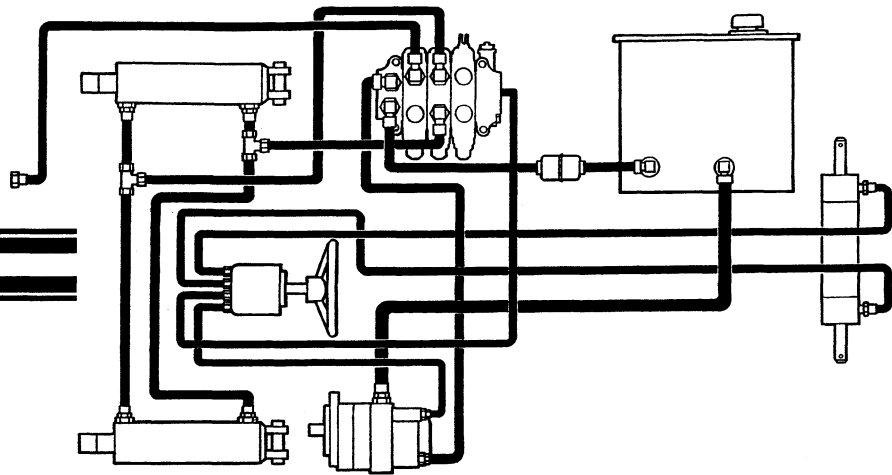


# HYDRAULIC SYSTEM

H2.00-3.20XM (H40-65XM)  
S2.00-3.20XM (S40-65XM)



# ***HYSTER***

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This section is for the following models:

H2.00-3.20XM (H40-65XM)

S2.00-3.20XM (S40-65XM)

# INTRODUCTION

## GENERAL

This section has a description of the hydraulic system and the gear pump assembly. Procedures for the repair of the gear pump assembly are also in this section. Repair information for the parts of the steering system are in the sections **THE STEERING AXLE, 1600 SRM 316** and **THE STEERING CONTROL UNIT, 1600 SRM 512**. Information on the control valve is in the section **MAIN CONTROL VALVE, 2000 SRM 516**. Information for pump drive assembly is in **THE TRANSMISSION- REPAIRS, 1300 SRM 501**. The CHECKS

AND ADJUSTMENTS and TROUBLESHOOTING for the gear pump assembly are at the end of this section.

## DESCRIPTION

### Hydraulic System (See FIGURE 1.)

The hydraulic system has the following parts: hydraulic tank, gear pump assembly, steering control unit, main control valve, lift cylinders, tilt cylinders, steering cylinder, oil filter and breather. The steering system and the lift and tilt system are separate circuits of the hydraulic system. Both circuits use a common hydraulic tank and gear pump. A breather at the top of the tank lets air into the hydraulic tank.

