

Chapter 6

Hydraulic System

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The hydraulic system generates, directs, and controls the pressure and flow of the hydraulic fluid within the power steering system. This system is comprised of a pump, steering gear, fan motor, fluid reservoir, oil cooler, fan control valve and interconnecting system lines and hoses.

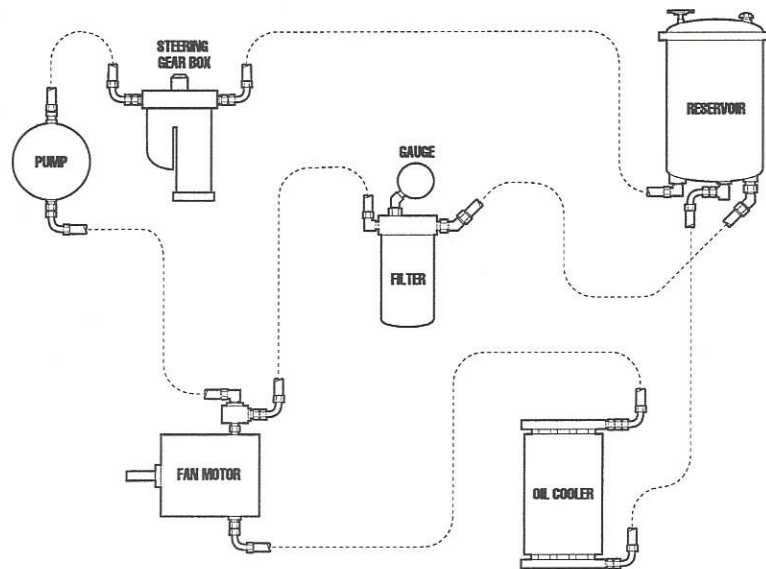


Figure 6.1. Hydraulic System Schematic

HYDRAULIC PUMP

The hydraulic pump on the Gillig chassis serves two purposes: operation of the power steering gear and operation of the hydraulic fan motor on the radiator.

CAUTION
DO NOT operate the hydraulic pump without fluid in the pump reservoir.

A priority valve inside the hydraulic pump is used to ensure that fluid flow to the steering gear is always available in sufficient quantity to enable the steering gear to operate. When sufficient additional flow is available, fluid is diverted to the cooling fan. The hydraulic fluid from the fan is also circulated through an externally mounted oil cooler on its way back to the reservoir.

HYDRAULIC FAN DRIVE SYSTEM

The cooling system on your Gillig chassis consists of a radiator, the hydraulic fan drive system, and the piping necessary to move the coolant from the engine to the radiator and back (see Figure 6.2) Refer to cooling system section of Chapter 1 for non-hydraulic components information

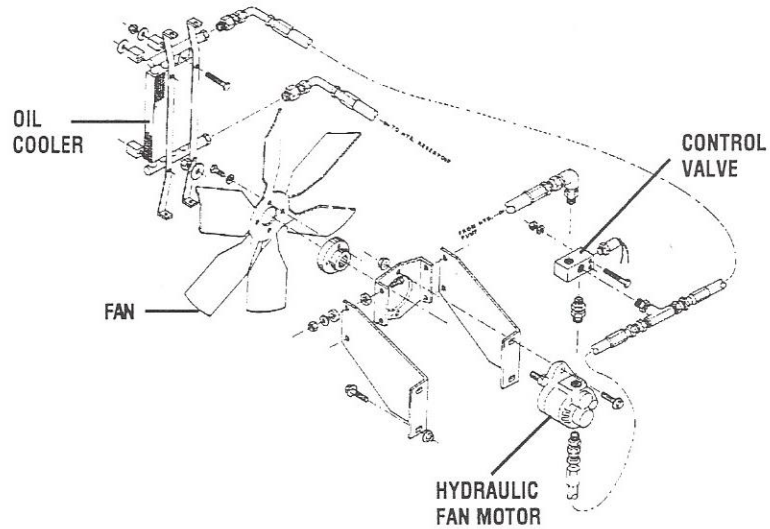


Figure 6.2. Hydraulic Fan and Motor

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Hydraulic Fan Operation

WARNING

The fan can start without warning whenever the engine is running.

