten or replace belt.
2) No fluid in power steering reservoir.	2) Fill reservoir and check for internal leaks.
3) Leaks in power steering, booster or accumulator hoses.	3) Replace defective components.
4) Leaks at tube fittings, power steering booster or accumulator connections.	4) Tighten fittings or replace tube seals, if defective.
5) External leakage at accumulator.	5) Replace booster assembly.
6) Faulty booster piston seal causing leakage at booster flange vent.	6) Replace all booster seals.
7) Faulty booster input rod seal with leakage at input rod end.	7) Replace all booster seals.
8) Faulty booster cover seal with leakage between housing and cover.	8) Replace all booster seals.
9) Faulty booster spool plug seal.	9) Replace all booster seals.
10) Internal leakage in booster.	10) Replace booster assembly.
11) Contamination in power steering fluid.	11) Flush power steering system and replace with new fluid.
12) Incorrect routing of hydraulic lines.	12) Re-route hydraulic lines.

BENDIX HYDRO-BOOST (Cont.)

HYDRO-BOOST DIAGNOSIS

CONDITION

POWER STEERING PUMP NOISY ON BRAKE APPLICATION

POSSIBLE CAUSE	CORRECTION
1) Insufficient fluid in pump reservoir.	1) If fluid level decreases approximately ½" on brake application, refill to proper level. If fluid is foamy, let vehicle stand for about one hour; then, bleed power steering hydraulic system as outlined in this article.

CONDITION

BRAKE PEDAL PULLS DOWN SLIGHTLY ON ENGINE START

POSSIBLE CAUSE	CORRECTION
1) Restriction in gear or booster return lines.	1) Replace lines or reposition to eliminate restriction.

CONDITION

ACCUMULATOR LEAKDOWN – SYSTEM DOES NOT HOLD CHARGE

Preliminary Check – Start engine and turn steering wheel until the wheels slightly contact wheel stops. Hold for a maximum of five seconds. Now release steering wheel and turn off engine. Depress and release brake pedal. There should be a minimum of three power assisted brake applications before a hard pedal is obtained.

Re-start engine and turn steering wheel until the wheels lightly contact wheel stops. There should be a light hissing sound as the accumulator is charged. Hold steering wheel lightly against stop for a maximum of five seconds. Release steering wheel and turn off engine. Wait one hour and apply brake pedal (do not re-start engine). There still should be a minimum of three power assisted brake applications before a hard pedal is obtained.

If either of these preliminary checks indicate that the accumulator is not holding a charge, the trouble may be in one of the following causes:

POSSIBLE CAUSE	CORRECTION
1) External leakage at accumulator.	1) Replace booster assembly.
2) Internal leakage at accumulator.	2) Replace booster assembly.
3) Internal leakage at booster accumulator valve (if accumulator is not leaking externally or internally).	3) Replace all booster seals and accumulator valves.

CONDITION

BRAKES GRAB ON APPLICATION

POSSIBLE CAUSE	CORRECTION
1) Broken spool return spring.	1) Replace spring.
2) Faulty spool action caused by contamination in system.	2) Inspect, clean and replace all booster seals.

BENDIX HYDRO-BOOST (Cont.)

HYDRO-BOOST DIAGNOSIS

CONDITION

BOOSTER CHATTER – PEDAL VIBRATES

POSSIBLE CAUSE	CORRECTION
1) Power steering pump belt slips.	1) Tighten belt.
2) Low fluid level in power steering pump reservoir.	2) Fill reservoir and check for external leaks.
3) Faulty spool operation caused by contamination in system.	3) Inspect, clean and replace all booster seals.
4) Excessive contamination in power steering fluid.	4) Flush power steering fluid from system and replace with new power steering fluid.
5) Air in power steering fluid.	5) Allow vehicle to stand for one hour; then bleed power steering hydraulic system as outlined in this article.