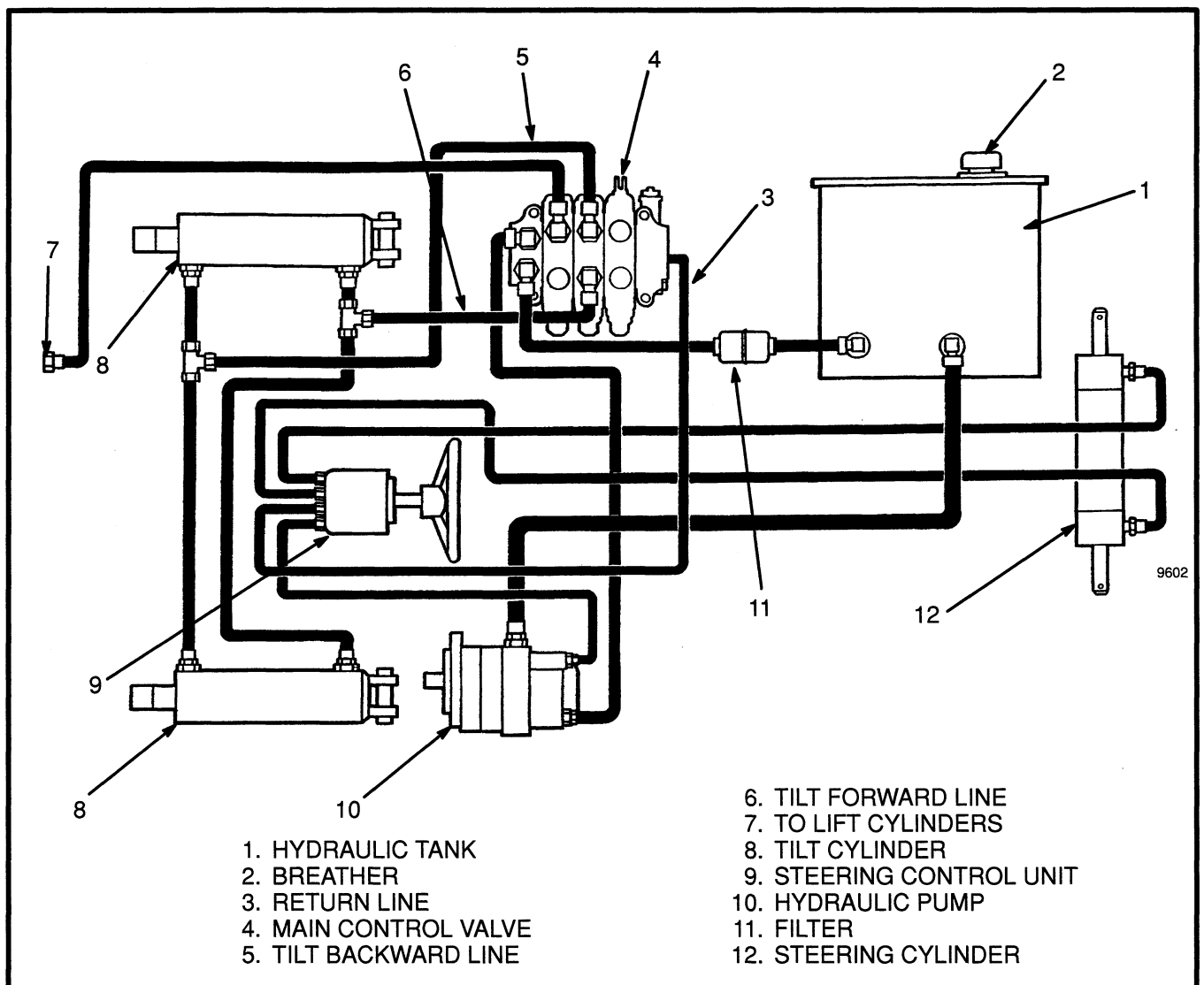


FIGURE 1. HYDRAULIC SYSTEM (1 of 2)

