Bendix® Hydro-Max Power Brake System

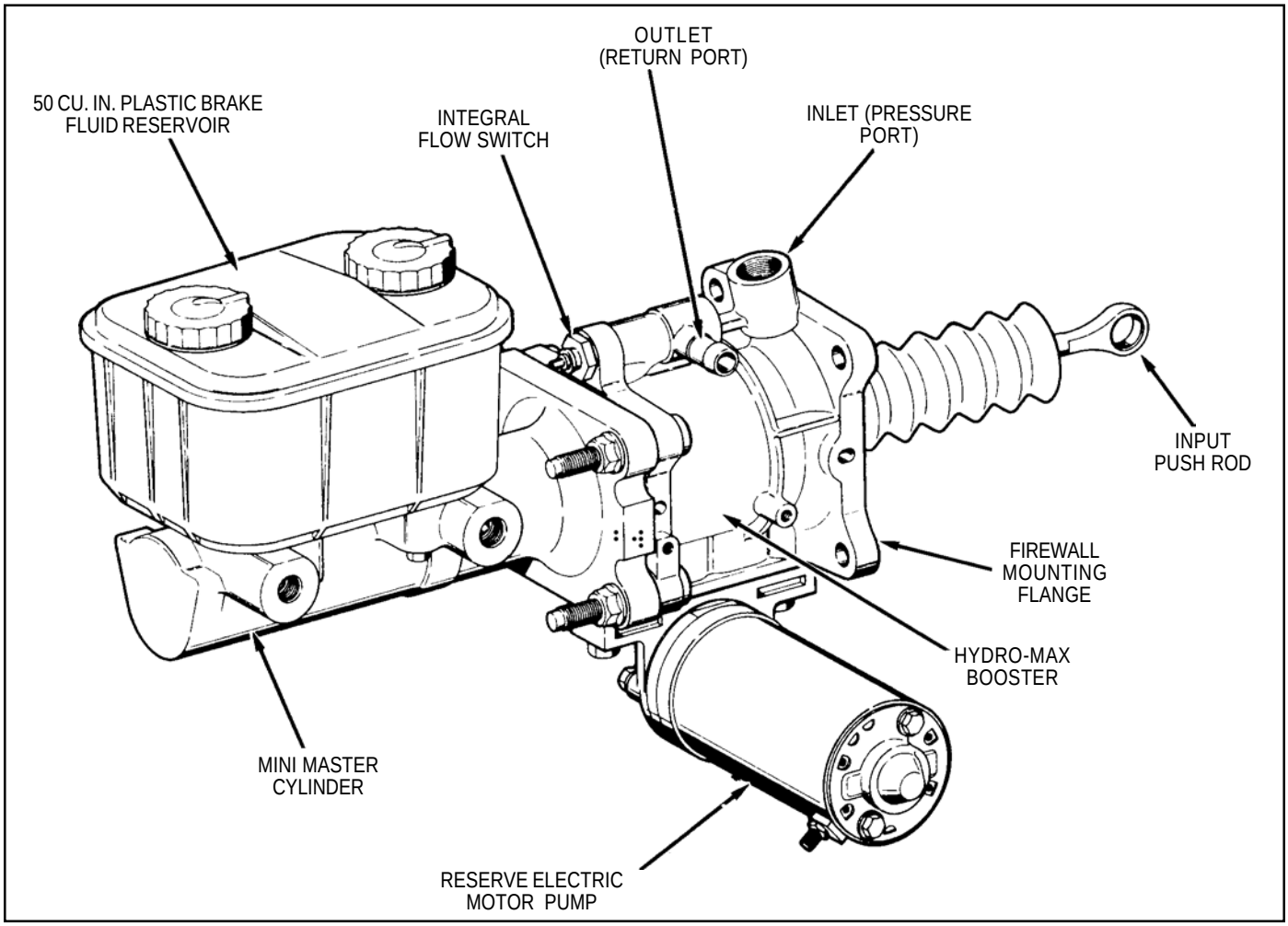

FIGURE 1 - HYDRO-MAX BOOSTER AND MINI MASTER CYLINDER ASSEMBLY

GENERAL DESCRIPTION

The Hydro-Max is a hydraulically powered booster which in conjunction with a mini master cylinder, reference Figure 1, provides a power assist for applying hydraulic brakes. Together they form the hydraulic brake actuation unit. The unit reduces the pedal effort and the pedal travel required to apply the brakes, as compared to a non-power system.

The hydraulic booster section is comprised of an open center valving and reaction feed back mechanism, a large diameter "boost" power piston, a reserve electric motor pump and an integral flow switch. It is powered by either the truck power steering pump or by a pump dedicated solely to the booster.

A reserve electric motor pump provides a redundant power source for the hydraulic booster. The pump's use is signaled by the integral flow switch.

The mini master cylinder is a split system type with separate brake fluid reservoirs, pistons, and output ports for the front and rear brake systems or, a single system master cylinder may be used where regulations are not applicable.

The Hydro-Max power brake is composed of four basic parts:

1. A hydraulically powered booster
2. A reserve electric motor pump
3. A hydraulic master cylinder
4. An integral flow sensing switch and warning system

HYDRAULIC PUMP OPERATING SYSTEMS

The Hydro-Max booster can be positioned in the vehicle's hydraulic circuit in one of two ways:

1. Integrated with the power steering hydraulic pump and steering gear. (Figure 2)

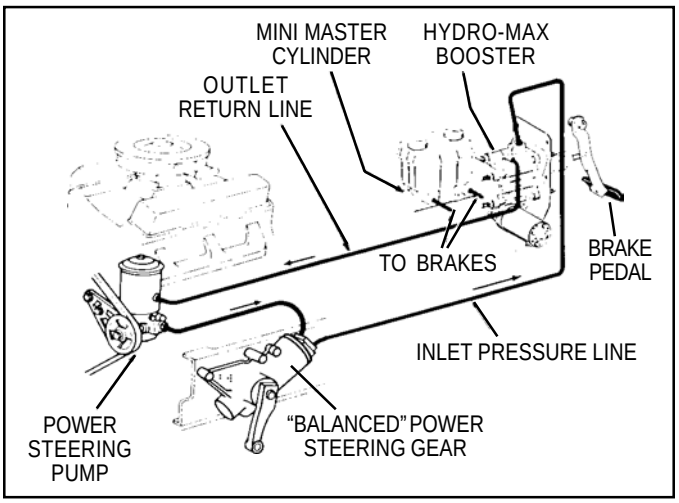

FIGURE 2

The Hydro-Max hydraulic booster operates in series with the power steering gear. As such, the pressure demands during simultaneous steering and braking are additive. (i.e.; if steering requires 1200 psi and pump relief is 2100 psi then booster will get 900 psi.)

The **power steering gear must be "balanced"** so that it can handle the pressures generated in the steering gear return line. It **MUST** also have an internal relief valve setting lower than pump relief. To allow the steering gear to relieve before the hydraulic pump does, it **MUST** also have an internal bypass to allow manual steering during reserve system operation.

The fluid **flow path** depicted is required to minimize the interaction between the power steering gear and the hydraulic booster.