CONDITION

SLOW BRAKE PEDAL RETURN

POSSIBLE CAUSE	CORRECTION
1) Excessive seal friction in booster.	1) Replace all booster seals.
2) Faulty spool action.	2) Clean spool and replace all booster seals.
3) Broken piston return spring.	3) Replace spring.
4) Restriction in return line from booster to pump reservoir.	4) Replace line.
5) Broken spool return spring.	5) Replace spring.
6) Excessive pedal pivot friction.	6) Lubricate pivot bushing or replace bushing.

REMOVAL & INSTALLATION

CHEVROLET & GMC

Removal – 1) Depress and release brake pedal several times to be sure that all pressure is discharged from accumulator prior to disconnecting hoses from booster. Raise Motor Home Chassis on hoist; all others, leave on ground. Clean all dirt from booster at hydraulic line connections and master cylinder. Remove nuts that secure master cylinder to booster and support bracket. Support master cylinder, and cover exposed end with clean cloth.

NOTE – *In most cases, it is not necessary to disconnect master cylinder hydraulic lines to remove booster unit.*

2) On all models except Motor Home Chassis, remove booster pedal push rod cotter pin and disconnect push rod from brake pedal ("C" and "K" models) or booster bracket pivot lever ("G" and "P" models). Remove booster support bracket ("C" and "K" models) or support braces ("G" and "P" models). Remove booster bracket-to-firewall or support bracket nuts and remove booster assembly.

3) On Motor Home Chassis, remove cotter pin, nut and bolt that secure operating lever to vertical brake rod. Remove the six nuts and bolts that secure booster linkage bracket to front and rear support brackets, and remove booster from vehicle by sliding booster off rear support studs. Remove cotter pin, nut, and bolt that secures operating lever to pedal rod. Remove brake pedal rod lever nut and bolt and then remove lever, sleeve and bushings.

Installation – To install, reverse removal procedure noting the following: Lubricate pedal rod and linkage pivot bolts, pins, sleeves and bushings with suitable lubricant (Delco Brake Lube). Bleed booster/power steering hydraulic system. Check brake pedal and stoplamp switch adjustment.

NOTE – *Bleeding Hydroboost system is separate from bleeding hydraulic systems. See Bleeding Hydroboost Systems in this article.*

BENDIX HYDRO-BOOST (Cont.)

DODGE & PLYMOUTH

Removal – Depress brake pedal several times to be sure all pressure is released from accumulator. Remove nuts holding master cylinder to booster. Lay master cylinder aside without kinking lines. Disconnect and plug lines from booster fluid ports. Disconnect brake pedal return spring. Remove bolt from push rod to pedal. Remove mounting nuts and booster from vehicle.

Installation – To install, reverse removal procedure. Tighten all nuts and hose connections. Bleed booster/power steering system. Check brake pedal and stop lamp switch adjustment.

NOTE – *Bleeding Hydroboost system is separate from bleeding hydraulic system. See Bleeding Hydroboost system in this article.*

BLEEDING HYDROBOOST SYSTEM

CHEVROLET & GMC

NOTE – ***If power steering fluid has foamed due to low fluid level, it will be necessary to park vehicle for approximately one hour (reservoir cap loose) so that foam can dissipate.***

1) Fill reservoir with suitable power steering fluid. Start engine and run momentarily. Add fluid if necessary. Repeat until fluid level remains constant after running engine. Raise vehicle so front end is off ground. Turn steering right and left, lightly contacting wheel stops. Add fluid if necessary. Lower vehicle.

2) Start engine and depress brake pedal several times while turning steering wheel from stop to stop. Turn engine off and depress brake pedal several times to deplete accumulator pressure. Add fluid if necessary.

3) If fluid is foamy, or has air in it, let vehicle stand several minutes, then repeat *steps 1 and 2.* The presence of air in system will cause fluid level to rise with engine off. Continue to bleed system until all air is expelled.