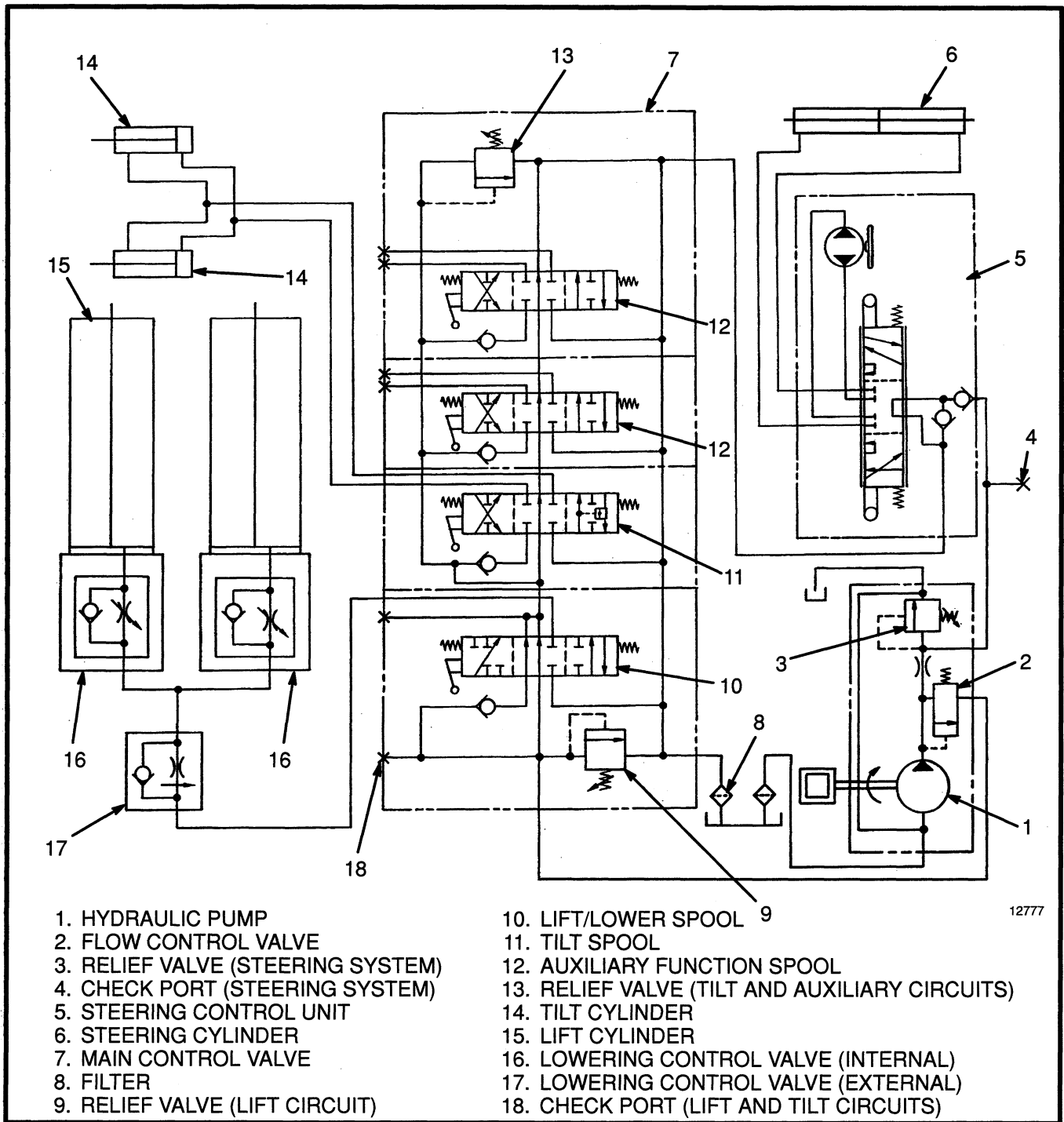


FIGURE 1. HYDRAULIC SYSTEM (2 of 2)

**Gear Pump Assembly (See FIGURE 2.)**

The gear pump assembly includes the gear pump, a flow control valve and a relief valve. The gear pump can have either one or two sets of gears. The pump with two sets of gears reduces hydraulic noise. The flow control valve and a relief valve are in the end housing of the pump. The inlet is in the side of the pump body. The pump out-

let connects directly to the end housing and the flow control valve. The flow control valve has the outlet for the primary flow and the outlet for the secondary flow. The primary flow is for the steering circuit. Flow from the relief valve goes to the pump inlet through an internal passage. Seals prevent leaks between sections to outside of the pump.