The **pressure line** must be a 1/2" flexible or rigid pressure line conforming to S.A.E. J188 and designed to run from the steering gear to the Hydro-Max inlet. The connections for the hose will consist of an adapter for the return side of the gear and the tube "O" arrangement for the Hydro-Max inlet. (See Figure 3)

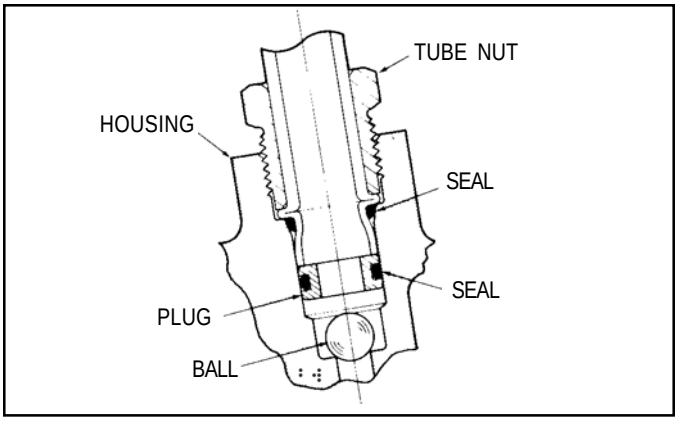

FIGURE 3

Maximum inlet port pressure is limited to approximately 1000 psi by the Hydro-Max pressure poppet and pressure regulator assembly.

The **return line** must be a hydraulic hose, conforming to S.A.E. J189, running from the Hydro-Max outlet (return) port to the reservoir of the pump. Hose clamps, conforming to S.A.E. J536b, are sufficient to withstand normal back pressure in the system.

2. Powered by a dedicated hydraulic power source. (Figure 4)

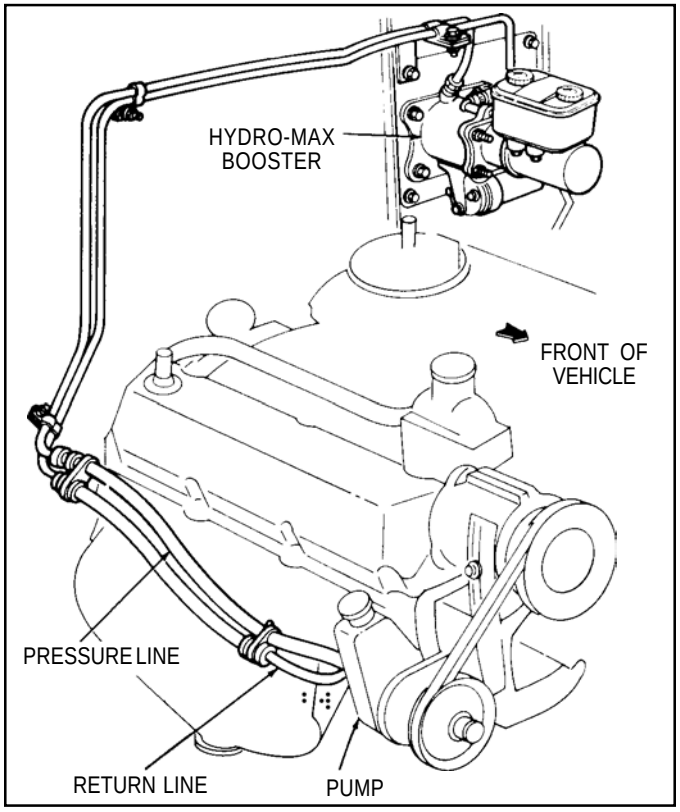

FIGURE 4

Power steering gear does not have to be "balanced", manual gear may be used.

Flow path must be adhered to.

The **pressure line,** conforming to S.A.E. J188, can be a 1/2" flexible or rigid pressure line designed to run from the dedicated hydraulic power source to the tube "O" Hydro-Max inlet pressure port.

Maximum inlet port pressure is the same as method No. 1.

Return line - same as method No. 1.

A typical Hydro-Max installation in a hydraulic braking system is shown in Figure 5 and interfaces with the following components:

BRAKES

1. A pressure differential warning valve
2. Drum/drum, disc/drum or disc/disc foundation brakes

ELECTRICAL

1. A relay
2. A 12 VDC battery

3. A warning light for the pressure differential warning valve
4. Electrical connectors and wiring
5. Brake pedal switch
6. A buzzer
7. A warning light for reserve motor
8. An (optional) electronic monitor module.

OPERATION OF THE HYDRO-MAX BOOSTER AND RESERVE ELECTRIC MOTOR PUMP (See Figures 6 and 7)

During normal system operation, fluid flow from a hydraulic power source (in the instance of the power steering pump), enters the inlet (pressure) port of the Hydro-Max booster, flows through the throttle valve and power piston, then thru the flow switch and exits from the outlet (return) port.

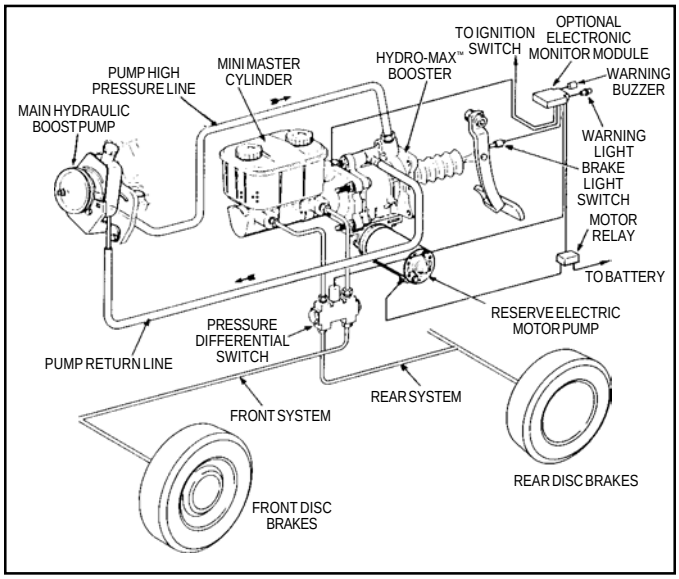

FIGURE 5

Force applied to the brake pedal by the vehicle operator is multiplied by the lever ratio of the pedal mechanism to move the input pedal rod of the booster. This movement activates the throttle valve, restricting flow through the power piston. The resulting pressure, acting on the power piston, applies a “boosted” force to the master cylinder primary piston. A reaction piston, inside the power piston subassembly, provides the driver "pedal feel” during an application of the brake pedal.

Fluid flow through the flow switch “opens” the reserve motor pump electrical circuit during normal operation. A separate check valve in the motor pump prevents backflow through the motor pump during normal power applications.

In the event normal flow from the power steering pump is interrupted, the electric motor pump provides the power for reserve stops. Upon flow interruption, the integral flow switch “closes”, energizing a power relay, thereby providing electrical power to the motor pump.

During reserve operation, fluid is retained within the booster by the inlet port check valve. The motor pump recirculates fluid within the booster assembly with pressure built on demand via the throttle valve. The number of applications is limited only by the electrical capacity of the vehicle.

Manual braking is also available in the event both the power and reserve systems are inoperative, as illustrated in the following performance curve.

Typical performance curve shown in Figure A.