DODGE & PLYMOUTH

1) Check power steering pump reservoir and fill with suitable power steering fluid (MOPAR Power Steering Fluid). Allow fluid to remain undisturbed for two minutes. Leave reservoir cap off during bleeding operation.

2) Start engine and run for ten seconds. Check fluid level and add fluid if necessary. Repeat procedure until fluid level remains constant. Raise front of vehicle and allow tires to clear floor. Start engine and run at 1500 RPM. Apply and release brakes several times, at the same time turn wheels back and forth, lock to lock. Turn off engine and check fluid level. Add fluid if necessary.

3) Lower vehicle. Start engine and run at 1500 RPM. Apply and release brake pedal several times, at the same time turn front wheels back and forth, lock to lock. Turn off engine and check fluid level. Add fluid if necessary. If fluid level is low, repeat bleeding procedure. Place cover on reservoir.

BLEEDING BRAKE CYLINDERS

See Hydraulic Brake Bleeding in this Section.

OVERHAUL

Disassembly – 1) Secure unit in vise (bracket end up) and use chisel to cut bracket nut that secures linkage bracket to power section. Cut nut at slot in threaded section to prevent damage to threads. Remove linkage bracket from unit.

2) Remove pedal rod boot (if equipped) and place rod retainer shearing tool (see tool chart for number) over rod. Place a punch through pedal rod from lower side of tool and push punch on through to rest on higher side of tool. Lift up on punch to shear pedal rod retainer. Remove pedal rod.

3) Remove remnants of rubber grommet from groove near end of pedal rod and from groove inside input rod end. With small screwdriver, pry plastic guide out of output push rod retainer. Disengage tabs of spring retainer from ledge inside opening near master cylinder mounting flange of booster. Remove retainer, piston return spring and output rod from opening.

4) Place booster cover in a soft-jawed vise and remove 5 screws securing booster housing to cover. Remove booster assembly from vise and while holding over a pan, separate cover from housing. Remove large seal ring from groove in cover and discard.

5) Remove input rod and piston assembly, spool assembly and spool spring from booster housing. If spool valve is defective, the complete assembly must be replaced. Inspect power piston, if deep scratches are evident, input rod and piston must be replaced.

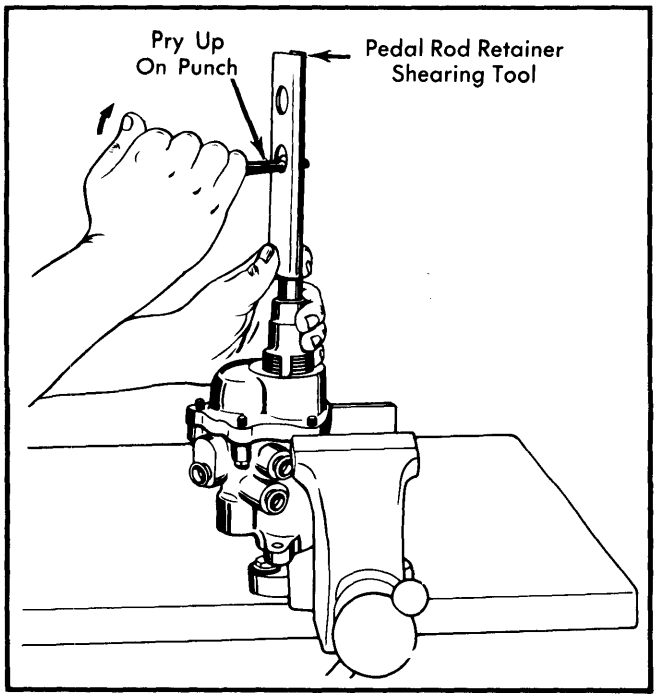

Fig. 2 Procedure for Removing Booster Pedal Rod

BENDIX HYDRO-BOOST (Cont.)