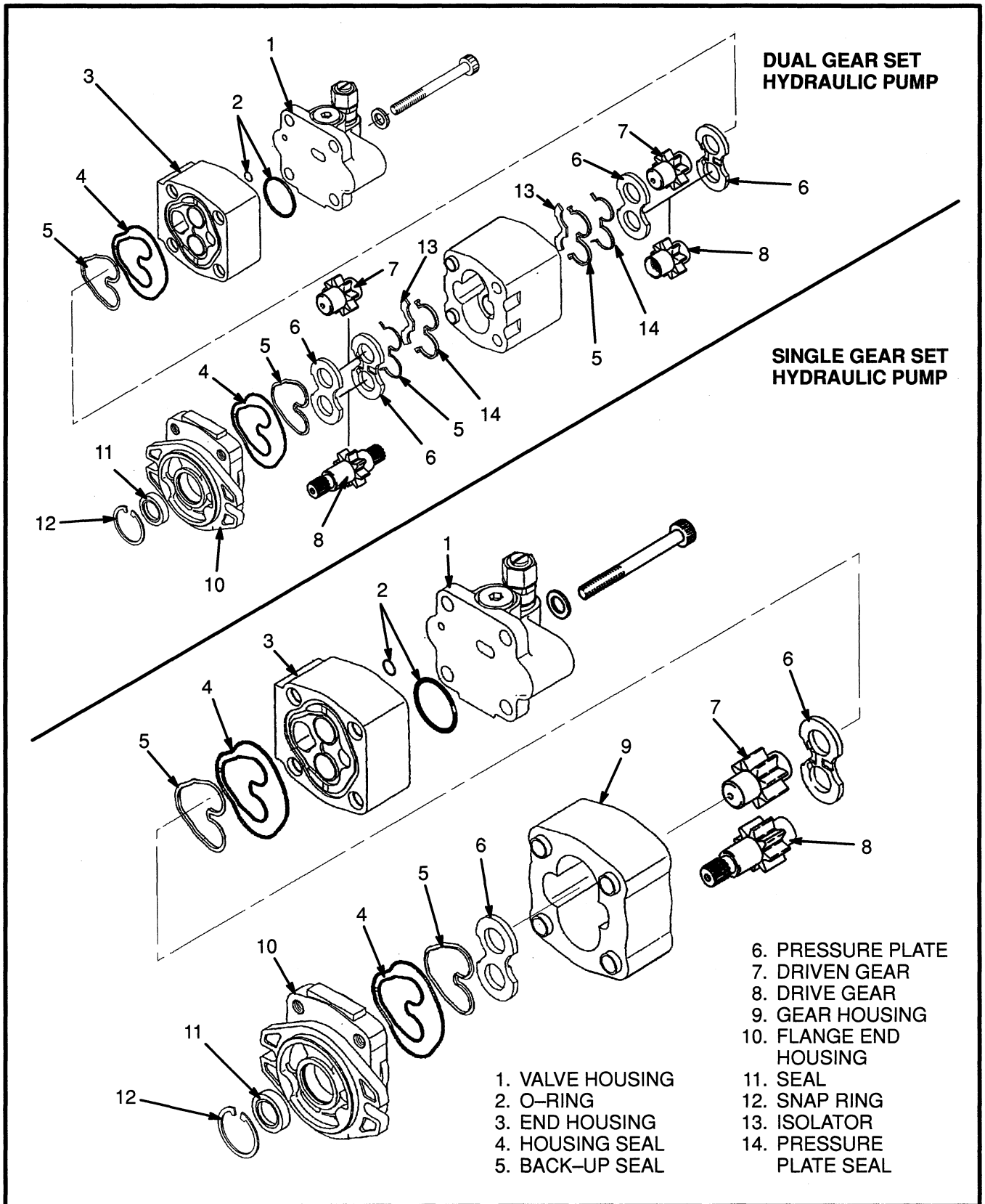


FIGURE 2. GEAR PUMP ASSEMBLY

The gear pump is driven by a chain drive arrangement in the transmission. The drive sprocket for the pump drive is connected by splines to the hub of the torque converter. The drive sprocket, in turn, drives the chain, the pump sprocket and the gear pump. See FIGURE 5.

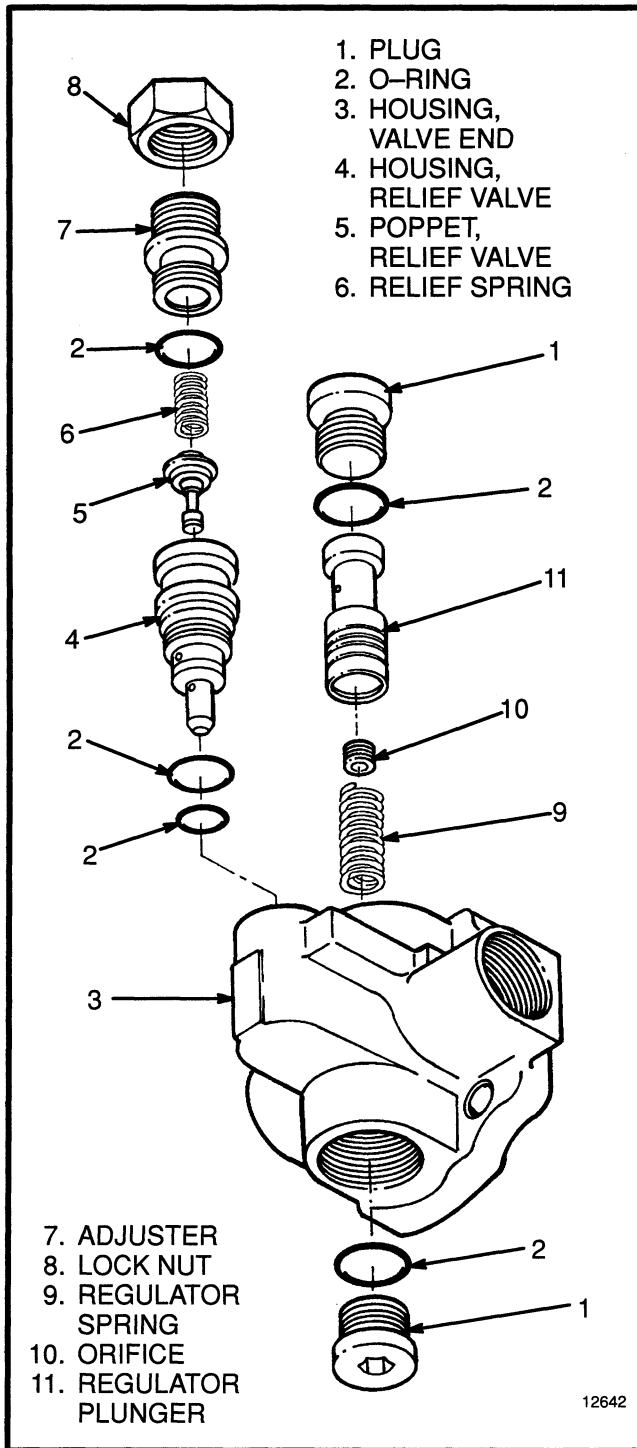


FIGURE 3. FLOW CONTROL VALVE AND RELIEF VALVE PARTS

### Flow Control Valve (See FIGURE 3.)

The flow control valve makes sure the steering system has a constant supply of oil. The flow control valve has a spring, a plunger with an orifice, and two plugs with O-rings. The spring keeps the plunger in the correct position. Oil pressure can move the plunger and compress the spring. The plugs keep the plunger and spring in the bore and also keeps the oil in the correct chamber. O-rings are used on the plugs and the plunger.