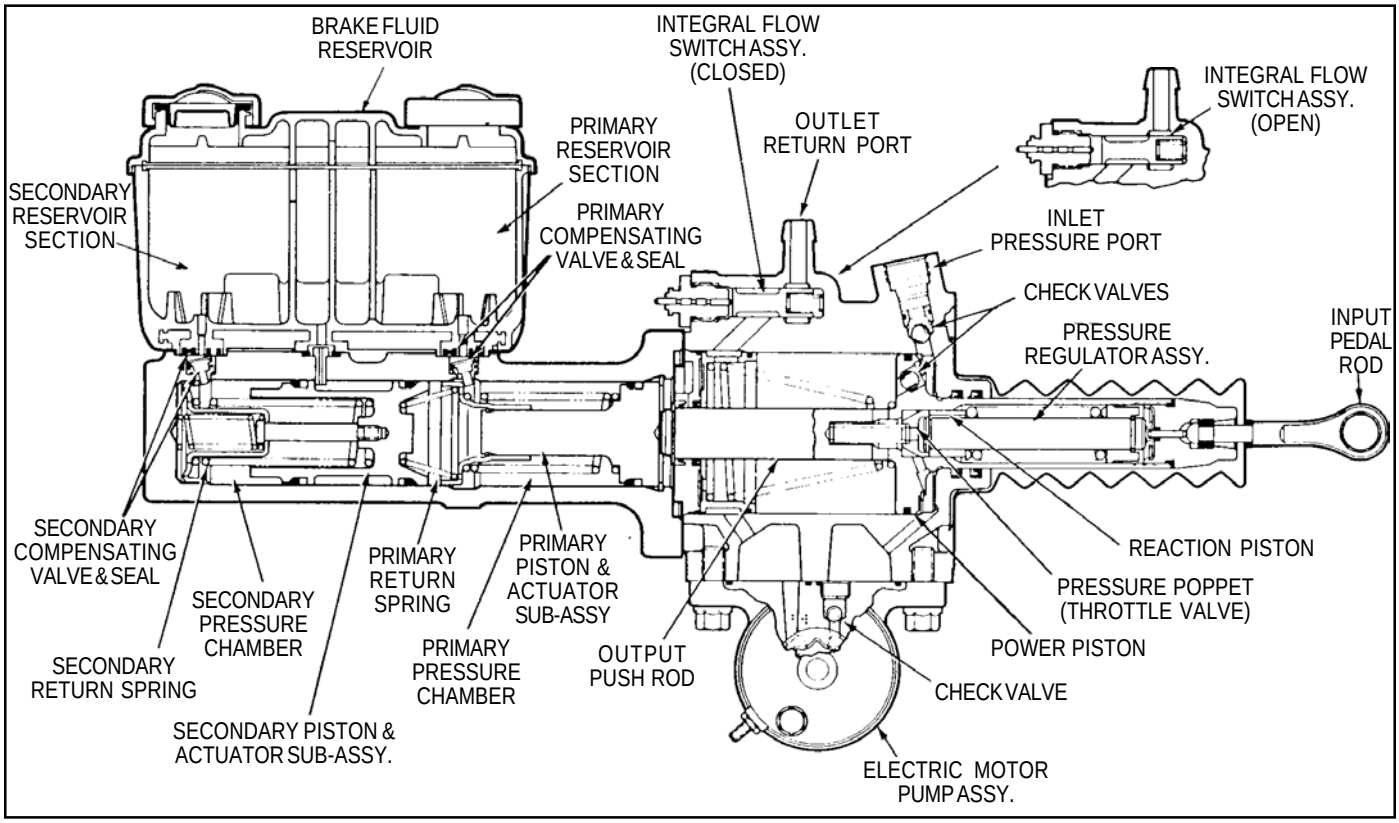

FIGURE 6 - HYDRO-MAX AND MINI MASTER CYLINDER

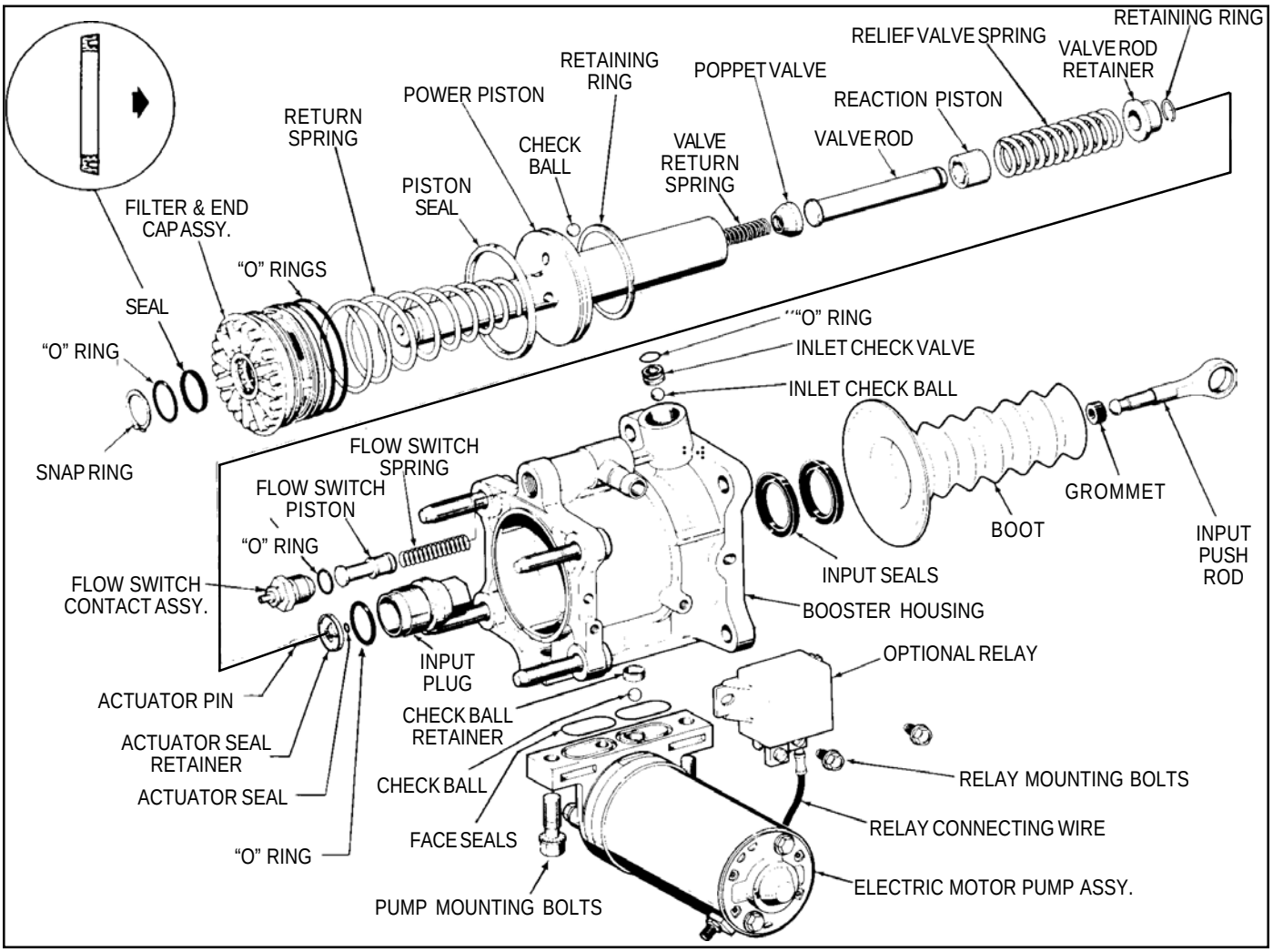

FIGURE 7 - EXPLODED VIEW HYDRO-MAX BOOSTER

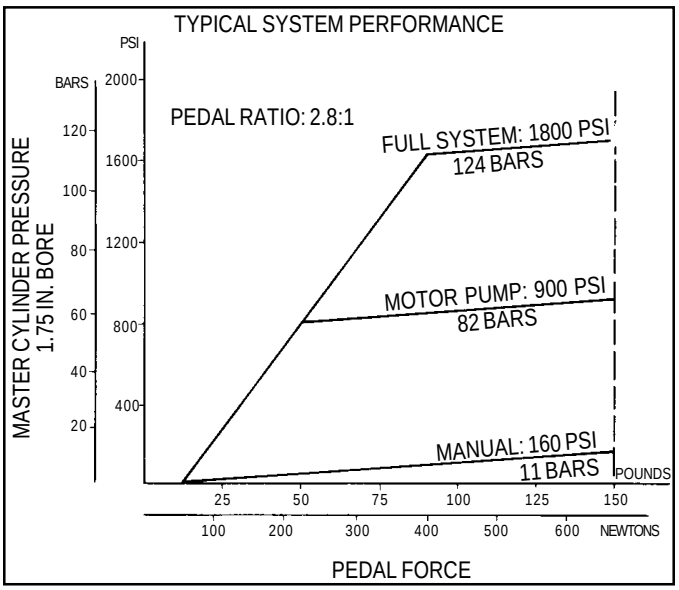

FIGURE A

OPERATION OF THE MINI MASTER CYLINDER

Each pressure chamber has a piston/actuator subassembly containing a preloaded (caged) spring and a return spring. In the released position, actuators of both the primary and secondary pistons are in contact with their respective compensating valve sterns, which project into the cylinder bore. This maintains the valves in an open position, which allows hydraulic fluid in the reservoir to replenish any fluid displayed from the cylinder bore.

Initial forward travel of the primary piston moves the primary actuator away from its compensating valve counterpart, permitting the valve to seat. Closure of this valve shuts off the passage between the primary pressure chamber and the reservoir section serving the primary chamber.

Further movement of the primary piston creates a pressure in the primary pressure chamber, causing the secondary piston and actuator to move. As the secondary piston and actuator move, the secondary compensating valve closes, shutting off the passage between the secondary pressure chamber and the reservoir section serving the secondary chamber. Additional movement of the primary piston causes both chambers to build pressure.

When the load on primary piston is removed, fluid pressure in each chamber, combined with return spring force, causes the primary and secondary pistons to return to their initial released positions. Each actuator opens its respective compensating valve, reopening the passage between the individual reservoir sections and its associated pressure chamber.

Should the rate of release be great enough to cause a partial vacuum in a chamber, the compensating valve will open to allow replenishment of fluid in the cylinder bore.

Any excess fluid remaining at the end of the stroke due to "pumping" and/or volume change due to temperature fluctuation is released as the compensating valve ports open.

OPERATION OF FLOW SWITCH AND WARNING SWITCH

The Hydro-Max hydraulic booster has a reserve electric motor pump which will provide hydraulic boost for emergency operation.

The basic signal for operation of the electric motor pump comes from the integral flow switch in the Hydro-Max booster itself.