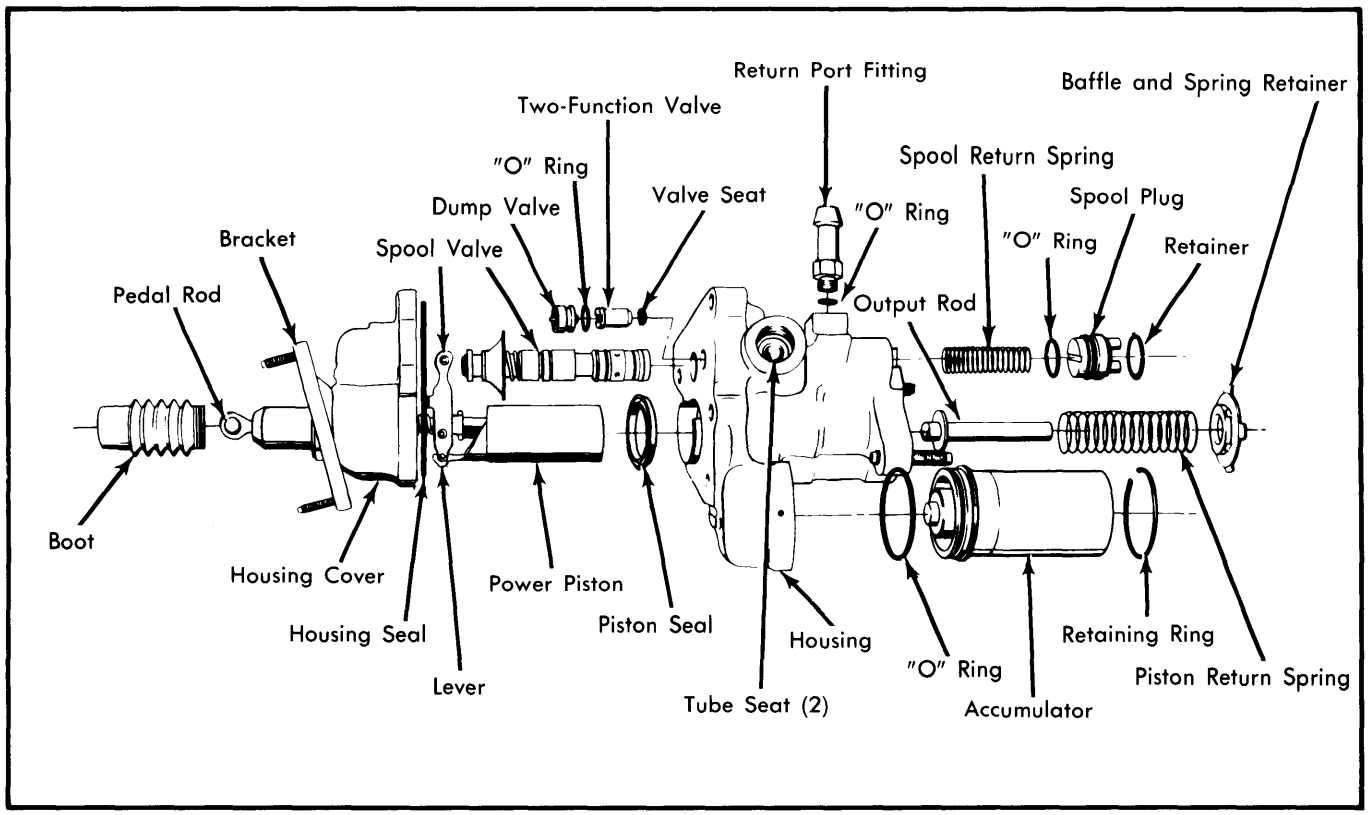

Fig. 3 Exploded View of Bendix Hydro-Boost Assembly Components (Unit with External Accumulator Shown)

6) Remove input rod seals and piston seal from piston bore. Place retaining cap tool (see tool chart for number) over master cylinder stud and install nut as shown in *Fig. 4*. Using a large "C" clamp, depress accumulator. Insert a punch into hole in housing and remove retaining ring with screwdriver.