The radiator fan is hydraulically driven and operates only on demand from the engine cooling system. When the engine coolant temperature is below 180°F, the fan control valve is energized and fluid flows through the valve to the hydraulic fluid filter and back to the reservoir. A small amount of fluid will flow to the fan motor and the fan may turn, but the speed will not vary up or down with the throttle speed.

When the coolant temperature reaches approximately 180°F, the temperature switch on the fan control valve de-energizes the valve. The hydraulic fluid then flows to the fan motor before traveling through the cooler and returning to the hydraulic reservoir. At this temperature, the fan should speed up and slow down as the engine accelerates and decelerates. When the engine coolant temperature falls to approximately 170°F, the control switch closes (energizes) the control valve and diverts the main flow of hydraulic fluid away from the fan motor.

The hydraulic pump supplies approximately four gallons per minute at all times to the power steering gear. Although the power steering gear always has priority over the fan motor, additional flow is available to be diverted to the fan motor.

The hydraulic system reservoir and filter are located in the right side of the engine compartment (Figure 6.3). The reservoir holds approximately nine quarts of fluid. Check the hydraulic fluid daily. The dipstick is removed by unscrewing the cap and pulling the dipstick out. If the fluid level is at the ADD mark, approximately one quart will be required to restore the reservoir to the FULL level. All hoses and fittings should be checked for leakage and the filter changed every 6,000 miles.

NOTICE

Some installations omit the filter. In this case the fluid flows thru the cooler and back to the reservoir, as it does when the motor is running

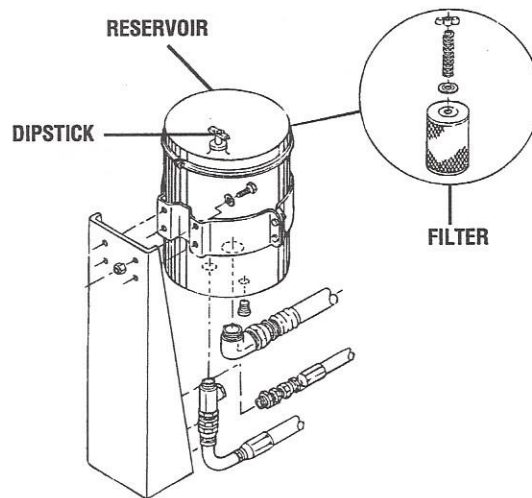


Figure 6.3. Hydraulic Reservoir and Dipstick

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HYDRAULIC SYSTEM INSPECTION

The power steering gear, the hydraulic pump, motor, and fan control valve should be periodically wiped clean and inspected for leaks. If you suspect leakage, follow the guidelines listed below. In some cases you will be able to locate the leak easily, but seepage leaks may be more difficult to find.

1. With the coach engine off, wipe the complete power steering system dry (gear, pump, hoses, and connections).
2. Check the fluid reservoir and adjust to the proper level as required.
3. Start the engine and turn the steering wheel from stop to stop several times. Do not hold the wheel at full corner for any length of time. Doing so can damage the hydraulic pump.
4. Find the exact point of the leakage.

Some leaks can be corrected easily (see **Quick Fixes**). If leaks are discovered that are not the result of loose or defective fittings, the problem should be referred to an authorized service facility for diagnosis and correction.

HYDRAULIC SYSTEM QUICK FIXES

The fluid in the steering system expands as it is heated during normal operation. If the system is overfilled, the excess may be forced through the filler cap hole and may be sprayed about the engine compartment by fan air blast. To diagnose and correct the problem, operate the engine and steering system until normal operating temperature is obtained. Then shut down the engine and remove the reservoir cap to check the graduated level on the dipstick. Adjust the fluid level as required. Retighten the reservoir cap snugly but do not over-tighten. An over-tightened reservoir cap will not be vented.

CAUTION

The hydraulic system operates under high pressures. Make sure the engine is completely stopped prior to removing the reservoir cap to check the fluid level. Also ensure that the cap is tightly screwed down after the level is corrected.

The hydraulic cap and components will be HOT after running the system. Precautions should be taken to avoid burns.

Hydraulic lines are pressurized. Use extreme caution to avoid burns or injury caused by broken or spewing lines.

Seepage at the hose connections may be due to loose connection nuts. If leakage is observed at hose connections and the nut is not cross threaded, tighten the nut to 30 ft lb of torque.

If either the pressure hose or the return hose leaks, replace the hose. After the source of a leak has been found and corrected, refill the system with fluid.