The interface of this electric motor with the vehicle's existing electrical system can be accomplished in at least two different ways.

1. This schematic represents the minimum requirements to interface properly and provide warning to the vehicle operator that the reserve system is in operation.

   The electric motor pump receives its power from the reserve system relay. The relay is in turn controlled by two dependent conditions. First, the positive or power lead to the coil of the reserve system relay comes from the brake switch. Secondly, the ground path for the coil of the relay is supplied by the Hydro-Max booster flow switch. When this switch is closed, a ground path is supplied to the relay coil. The flow switch senses flow through the booster. When the flow drops below a set point, the flow switch closes.

   When power to the relay coil is available and the flow switch is closed, the relay energizes and supplies power to the reserve electric motor pump. Therefore, when the flow switch is closed and the brake pedal is depressed, the electric motor pump is operating and the reserve system is operational.

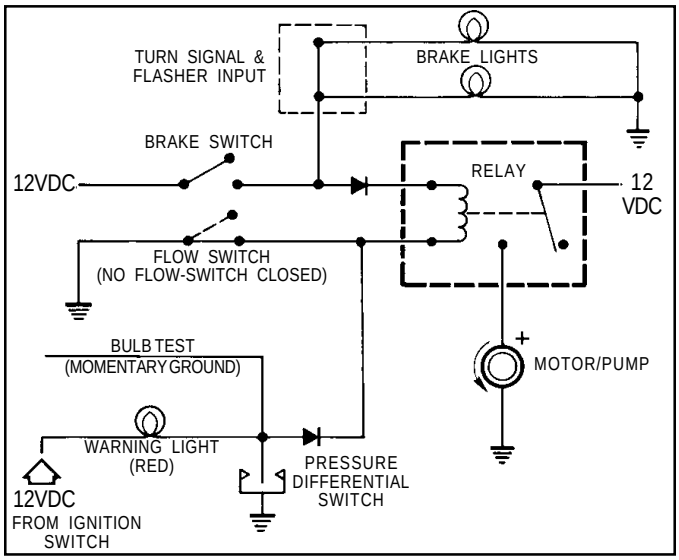

FIGURE 8

The following chart illustrates the operation of the basic warning system presented in Figure 8.

	VEHICLE SYSTEM CONTROLS			SYSTEM OPERATION INDICATORS		REMARKS
	Engine	**Ignition**	**Brake**	**Red Lamp**	**Motor Pump**	
NORMAL OPERATION	Off	Off	Released	Off	Off	Everything is off.
	Off	Off	Depressed	Off	On	Electric motor circuit is okay.
	Off	On	Released	On	Off	Warning light is functioning.
	Off	On	Depressed	On	On	Normal - Motor pump running.
	On	On	Released or Depressed	Off	Off	Brake system operation is normal.
CONDITIONS REQUIRING SERVICE	Off	Off	Depressed	Off	Off	No reserve boost. (Hard pedal.) Do not operate vehicle except for emergency removal from roadway.
	Off	On	Released	Off	Off	Use bulb test. Operate vehicle with extreme caution and seek immediate service.
	Off	On	Depressed	On	Off	No reserve boost. (Hard pedal.) Do not operate vehicle except for emergency removal from roadway.
	On	On	Depressed	On	On	Loss of primary boost, reserve boost operating. Operate vehicle with extreme caution and seek immediate service.
	On	On	Released or Depressed	On	Off	Loss of primary or secondary brake circuit (differential), pressure switch operating. Operate vehicle with extreme caution and seek immediate service.

NOTE: IF NONE OF THE ABOVE CONDITIONS APPLY, CHECK FOR ELECTRICAL SHORT, OPEN CIRCUIT OR BURNT-OUT INDICATOR BULB.