### Relief Valve (See FIGURE 3.)

The relief valve for the steering system is in a bore in the end housing of the gear pump. The relief valve prevents the oil pressure in the steering system from increasing above specifications. The relief valve has the following parts: a relief valve housing, a poppet, a spring, an adjuster, a lock nut and O-rings. The position of the adjuster and the amount of compression of the spring determine the relief pressure. When the adjustment is correct, the lock nut will hold the adjuster in the correct location and O-ring will seal the adjuster against the relief valve housing.

### OPERATION

#### Hydraulic System (See FIGURE 1.)

The gear pump sends oil flow to the steering system and the lift and tilt system. The gear pump receives oil from the hydraulic tank through a screen at the outlet of the tank. The oil from the pump flows directly to the flow control valve. The flow control valve supplies a constant supply of oil to the steering system. This quantity of oil flow is controlled by the steering control unit to operate the steering cylinder. The relief valve on the gear pump assembly limits the pressure in the steering system.

The secondary flow from the pump goes to the main control valve. This valve controls the flow of oil to the lift, tilt and any auxiliary functions. A relief valve in the main control valve limits the pressure in the hydraulic system. Test ports permit checking the relief pressures of each system. The location of the test ports is shown in FIGURE 1. The oil returning from the main control valve flows through a filter in the return line to the hydraulic tank.

### Gear Pump (See FIGURE 2. and FIGURE 4.)

The two gears in the pump have their teeth engaged in the center of the pump body. The gears have close toler-

ances between themselves and the pump body When the input shaft is turned, the drive gear turns the driven gear. The tolerances and seals make tight chambers between the gear teeth. When the teeth of each gear move apart at the inlet port, they make a vacuum. Oil from the tank enters the inlet port and is moved by the gear chambers around the circumference. Passages opposite the inlet connect the gear chambers for outlet oil flow to the flow control valve. Oil at the inlet flows through bores and passages in the bushings to both sides of each bushing. Oil lubricates the bushings and the gear surface of each bushing. Other bores and passages in the bushings let the outlet oil go to the sides of the bushings away from the gears. The passages also let this outlet oil flow to the side of the inlet circumference of each bushing. The pressure on each bushing is kept equal by the passages and the oil.

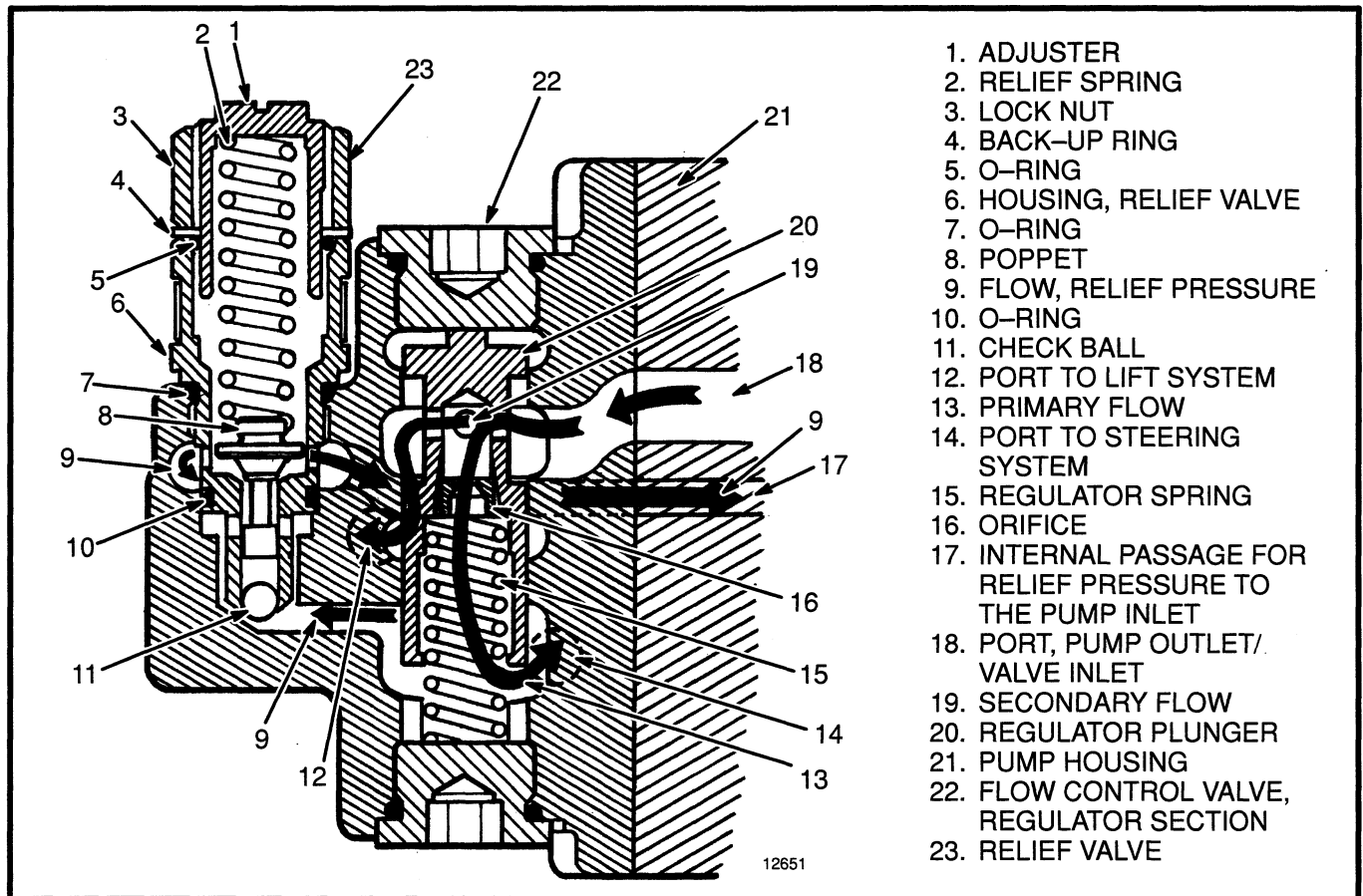
### Flow Control Valve (See FIGURE 4.)