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear at the pitman shaft and stud shaft, and on the driveshaft of the pump. When leakage occurs at one of these areas, refer the problem to a qualified service facility for repair. Complete service instructions for the steering gear can be obtained from Gillig Corporation Publications Department.

When filling, checking, or adjusting the fluid level in the system, be sure to thoroughly clean the hydraulic reservoir cap before removing it. This will prevent dirt from getting into the system. Do not add fluid from containers which could have been contaminated. Use of previously unopened containers of fluid is recommended when possible. Use only recommended fluid, Dexron II®, to fill or adjust the level of the system.

When any hose has been disconnected or when fluid has been lost or replaced for any reason, the system must be bled. Follow instructions provided in this chapter to bleed the hydraulic system.

BLEEDING THE HYDRAULIC SYSTEM

Air in the hydraulic fluid system causes spongy action and noisy operation. When any hose has been disconnected, or power steering gear, hydraulic pump, fluid reservoir or in-line filter has been removed, the hydraulic system must be bled before returning the vehicle to operation. The system should also be drain and bled if air is indicated or if adjustments are made to the system.

Bleed the system as follows:

1. Fill power steering pump reservoir to "Full" mark on dipstick. Let the fluid stand undisturbed for 2-3 minutes.
2. Disconnect the drag link from the pitman arm or raise the front end of the coach until the front wheels are off the ground.

3. Turn the front wheels to right and left wheel stops to eliminate air pockets in the power steering gear and hydraulic system. Continue turning the wheels while keeping the fluid level in the reservoir to the "Full" level until the fluid in the reservoir stops bubbling.
4. Start and run the engine at idle for 2–3 minutes. Turn the front wheels right and left but **DO NOT** hit the wheel stops. Maintain the "Full" fluid level in the pump reservoir. Check the system lines and connections for leaks. Continue this procedure until the reservoir fluid is clear and free of bubbles.
5. Increase the engine speed and run at half throttle until all air bubbles cease to appear in the reservoir. Turn the front wheels to the right and left without hitting the wheel stops.
6. Connect the drag link to the pitman arm or lower the coach to the ground and turn the wheels to the right and left while rechecking for fluid leaks.
7. Recheck fluid level in the reservoir and refill to the "Full" mark on the dipstick if necessary.

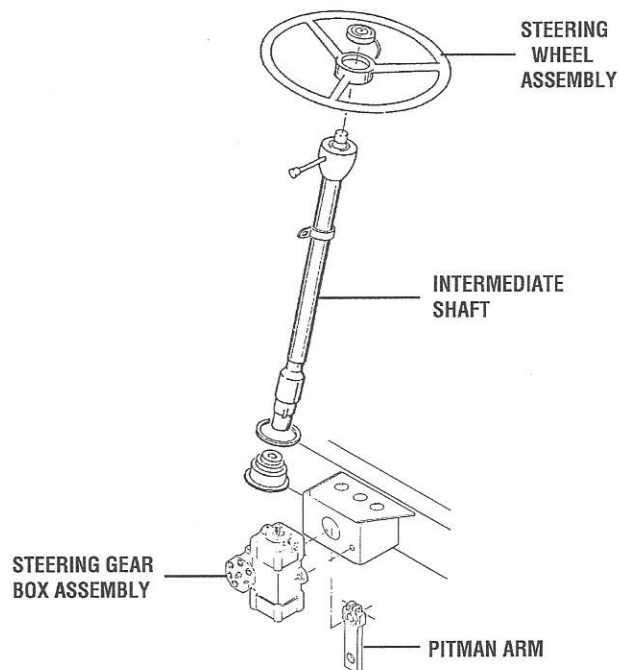


Figure 6.4. Power Steering System

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POWER STEERING SYSTEM

The steering system (Figure 3.4) consists of the steering linkage, power steering gear, pitman arm, drag link, tie rod, steering propeller shaft, shaft arm, steering column, and steering wheel. Turning the steering wheel causes the steering gear to change the direction of the front wheels through a series of mechanical linkages. The pressure of the hydraulic system reduces the effort needed for steering.

The hydraulic system components used to assist in steering consist of the hydraulic pump, and connecting hoses. The hydraulic fluid provided by the pump is controlled by valves within the steering gear to cause left or right turns.