2. OPERATION OF THE OPTIONAL BENDIX ELECTRONIC MONITOR MODULE

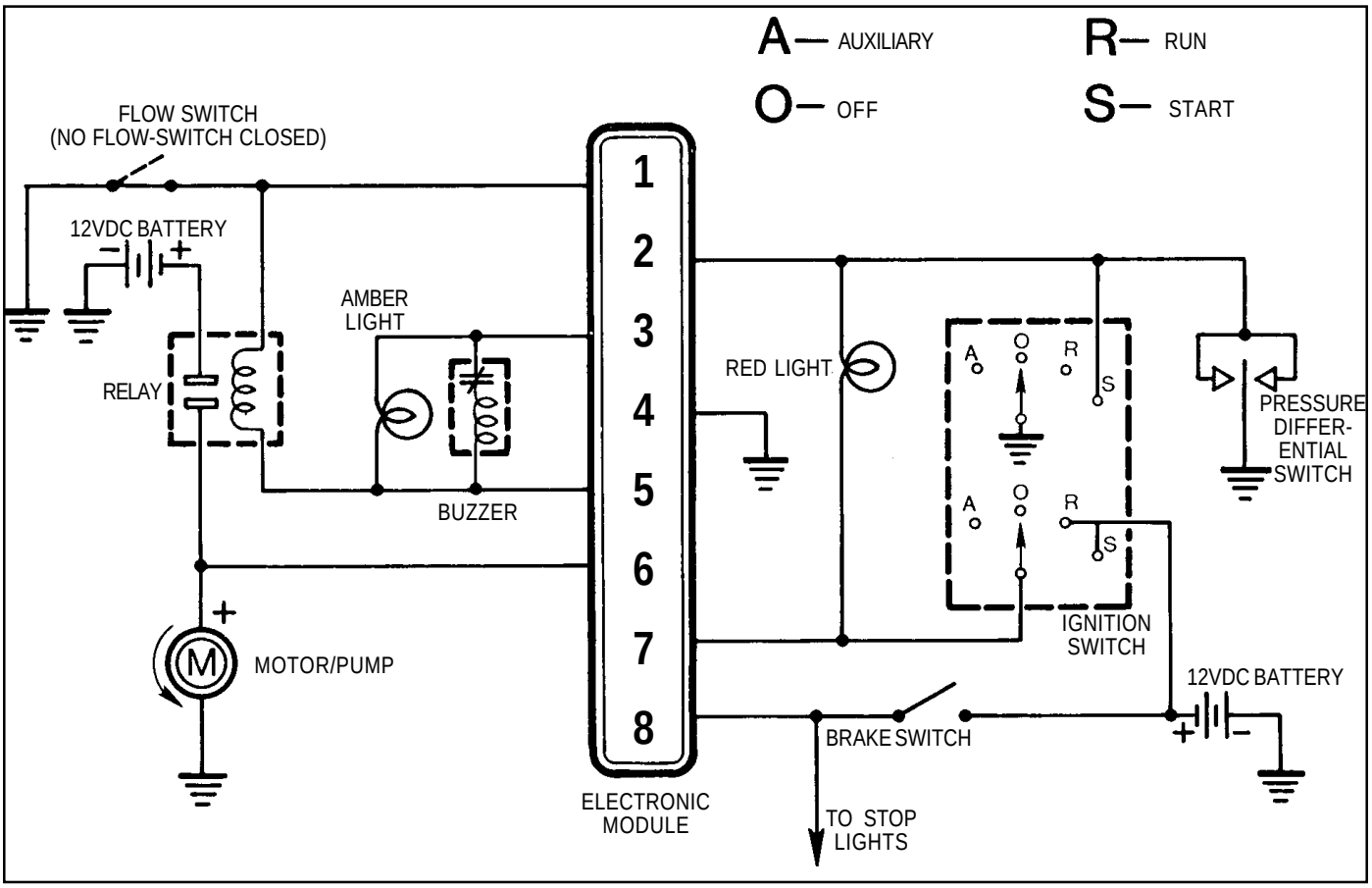

FIGURE 9

The electronic monitor is optional since interface with the vehicle's existing electrical system is a O.E.M. related decision.

The electronic module receives power from two sources. The module is powered by the ignition switch; power is supplied when the ignition switch is in the run and start positions. The second source of power for the module is received from the brake light switch. When the brake pedal is depressed and the brake switch closes, power flows to the brake lights and to the electronic module. Therefore, the module is powered anytime the vehicle ignition is turned on or anytime the brake pedal is depressed.

The Hydro-Max reserve system is powered by an electric motor pump. This electric motor receives its power from the reserve system relay. The relay is in turn controlled by two dependent conditions. First, the positive or power lead to the coil of the reserve system relay comes from the electronic module. Secondly, the ground path for the coil of the relay is supplied by the Hydro-Max booster flow switch. When this switch is closed, a ground path is supplied to the relay coil. This flow switch senses flow through the booster. When the flow drops below a set point, the flow switch closes.

Current is available to the coil of the relay whenever the module is powered. When power to the relay coil is available and the flow switch is closed, the relay energizes and supplies power to the reserve electric motor pump. Therefore, when the flow switch is closed and either the brake pedal is depressed or the ignition is on, the electric motor pump is operating and the reserve system is operational.

The following chart illustrates the operation of the Bendix Electronic Monitor Module warning system presented in Figure 9.

	VEHICLE SYSTEM CONTROLS			SYSTEM OPERATION INDICATORS Lamps			REMARKS
	Engine	Ignition	Service Brakes	Amber	Red	Buzzer	
NORMAL OPERATION	Off	Off	Released	Off	Off	Off	Everything is off. Electric motor circuit is okay. Warning lights and buzzer are functioning okay. Normal, system is okay.
	Off	Off	Depressed	On	Off	On	
	Off	Run or Start	Released or Depressed	On	On	On	
	On	Run or Start	Released	Off	Off	Off	
CONDITIONS REQUIRING SERVICE	Off	Off	Depressed	Off	Off	Off	No reserve boost. (Hard pedal.) Do not operate vehicle except for emergency removal from roadway.
	Off	Run or Start	Depressed	Off	On	Off	No reserve boost. (Hard pedal.) Do not operate vehicle except for emergency removal from roadway.
	On	Run or Start	Released or Depressed	Off	On	Off	Loss of primary or secondary brakes. Operate vehicle with extreme caution and seek immediate service.
	On	Run or Start	Released or Depressed	Oil	Off	On	Reserve system failure. Do not operate vehicle except for emergency removal from roadway.
	On	Run or Start	Released or Depressed	On	On	On	Booster pump malfunction, reserve system operating. Operate vehicle with extreme caution and seek immediate service.

NOTE: IF NONE OF THE ABOVE CONDITIONS APPLY, CHECK FOR ELECTRICAL SHORT, OPEN CIRCUIT OR BURNT-OUT INDICATOR BULB.

HYDRO-MAX BRAKE SYSTEM FLUIDS

The Hydro-Max brake assembly is composed of the Hydro-Max booster and Mini Master cylinder. Each of these two devices is GENERALLY operated by distinctly different and incompatible hydraulic fluids which **MUST NOT BE MIXED.**

a. The Hydro-Max booster operates on power steering fluid, automatic transmission fluid, or in general generic terms - a petroleum based hydraulic fluid.

b. The Mini Master cylinder operates on a glycol based hydraulic brake fluid.

PREVENTIVE MAINTENANCE

Every three months; 25,000 miles or 900 operating hours whichever occurs first:

1. Check the brake fluid level of the master cylinder reservoir and replenish if necessary.
2. Check the Hydro-Max exterior and all connecting lines for fluid leakage. Remove grime from the exterior of the Hydro-Max.
3. Check for loose or disconnected electrical connections and damaged wiring.
4. Check the vehicle brake warning system (Reference Figures 8 and 9) comparing the reaction of warning lights and buzzers to the vehicle's handbook.