7) Slowly back off clamp until tension on accumulator is released, then remove accumulator and "O" ring. If accumulator valve is faulty, remove valve using a small diameter wire tool. See *Fig. 5*. Remove the dump valve by catching the tool under the pin guide near the center of the valve, then remove 2 function valve and seat.

8) Remove return hose "O" ring fitting if it is leaking. Remove spool valve plug, retaining ring and "O" ring. Remove tube seats using a No. 4 Easy Out.

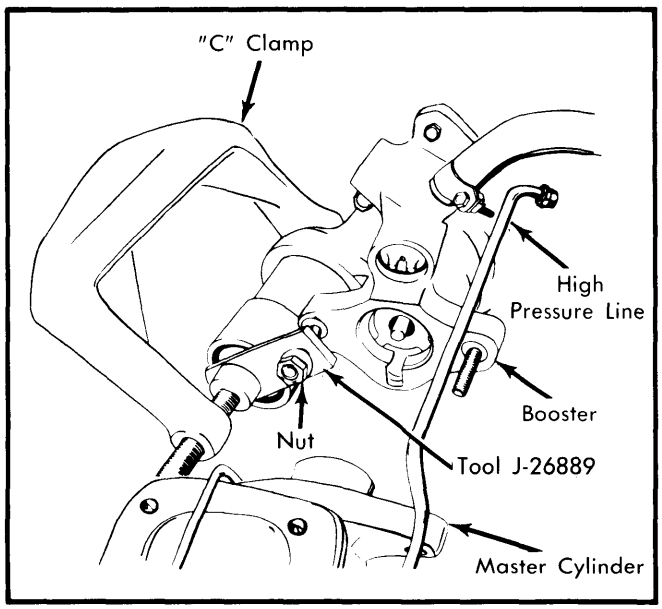

Fig. 4 Compressing Accumulator

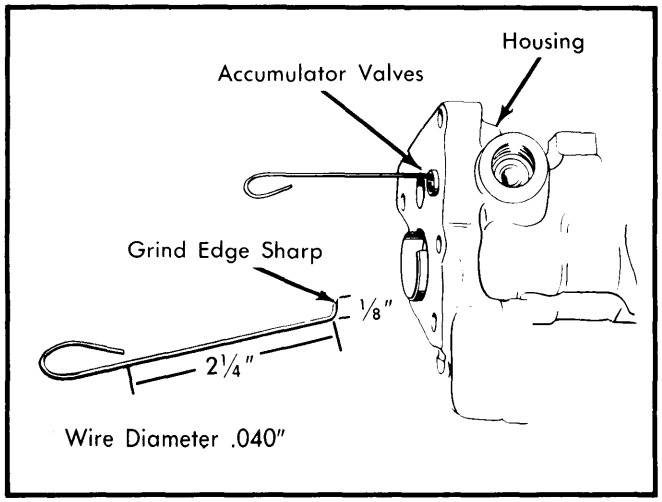

Fig. 5 Removing Accumulator Valves

BENDIX HYDRO-BOOST (Cont.)

Cleaning & Inspection – **1)** Clean all metal parts in a suitable solvent. Inspect valve spool and valve spool bore in booster housing for corrosion, nicks, scoring or other damage. Discoloration of spool or bore, particularly in grooves, is not harmful.

2) If valve spool or spool bore has nicks or scoring that can be felt with a fingernail, particularly on the lands, the entire booster should be replaced as an assembly.

3) Inspect input rod, piston assembly, and piston bore for corrosion, nicks, scoring or other damage. Replace damaged parts.

Reassembly – **1)** Be sure that all parts are absolutely clean. Lubricate all seals and metal friction points with power steering fluid.