The steering gear is the recirculating ball type, which provides for ease of handling by transmitting forces from the worm shaft to the pitman shaft through the use of ball bearings.

Power Steering System Inspection

The power steering system is dependent upon adequate fluid pressure and fluid flow to enable the steering gear to operate as designed. When diagnosing steering gear problems, back pressure and operating temperature should be considered. A clogged filter, undersized fittings and lines, pinched lines and high flow rates are possible causes of back pressure.

Conditions such as hard or loose steering, road shock, or vibrations are not always due to the steering gear or pump, but are often related to such factors as low tire pressure and poor front end alignment. These conditions should be checked and corrected before any adjustment or disassembly of the power steering gear or hydraulic pump is considered.

High system fluid temperatures caused by restricted flow or inadequate fluid capacity reduce overall efficiency of the hydraulic pump and power steering gear. For accurate results, check the power steering system fluid level after 2 hours of normal operation.

Visually check for presence of air mixed with fluid in the steering system. Power steering fluid should be clear. Any signs of frothing indicates air leaks in the system. The system must be drained and bled if inspection indicates air in the system (refer to Bleeding the Hydraulic System).

After the source of the malfunction has been found, determine the cause. For example, if the fluid level in the reservoir is found to be low, refill the reservoir and then check the entire hydraulic system for fluid leaks. Refilling the reservoir will not necessarily correct the problem, since low fluid may only be a symptom of another problem. Symptoms & Possible Causes are provided in the "Troubleshooting Steering Problems" section.

Power Steering System Maintenance

WARNING
DO NOT operate the hydraulic pump without fluid in the pump reservoir.

The power steering system requires minimal maintenance to keep the system functioning properly. To insure maximum performance, insure that the system is kept clean and free of air and debris.

The fluid level must be checked regularly and fluid added to the hydraulic pump reservoir whenever the level is at or below the "Add" mark on the dipstick.

When the slightest evidence of dirt, sludge or water is discovered in the system, disconnect the fluid lines to the power steering gear and drain the system. After refilling the system with fluid, bleed the system of air following the procedure provided in the Bleeding the Hydraulic System section of this chapter.

Power Steering System Troubleshooting

Symptoms

Possible Causes

- | Symptoms | Possible Causes |
|-----------------|--|
| I. Road Wander | <ul style="list-style-type: none"> • Tire pressure incorrect or unequal left to right. • Components in steering linkage loose or worn. • Wheel bearings improperly adjusted or worn. • Front end out of alignment. • Steering gear mounting bolts loose on frame. • Steering gear improperly adjusted. |
| II. No Recovery | <ul style="list-style-type: none"> • Tire pressure low. • Front end alignment incorrect. • Tight front axle king pins. • Steering column binding. • Pump flow insufficient. • Steering gear improperly adjusted. • Steering gear control valve sleeve sticking. |
| III. Shimmy | <ul style="list-style-type: none"> • Badly worn or unevenly worn tires. • Improperly mounted tire or wheel. • Wheel bearings improperly adjusted or worn. • Components in steering linkage loose or worn. • Wheels or brake drums out of balance. |

- IV. Oversteering
 - Front end alignment incorrect.
 - Air in hydraulic system.
- IV. Oversteering
 - Front end components binding or loose.
 - Steering column binding.
 - Steering gear improperly adjusted.
 - Steering gear control valve sleeve sticking.
- V. High Steering Effort in One Direction
 - Unequal tire pressure.
 - Vehicle overloaded.
 - Inadequate hydraulic system pressure.
- VI. High Steering Effort in Both Directions
 - Low tire pressure.
 - Vehicle overloaded.
 - Low hydraulic fluid level.
 - Low pressure or flow from pump.
 - Steering system components binding.
 - Restriction in return line or line too small in diameter.
- VII. Lost Motion at the Steering Wheel
 - Steering wheel loose in shaft.
 - Steering gear loose on frame.
 - Pitman arm loose on output shaft.
 - Components in steering linkage loose or worn.
 - Steering gear improperly adjusted.
- VII. Excessive Heat (50°F (65.6°C) Over Ambient)
 - Excessive pump flow.
 - Vehicle overload.
 - Undersized replacement hose or line.
 - Restricted hose or line.

CAUTION

If the hydraulic system fluid becomes overheated, the seals in the steering gear and pump may shrink, harden or crack, and lose their sealing ability.