TROUBLESHOOTING CHART

SYMPTOM	CAUSE	REMEDY
1. Fluid leakage between booster and master cylinder	A. Worn or damaged master cylinder primary pressure seal or back-up ring.	A. Repair or replace master cylinder.
	B. Worn or damaged seals or o-rings in booster end cap assembly.	B. Repair or replace booster.
2. Fluid leakage on booster or booster pump. (Power steering pump)	A. Damaged or missing seals at booster and electric motor pump mating surface.	A. Replace seals.
	B. Loose or improperly torqued cap screws securing electric motor pump to booster housing.	B. Retorque to 18-25 ft. lbs. (24-34 N.M)
	C. Porous booster pump housing and/or worn pump.	C. Replace pump.
	D. Worn or damaged electric motor pump.	D. Replace pump.
	E. Worn or damaged boot on booster.	E. Repair booster.

SYMPTOM	CAUSE	REMEDY
	F. Worn or damaged seals around flow switch connector pin plug.	F. Repair booster.
	G. Worn or damaged booster housing.	G. Replace booster housing.
3. Noise from hydraulic booster pump. (Power steering pump)	A. Loose belt.	A. Tighten belt to specified tension.
	B. Supply and return lines touching chassis.	B. Reroute lines out of contact with chassis.
	C. Low fluid level.	C. Refill to specified level.
	D. Aerated fluid.	D. Bleed system.
	E. Contaminated fluid.	E. Change fluid.
	F. Excessive back pressure caused by lines or booster head.	F. Replace lines and/or booster head.
	G. Internal damage in pump.	G. Replace pump.
4. Hard brake pedal with engine running.	A. Loose pump belt.	A. Tighten belt to specified tension.
	B. Excessive output pressure at pump. (Gauge at inlet line to booster pump reads 5515 kPa (800 psi) at least before pedal is hard.	B. Replace pump.
	C. Binding pedal rod linkage.	C. Repair cause of restriction. Replace components as required.
	D. Worn or wet brake linings.	D. Repair or replace brake linings.
5. Sluggish booster operation with little or no assist.	A. Slipping belt.	A. Replace belt if required. Tighten belt to specified tension.
	B. Low fluid level in booster pump reservoir.	B. Refill to specified level.
	C. Binding pedal rod linkage.	C. Remove restriction. Replace components are required.
	D. Restricted hose or line.	D. Remove restriction in hose or line.
	E. Worn or damaged booster.	E. Repair or replace booster.
	F. Air in fluid.	F. Bleed system.
	G. Internal wear or damage in booster pump.	G. Replace booster pump.
	H. Motor pump check valve leaking in booster.	H. Check booster pump pressure at inlet with full brake application. Replace electric motor pump if low pressure is noted.
6. Electric motor pump does not operate with engine off, ignition off and brake pedal depressed.	A. Brake switch out of adjustment.	A. Adjust.
	B. Brake switch worn or damaged.	B. Replace switch.
7. Electric motor pump does not operate with engine off and ignition on.	A. Ignition switch or connecting wires.	A. Check condition of switch and wiring or replace as necessary.
	B. Loose, disconnected or broken power lead wire at motor pump.	B. Repair or replace.
	C. Loose, disconnected or broken flow switch wire.	C. Repair or replace.
	D. Inoperative motor pump relay.	D. Repair or replace.
	E. Inoperative booster flow switch.	E. Repair or replace.
	F. Inoperative electronic monitor module. (Optional device not on all vehicles; check vehicle maintenance manual.)	F. Replace monitor module. (See module tests elsewhere in this manual.)
	G. Inoperative electric motor pump.	G. Check operation and replace as required.

SYMPTOM	CAUSE	REMEDY
8. Electric motor pump runs continuously with ignition off and brake pedal **NOT** depressed.	A. Brake light switch.	A. Adjust, repair or replace.
	B. Inoperative, damaged motor pump relay.	B. Replace.
	C. Inoperative electronic monitor module. (Optional device not on all vehicles, check vehicle maintenance manual.)	C. Replace monitor module. (See module tests elsewhere in this manual.)
9. Electric motor pump operates normally but with little or no boost.	A. Battery voltage.	A. Minimum 10 volts required. Recharge or replace battery.
	B. Electric motor pump.	B. Disconnect power lead at motor pump and read 10 or more volts and replace motor pump. Read less than 10 volts and replace wire.

REPAIRING THE HYDRO-MAX

General

If after troubleshooting the brake system it is determined that the Hydro-Max booster is not functioning properly, it is recommended that it be replaced or repaired using genuine Bendix maintenance kits.

In order to properly disassemble and reassemble the Hydro-Max, the use of one seal bullet, and in some cases two, is recommended. Bendix seal bullet part number 74015 is used to install the power piston in the booster housing on units found on 1981 and earlier model year vehicles. The bullet to install the power piston in the end cap and filter assembly on all Hydro-Max units must be fabricated. (Refer to Figure 10)

It is recommended that these instructions be thoroughly read and understood before attempting to install the kit.

The instructions that follow presuppose the use of a Bendix maintenance kit. Refer to Figures 6 and 7 for disassembly and assembly. Disassembly and reassembly should not be attempted without a kit on hand.

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around brake systems and components, the following precautions must be observed at all times:

1. **Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. When working around or under the vehicle, stop the engine and remove the key from the ignition. Always keep hands away from chambers as they may apply as system pressure drops. Always wear safety glasses.**
2. **When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, extreme caution should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.**
3. **Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to the use of those tools.**
4. **Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.**
5. **If the vehicle is equipped with an air over hydraulic brake system or any auxiliary pressurized air system, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS™ air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.**
6. **Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or pipe plug unless you are certain all system pressure has been depleted.**
7. **Never exceed manufacturer's recommended pressure.**
8. **Never attempt to disassemble a component until you have read and understand all recommended procedures. Some components contain powerful springs and injury can result if not properly disassembled. Use only proper tools and observe all precautions pertaining to use of those tools.**
9. **Use only genuine Bendix® replacement parts, components and kits.**
   - **A. Use only components, devices and mounting and attaching hardware specifically designed for use in hydraulic brake systems.**
   - **B. All replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as the original equipment.**

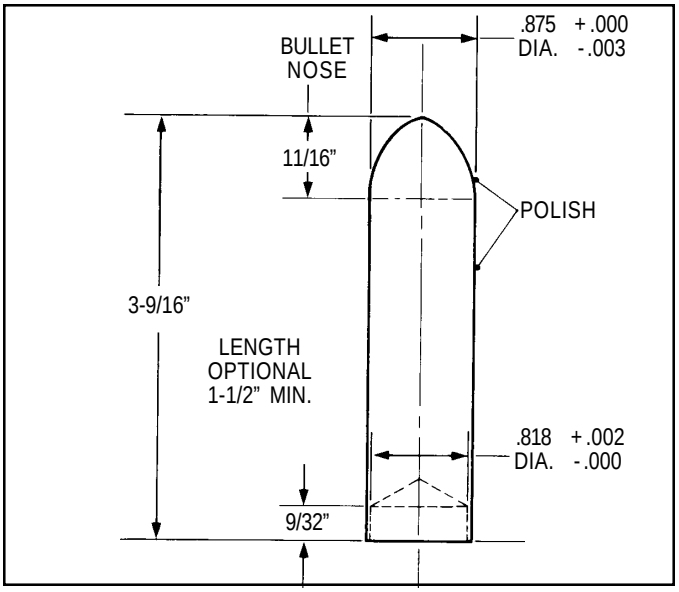

FIGURE 10 - SEAL BULLET (FOR ASSEMBLING HYDRO-MAX FILTER AND END CAP OVER POWER PISTON)