2) On Chevrolet and GMC models, install tube seat as shown in *Fig. 7*. On Dodge and Plymouth models, position tube seats in booster ports and screw a spare tube nut into each port to seal tube seat. Remove spare nuts and ensure that ports are free from burrs or shavings.

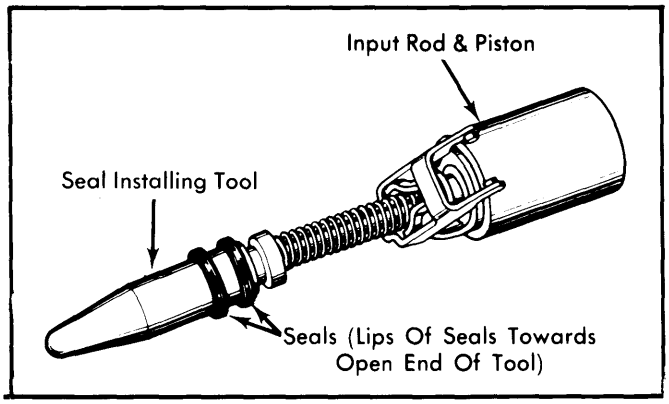

Fig. 6 Installing Input Rod Seals

3) Install "O" ring, spool valve plug and retaining ring. Coat piston seal and bore with clean power steering fluid and place seal in bore. Lip of seal must be facing away from master cylinder mounting flange. Lubricate input rod end, new input rod seals and seal installer tool (see tool chart for number) with clean power steering fluid.

4) Slide seals on tool with lip of cups toward open end of tool. See *Fig. 6*. Slide tool over input rod end and down to second groove. Then slide forward seal off tool and into groove. Assemble other seal in first groove. Make sure both seals are seated.

NOTE – *Chevrolet and GMC diesel models use only 1 seal on input rod.*

5) Lubricate piston and piston installation tool (see tool chart for tool number) with clean power steering fluid. Hold the large end of the tool against the piston and slide the tool and piston into the piston bore and through the piston seal. Remove tool. Install return hose "O" ring fitting. If accumulator valve was removed, install new seat in valve bore by installing 2 function valve, which forces seat to bottom in bore.

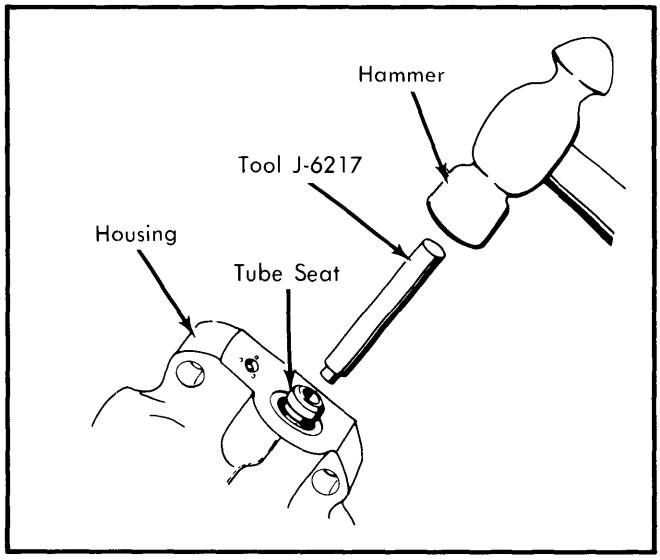

Fig. 7 Installing General Motors Tube Seats

6) If removed, insert new dump valve over the 2 function valve, making certain the dump valve plunger is held in place until installation is complete. Insert spool valve spring and valve assembly into bore. Extend power piston lever to accept sleeve on spool valve, then slide lever pins into slot in sleeve.

7) Install new seal in groove in housing cover, then join booster housing and cover and secure with 5 screws. Install output rod, spring and new spring retainer. Install new baffle and spring retainer by pushing in on it with a $\frac{7}{8}$" socket.