The oil at the outlet of the gear pump enters the valve chamber near the center of the plunger. The oil flows

through the orifice in the plunger to the steering system port. This oil also flows to the relief valve. If the oil flow at the pump outlet is more than the primary flow for the steering system, the plunger will move. This plunger movement connects part of the oil flow to the lift and tilt system port. The plunger will also move back and decrease or stop the flow of oil to the lift and tilt system if the pump flow decreases. The plunger keeps moving to make sure the steering system always has a constant supply of oil.

### Relief Valve (See FIGURE 4.)

The pressure in the steering system is sensed at the relief valve (23). If the pressure increases to the relief valve setting, the poppet (8) in the relief valve will move against the spring (2). When the poppet moves off the seat, oil flows through an internal passage (17) that directs the oil flow to the pump inlet to decrease the pressure. The decrease in pressure lets the spring return the poppet back to the seat.



1. ADJUSTER
2. RELIEF SPRING
3. LOCK NUT
4. BACK-UP RING
5. O-RING
6. HOUSING, RELIEF VALVE
7. O-RING
8. POPPET
9. FLOW, RELIEF PRESSURE
10. O-RING
11. CHECK BALL
12. PORT TO LIFT SYSTEM
13. PRIMARY FLOW
14. PORT TO STEERING SYSTEM
15. REGULATOR SPRING
16. ORIFICE
17. INTERNAL PASSAGE FOR RELIEF PRESSURE TO THE PUMP INLET
18. PORT, PUMP OUTLET/ VALVE INLET
19. SECONDARY FLOW
20. REGULATOR PLUNGER
21. PUMP HOUSING
22. FLOW CONTROL VALVE, REGULATOR SECTION
23. RELIEF VALVE

FIGURE 4. OPERATION OF THE FLOW CONTROL VALVE AND RELIEF VALVE

# REPAIR

## GEAR PUMP ASSEMBLY

**NOTE:** Worn or damaged seals are the most common cause of pump damage. The pump bushings, gears and shafts also wear. They must be checked during disassembly. Do not make any repairs to the parts. To prevent more failures, always replace parts that are worn or damaged. If several main parts need replacing, replace the complete group.

### Removal and Disassembly (See FIGURE 2., FIGURE 3. and FIGURE 5.)

1. If necessary, put a drain pan under the hydraulic tank. Disconnect the return line at the bottom of the tank. Drain the oil from the tank. The drain pan must have capacity of approximately 30 litres (8 gal).

2. Put a drain pan under the pump assembly. Put tags on the hydraulic lines for correct connections during installation. Remove all hydraulic lines connected to the pump assembly. Put caps on all the fittings and ports.

3. Hold the pump assembly to keep it from falling. Remove the two capscrews and the washers that fasten the pump to the transmission housing. Remove the pump assembly.