10. **Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.**
11. **Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.**

VEHICLE PREPARATION & REMOVAL OF HYDRO-MAX

1. Park the vehicle on a level surface and prevent movement by means other than the brakes.
2. Disconnect the negative terminal of the vehicle's battery.
3. Disconnect the Hydro-Max input push rod from the vehicle brake pedal.
4. Detach the electrical power lead from the Hydro-Max pump motor. Disconnect the electrical lead from the flow switch. On assemblies which include the relay mounted on the booster, disconnect the vehicle wires at the relay.
5. Identify and remove the inlet and return hoses from the Hydro-Max. Plug the ends of both hoses and the open ports of the Hydro-Max. CAUTION: DO NOT APPLY THE BRAKES after removal of the input hose unless the reserve system is disconnected. Reserve boost pressure will blow the inlet check valve out of the booster.
6. Remove the four cap nuts that secure the master cylinder to the Hydro-Max. NOTE: The master cylinder must be supported in some fashion so that weight is not exerted on the steel brake lines connected to the master cylinder.
7. Remove the four bolts that secure the Hydro-Max to the vehicle and remove the Hydro-Max.

DISASSEMBLY

1. If the Hydro-Max is equipped with an optional relay, remove the two cap screws that secure the relay to the booster housing.
2. Remove the two cap screws that secure the pump motor to the Hydro-Max body and remove the pump motor. NOTE: Approximately three cups of oil will drain out of the Hydro-Max when the pump is removed. Avoid damaging the mating surfaces when removing the pump motor.
3. Remove and discard the two pump motor face seals (oval o-rings).
4. Remove the boot from the input push rod.
5. Push in on input push rod to force power piston assembly from booster. (Rotate end cap to ease piston removal.) NOTE: During piston removal, pull straight out on piston to avoid scratching rear piston on external bore surface area. HANDLE PISTON WITH CARE. ALUMINUM SURFACE WILL SCRATCH EASILY.
6. Remove and discard the two power piston input seals from the rear of the booster housing.
7. Disassemble the flow switch. There are two types of flow switch assemblies with the difference being the method by which the flow switch contact assembly is retained.

Threaded Contact Assembly

Using a 3/4" wrench, remove the contact assembly. Remove and discard the o-ring seal from the contact assembly. Using a small magnet, extract the flow switch piston and spring.

Snap Ring Contact Assembly

Press in on the contact assembly until tension is removed from the snap ring that retains the contact assembly. Remove and discard the snap ring. Remove the contact assembly; remove and discard the o-ring that seals it. Using a small magnet, extract the flow switch piston and spring.

8. Clamp input push rod in vise. **DO NOT CLAMP ONTO POWER PISTON.** Push against the filter and end cap assembly compressing the return spring 1/4 - 1/2". Remove the snap ring, filter and end cap assembly and return spring. Discard the snap ring.
9. Clamp the **FLATS** of the input plug in a vise. DO NOT OVER TIGHTEN THE VISE. To remove the input plug assembly, grasp the large diameter of the power piston by hand and rotate counterclockwise. Do not grip piston surface with any tool. If additional leverage is required, a drift may be inserted through the flow holes in the output shaft.
10. Remove the valve rod and reaction piston assembly, poppet valve and valve return spring from the power piston. **DO NOT DISASSEMBLE THE VALVE ROD AND REACTION PISTON ASSEMBLY.**
11. Pry the actuator seal retainer from the input plug and discard. Remove actuator pin and discard actuator seal. Remove and discard input plug o-ring.
12. Remove and discard the o-ring and lip seal from the I.D. of the filter and end cap assembly.
13. Remove and discard both o-rings from the O.D. of the filter and end cap assembly.

14. Use a “hooked” piece of wire to remove the inlet check valve and o-ring from the inlet port of the booster housing. Discard these and the inlet check ball.
15. Gently clamp the input plug flats in the jaws of a vise. Insert a 5/8" rod or other appropriate tool through the hole in the input push rod. Using the 5/8" rod as a lever, carefully pull the input push rod out of the input plug. Up to a 100 lb. load may be required to pull the rod from the plug. Remove and discard the grommet from the input push rod. NOTE: If the input plug is the blue plastic type, special care should be taken in clamping not to damage it. All rubber debris from the sheared grommet must be completely removed from the input rod and plug.

CLEANING

Use clean power steering fluid for cleaning and lubricating parts and seals.

INSPECTION

1. Inspect the piston input and output shaft surfaces for scratches or nicks. Also, check that the large piston seal surface is smooth and continuous without excessive wear. If any defects are found, replace the power piston assembly. Confirm that the check ball is in place and is clean and free to move. Confirm that the reaction piston bore and poppet seat surface inside the piston are clean and undamaged.
2. Inspect housing for grooves, scratches or nicks in the input bore area. If any are found, replace the entire Hydro-Max assembly. Minor wear, as indicated by a shiny appearance on the large bore surface area, is normal.
3. Inspect the input plug for wear in the actuator pin hole. Replace plug if wear is evident. NOTE: The blue plastic input plug is not available for service replacement and is not interchangeable with the aluminum input plug.
4. Replace the filter end cap assembly if cracked or damaged. The 12 rib cap is interchangeable with the 4 rib cap.

ASSEMBLY

1. Remove the three largest O.D. o-rings from the kit and note that two of the three are identical in thickness with the third o-ring being noticeably thicker. Note whether the filter and end cap assembly in use has four or twelve ribs.

   (NOTE: The unit illustrated in Figure 7 is the 12 rib version.) If the cap is the four rib version, discard the thickest o-ring of the three and install the two identical o-rings in their respective grooves on the O.D. of the cap. If the cap is the 12 rib version as illustrated, discard one of the two thin o-rings. Install the thick o-ring in the O.D. groove closest the end cap ribs and the thin o-ring in the other O.D. groove.
2. Remove the 1" O.D. o-ring and the smallest of the three lip seals in the kit. Lubricate and install the o-ring and lip seal in the appropriate grooves in the I.D. of the filter and end cap assembly. IMPORTANT: Make certain that the lip of the lip seal faces the power piston when the filter and end cap assembly is installed on the power piston shaft. Incorrect orientation of the seal will allow pressurized fluid to leak from the interior of the Hydro-Max booster. Refer to Figure 7 for proper assembly.
3. Install the grommet on the input push rod and insert the input push rod into the input plug. Make certain that the grommet is completely seated in the input plug and is capable of retaining the input push rod. **CAUTION: If the input push rod is not properly installed, the push rod could become disconnected from the input plug. The result will be a "no brake” condition.**

   NOTE: The following references to “lubricate” parts means lubrication with fresh, clean power steering fluid. **DO NOT USE BRAKE FLUID.**
4. Lubricate and install the actuator seal (smallest seal in kit) in the recess inside of the input plug. Lubricate and insert the actuator pin in the seal.
5. Install the actuator seal retainer in the input plug with its flat side toward the input plug.
6. Of the o-rings remaining in the kit remove the two with the largest diameter.

   If the input plug assembly is aluminum, install the 1-3/16 inch O.D. o-ring and discard the remaining o-ring. The correct one is the thinner of the two.