8) Lubricate accumulator seal with clean power steering fluid and install seal and accumulator in housing. Place retaining ring over accumulator. Place tool (see tool chart for tool number) over accumulator. Using "C" clamp, compress accumulator straight in. Snap retaining ring into the housing groove, and remove "C" clamp and tool.

9) Position mounting on booster. Tab on inside diameter of large hole in bracket should fit into slot in threaded portion of booster hub. Install new bracket nut with staking groove outward on the threaded hub of booster. Using deep socket tool (see tool chart for tool number) and a torque wrench, tighten nut to 110 ft. lbs.

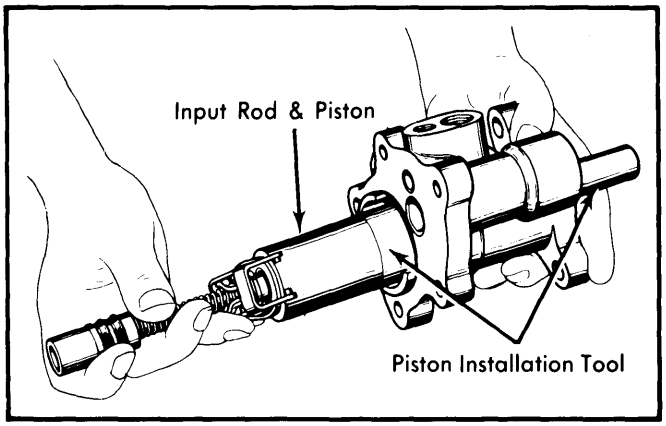

Fig. 8 Installing Input Rod Assembly into Booster

BENDIX HYDRO-BOOST (Cont.)

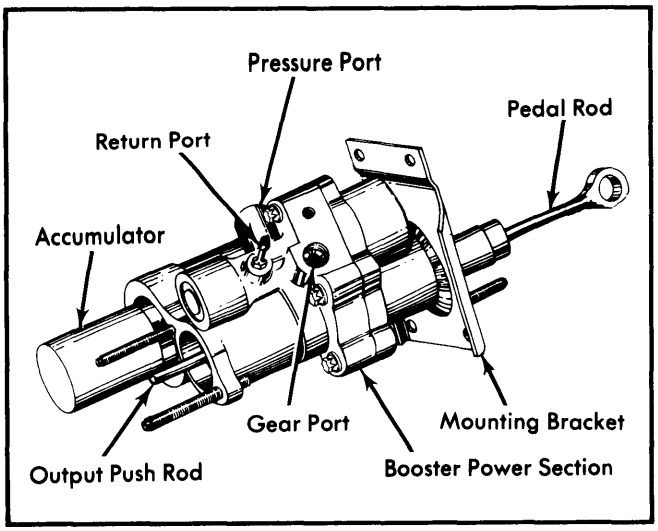

Fig. 9 Bendix Hydro-Boost Assembly

10) Using a hammer and punch, stake the nut in place. Assembly boot (if used) on pedal rod. Assemble new grommet in groove near end of pedal rod. Moisten grommet with water and insert grommet end of the pedal rod into the input rod end of the booster housing. Push on end of pedal rod to seat grommet. Slide the boot on the pedal rod and assemble the large end of the boot onto the hub of the power section.

TOOL NUMBER CHART

Application	GM Number	Chry. Number
Retainer Shearer	J-24569	C-4396
Retaining Cap Tool	J-26889	.....
Input Rod Seal Tool	.....	C-4394
Rear Drum Models		
Gasoline	J-24553	.....
Diesel	J-28485	.....
Rear Disc Models	J-28497	.....
Piston Installation Tool	.....	C-4393
Diesel Models	J-25083	.....
All Others	J-24551	.....
Special Deep Socket	J-24554	C-4395
Tube Seat Installer	J-6217	.....

TIGHTENING SPECIFICATIONS

Application	Ft. Lbs.
Booster Housing	20
Mounting Bracket Nut	110
Booster Brackets	25