4. Put the pump body in a vise. Do not damage the inlet port. Put an alignment mark on the valve end housing and the pump body.

5. Remove the capscrews that hold the pump together. Remove the flange end housing. Remove the valve housing. Do not let the seals and gears fall.

6. Make a note of the position of the seals. Carefully remove the oil seals, pressure plates and gears from the housings. Remove the snap ring and shaft seal from the flange end housing.

7. Check the parts for wear and damage.

**NOTE:** If the lock nut is not removed from the adjuster, the relief valve setting will not change.

8. See FIGURE 3. Remove the plugs and O-rings at each end of the flow control valve. Remove the regulator plunger and spring.

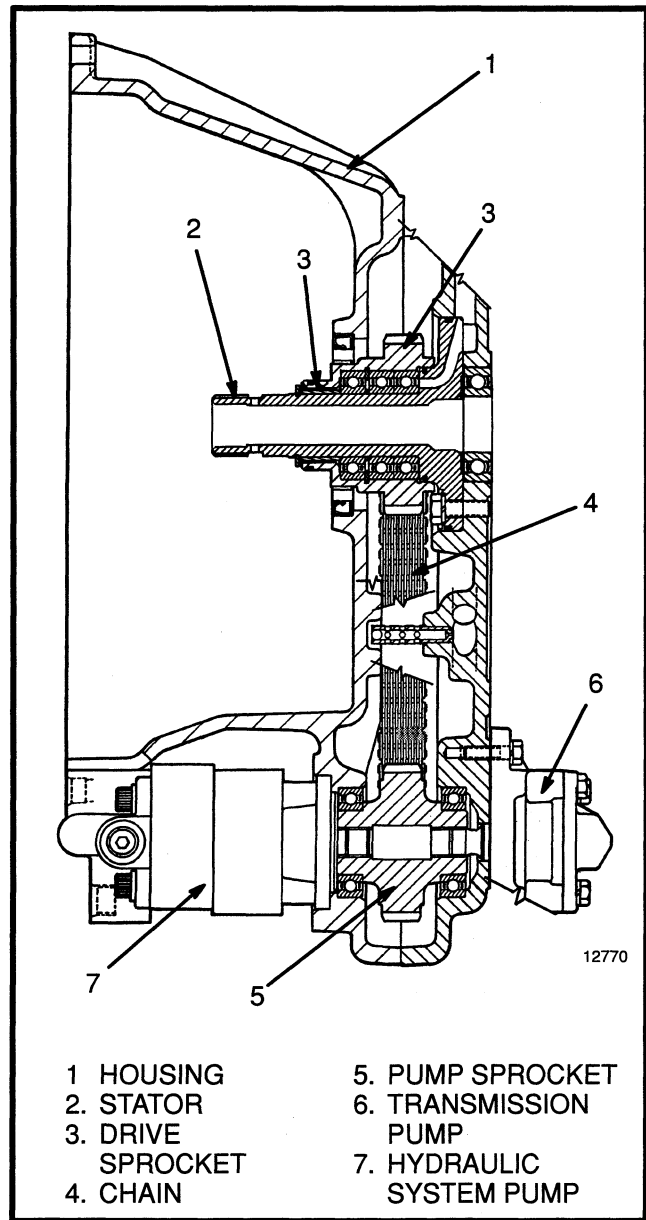


FIGURE 5. PUMP DRIVE ARRANGEMENT

9. See FIGURE 3. Remove the lock nut (8) from the adjuster (7). Remove the adjuster and parts of the relief valve. Remove the relief valve housing (4).

### Assembly and Installation (See FIGURE 2., FIGURE 3. and FIGURE 5.)

1. Put oil on all parts of the pump and valves. Use the hydraulic oil shown in the **PERIODIC MAINTENANCE** section. Make sure to keep the parts clean.

2. See FIGURE 3. Install the bottom plug and O-ring for the regulator plunger (11). Install the orifice (10) in



the regulator plunger. Install the spring (9) and regulator plunger (11) in the housing. Install the O-ring and plug at the top of the housing.

3. See FIGURE 3. Install the O-rings on the relief valve housing (4). Install the relief valve housing in the valve end housing. Install the relief valve poppet (5) and spring (6). Install the O-ring, adjuster (7) and lock nut (8). Do not tighten the adjuster or lock nut until the setting is adjusted as described in CHECKS AND ADJUSTMENTS.

4. Use new seals and install the pressure plates and gears. Make sure to install the pressure plates as removed during disassembly. See the notes made during disassembly. Make sure all seals are complete and in the correct positions.