   If the input plug assembly is blue plastic, install the 1-5/32 inch O.D. o-ring and discard the remaining o-ring. The correct one is the thicker of the two.
7. Remove the two remaining lip seals from the kit. Lubricate and install both seals in the small I.D. of the booster housing bore. The lip of both seals should face the interior of the booster housing.
8. Of the three remaining o-rings in the kit two are identical in size with the third slightly larger in diameter. Lubricate and install one of the small diameter o-rings in the groove of the inlet check valve.
9. Install the inlet check ball in the inlet port of the booster housing. Lubricate and install the assembled inlet check valve and o-ring in the inlet port. Push the inlet check valve in until it comes to rest.
10. Install the flow switch spring and then the flow switch piston in the booster housing.
11. Determine the type of flow switch contact assembly that is in use.

    Threaded Contact Assembly

    If the contact assembly in use is threaded, lubricate and install the larger diameter of the two remaining o-rings on the contact assembly. Install the contact assembly in the booster housing and torque to 20-40 inch pounds (2.26-4.52 N.M).

    CAUTION: Do not over-tighten the contact assembly, as over-tightening will result in a failed and/or leaking assembly.

    Discard the remaining small diameter o-ring and the plain wire “C” type snap ring. Do not confuse the “C” ring with the Tru-Arc type snap ring which will be installed later on the power piston shaft.

Snap Ring Contact Assembly

If the contact assembly requires a snap ring to secure it in the booster housing, lubricate and install the smallest of the two remaining o-rings on the contact assembly. Install the contact assembly in the booster housing and install the "C" type snap ring to secure it. Make certain that the "C" type snap ring is **FULLY SEATED** in its groove. Discard the last remaining o-ring.

12. Install the return spring on the output shaft of the power piston, small end first.
13. Lubricate the lip seal and o-ring in the I.D. of the filter and end cap assembly and install on the piston shaft. To prevent damage to the lip seal in the end cap assembly, install a fabricated seal bullet on the end of the shaft and depress the end cap onto the shaft until the snap groove on the piston shaft is exposed. Install the Tru-Arc type snap ring on the piston shaft making certain the snap ring is fully seated in its groove.

    NOTE: It is strongly recommended that a fabricated seal bullet tool be used to install the filter and end cap assembly; however, in an emergency plastic electrical tape can be applied to the end of the shaft. The tape must be applied in such a way that it covers the snap ring groove and forms a smooth forcing surface for the lip of the seal. If this method is used, make certain that all tape fragments and adhesive residue are removed from the assembly. Adhesive residue may be removed with clean alcohol. Relubricate with clean power steering fluid.
14. Install the poppet valve return spring in the hollow end of the power piston and then install the poppet valve. MAKE CERTAIN the poppet valve is installed with the cone shaped end toward the return spring. Refer to Figure 7 for proper assembly.
15. Install the valve rod and reaction piston assembly in the hollow end of the power piston. Insert the reaction piston end in the power piston first.
16. IMPORTANT: The next phase of assembly will depend upon the type of input plug in use on the power piston. If the aluminum plug is in use, proceed to Step 17. If the input plug is blue plastic, proceed to Step 19. THE PLASTIC AND ALUMINUM PLUGS ARE **NOT** INTERCHANGEABLE.
17. Screw the input plug and push rod assembly into the power piston and hand tighten. Gently clamp the input plug flats in the jaws of a vise and firmly **HAND** tighten the power piston and plug until seated. DO NOT USE TOOLS TO TIGHTEN.
18. Lubricate the exterior of the input plug and power piston input shaft. Insert the power piston in the booster housing with a gentle twisting motion to start the input plug on its way through the two lip seals in the small diameter of the booster housing bore. Proceed to Step 21 of the assembly instructions.
19. Install a seal bullet (Bendix tool 74015) over the open end of the power piston input shaft and lubricate the bullet and shaft. Install the power piston using the seal bullet to start the piston shaft through the two lip seals in the booster housing.

    NOTE: While it is strongly recommended that a seal bullet be used to install the power piston, in an emergency the following alternate method may be of use.

    Install the blue plastic input plug in the hollow end of the power piston and tighten by hand. Wrap plastic electrical tape around the input plug so that a smooth forcing surface is formed for the two lip seals in the booster housing. Make certain that the tape is **not** wrapped on any portion of the major diameter of the plug or shaft. After installing the power piston, inspect the tape. If fragments of the tape are missing, remove the power piston from the booster housing. Remove all tape fragments and use a seal bullet to reinstall.
20. Install the blue plastic input plug and firmly **HAND** tighten until seated. DO NOT USE TOOLS TO TIGHTEN.
21. Lubricate and install the two oval face seals in the grooves of the electric motor pump assembly.
22. Before installing the electric pump motor assembly on the booster housing, check to be sure that the motor pump check ball and retainer is present in the delivery port. Secure the pump to the housing using two cap screws. Torque the cap screws to 18-25 foot pounds (24.4 - 33.9 N.M).

    CAUTION: The electrical pump motor assembly CAN BE INCORRECTLY installed. The pump motor **MUST** be installed with its delivery port closest to the input push rod end of the booster housing. The position of the inlet and return ports on the booster housing should have the same relationship to the delivery and return of electric pump motor assembly. A check ball is visible in the delivery port of the electric pump motor. Do not mar the mating surfaces when installing the pump motor on the booster housing. Refer to Figure 7 for proper orientation.
23. Install the boot on the input push rod.
24. If the optional electrical relay is in use, secure it to the booster housing using two cap screws. Torque the cap screws to 35-50 inch pounds (4.0 - 5.6 N.M).

INSTALLATION

1. Mount the Hydro-Max on the vehicle using four bolts. Torque the mounting bolts to 18-25 foot pounds (24.4 - 33.9 N.M).
2. Install the vehicle master cylinder on the Hydro-Max and torque the four cap nuts to 25-30 foot pounds (33.9- 40.7 N.M). **CAUTION: DO NOT OVER OR UNDER TIGHTEN!**
3. Reconnect the vehicle inlet and return hoses to the Hydro-Max. Torque the inlet hose fitting to 16-25 foot pounds (21.7 - 33.9 N.M). Do not overtighten the inlet hose - stripping of the aluminum booster housing will result.

4. Reconnect the vehicle electrical power lead to the pump motor. Reconnect the vehicle electrical lead to the flow switch contact assembly. If the optional relay was used, reconnect the lead from the pump motor to the relay, if removed, and connect the vehicle power lead to the relay. Firmly reconnect the plastic pin connector to the relay.
5. Reconnect the vehicle's negative lead to the battery.
6. Before placing the vehicle in service, perform the Refilling & Bleeding and Check Out procedures.

REFILLING & BLEEDING HYDRO-MAX

NOTE: **DO NOT USE BRAKE FLUID:** Use only clean power steering fluid.

1. Check hydraulic pump or power steering pump reservoir supplying Hydro-Max and fill with clean power steering fluid.
2. Crank engine several revolutions. (Do not start engine.) Check pump reservoir and refill if necessary.
3. Again crank engine several revolutions. (Do not start engine.) Check pump reservoir and refill if necessary.

CHECK OUT BRAKE SYSTEM

Before moving vehicle, check the system for correct operation.

1. With engine off depress the brake pedal. The warning light and/or buzzer should come on and the electric motor should run giving you some brake assistance.
2. Start the engine. Depress the brake pedal. No warning lights or buzzer or electric motor should come on. Check for leaks.
3. Refer to operational information, Pages 7-11, or vehicle's service manual to perform a more comprehensive check of system integrity.
4. Stop the engine, check the fluid level in power steering pump reservoir. Add fluid if necessary.