5. Make sure the dowels are installed in the end that has the drive shaft and on the side that has the inlet. Install a new oil seal in the flange end housing. Put tape on the drive shaft splines and carefully install the flange end

housing. Do not move the pressure plates. Make sure the seals do not move out of the correct position.

6. Carefully install the valve end housing on the pump body using the four capscrews and lock washers. Make sure the pressure plates do not move and that the seals stay in the correct position. Make sure the marks made during disassembly are aligned. Tighten the capscrews to 46 to 49 Nm (34 to 36 lb<sub>f</sub> ft) torque.

7. Put a liquid gasket material on the pump flange. Hold the pump in the correct position on the engine. Install the capscrews and washers that fasten the pump to the transmission housing.

8. Connect the hydraulic lines as shown by the tags. Do not tighten the inlet fitting. Fill the tank using the hydraulic oil shown in the **PERIODIC MAINTENANCE** section. Let some of the oil run out around the pump inlet fitting. Tighten the fittings. This procedure will make sure the pump has oil for first operation.

9. Adjust the steering relief setting as described in CHECKS AND ADJUSTMENTS.

## CHECKS AND ADJUSTMENTS

**NOTE:** Adjust the relief pressure for the lift and tilt system as described in the section for the **MAIN CONTROL VALVE, 2000 SRM 516**.

### CHECK AND ADJUST STEERING RELIEF PRESSURE (See FIGURE 1. and FIGURE 4.)

1. Connect a tachometer to the engine.
2. Connect a gate valve and pressure gauge to the test port located at the tee fitting. The tee fitting is on the inlet line near the steering control unit.
3. Operate the engine at 700 rpm. Operate the hydraulic system until the oil temperature is 55 to 65°C (130 to 150°F). Turn the steering wheel to the stop and hold it in that position.
4. Check the gauge. The correct pressure is 10.6 to 11.7 MPa (1545 to 1700 psi).

5. If the pressure is less than the specifications, loosen the lock nut (3) and turn the adjuster (1) for the relief valve clockwise. See FIGURE 4. If the pressure is higher than the specification, turn the adjuster counterclockwise. After the setting is correct, hold the adjuster and tighten the lock nut.

6. Remove the pressure gauge, gate valve and tachometer. Install the test port cap.

### CHECK GEAR PUMP FOR CORRECT FLOW

**NOTE:** Make sure the hydraulic oil is at operating temperature 35 to 65°C (100 to 150°F).

1. Install a flow meter in the outlet line of the gear pump. Follow the manufacturer's recommended procedure for operation.
2. Check the output of the gear pump. The correct rate for the priority flow is 10.0 litre/min (2.64 gal/min).

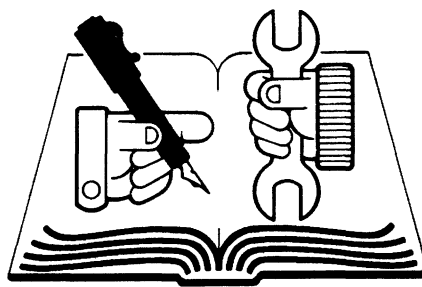
## TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE
The pump makes too much noise.	The oil level is low or there is no oil in the tank.
	The suction screen has a restriction.
	The inlet fitting is loose.
	The bearings or gears have damage.
	The capscrews that hold the pump together are loose.
	The pump is loose at the transmission.
The output of the pump is less than specifications.	The shafts or gears have damage.
	The seals or gaskets have leaks.
	The fittings at the pump have leaks.
	The capscrews that hold the pump together are loose.
	The flow control valve is damaged.
	The relief valve is not adjusted correctly.
The pump has leaks.	The fittings on the pump are loose or damaged.
	The capscrews that hold the pump together are loose.
	The seals in the pump are damaged.
The pressure for the steering system is below specifications.	The relief valve is not adjusted correctly.
	The relief valve is damaged.
	The pump is worn.
The flow for the steering system is below specifications.	The flow control valve is damaged.
	The relief valve is not adjusted correctly.

# SAFETY PRECAUTIONS

## MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure that all slings, chains or cables are correctly fastened and that the load being lifted is balanced. Make sure that the crane, cables and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand. Use a lifting mechanism.
- Wear safety glasses.
- **DISCONNECT THE BATTERY CONNECTOR** before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See “How To Put The Lift Truck On Blocks” in the **OPERATING MANUAL** or the **PERIODIC MAINTENANCE** section.
- Keep the unit and working area clean and in order.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure that all nuts, bolts, snap rings and other fastening devices are removed before using force to remove parts.
- Always fasten a **DO NOT OPERATE** sign to the controls of the unit when making repairs or if the unit needs repairs.
- Make sure you follow the **DANGER, WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), and Diesel are flammable fuels. Make sure that you follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area has ventilation.



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