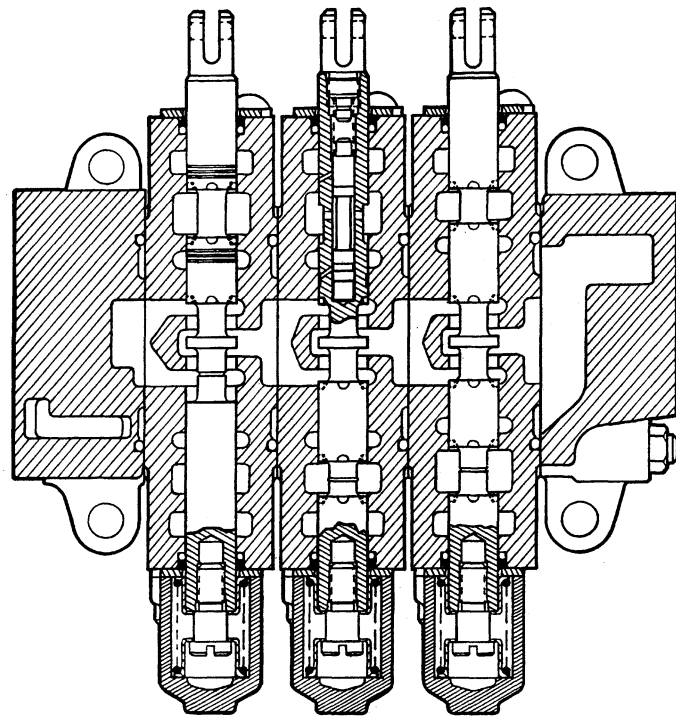


MAIN CONTROL VALVE

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



HYSTER

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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This section is for the following models:
S/H2.00-3.20XM (S/H40-65XM)

**"THE
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**HYSTER
APPROVED
PARTS**

INTRODUCTION

GENERAL

This section has a description and the repair procedure for the main control valve.

DESCRIPTION

The main control valve controls the operation of the lift, tilt, and auxiliary cylinders. The main control valve is installed to the right of the operator's seat. It is fastened to a bracket on the frame of the lift truck. The main control valve has the following sections (See FIGURE 1.):

- inlet section with the primary relief valve
- outlet section with the secondary relief valve
- lift and lower section

- tilt section
- auxiliary section(s)

The sections are held together with three through bolts.

Each function of the main control valve is made as a separate section having a spool and valve body. Each valve body casting is the same. The control spools are different for each function. Other sections are added to the main control valve to control optional auxiliary functions.

Each spool has a spring that returns the spool to the neutral position when the control lever is released. Each valve section has a check valve in the valve body. The check valve and spring is held in the valve body by the next section.

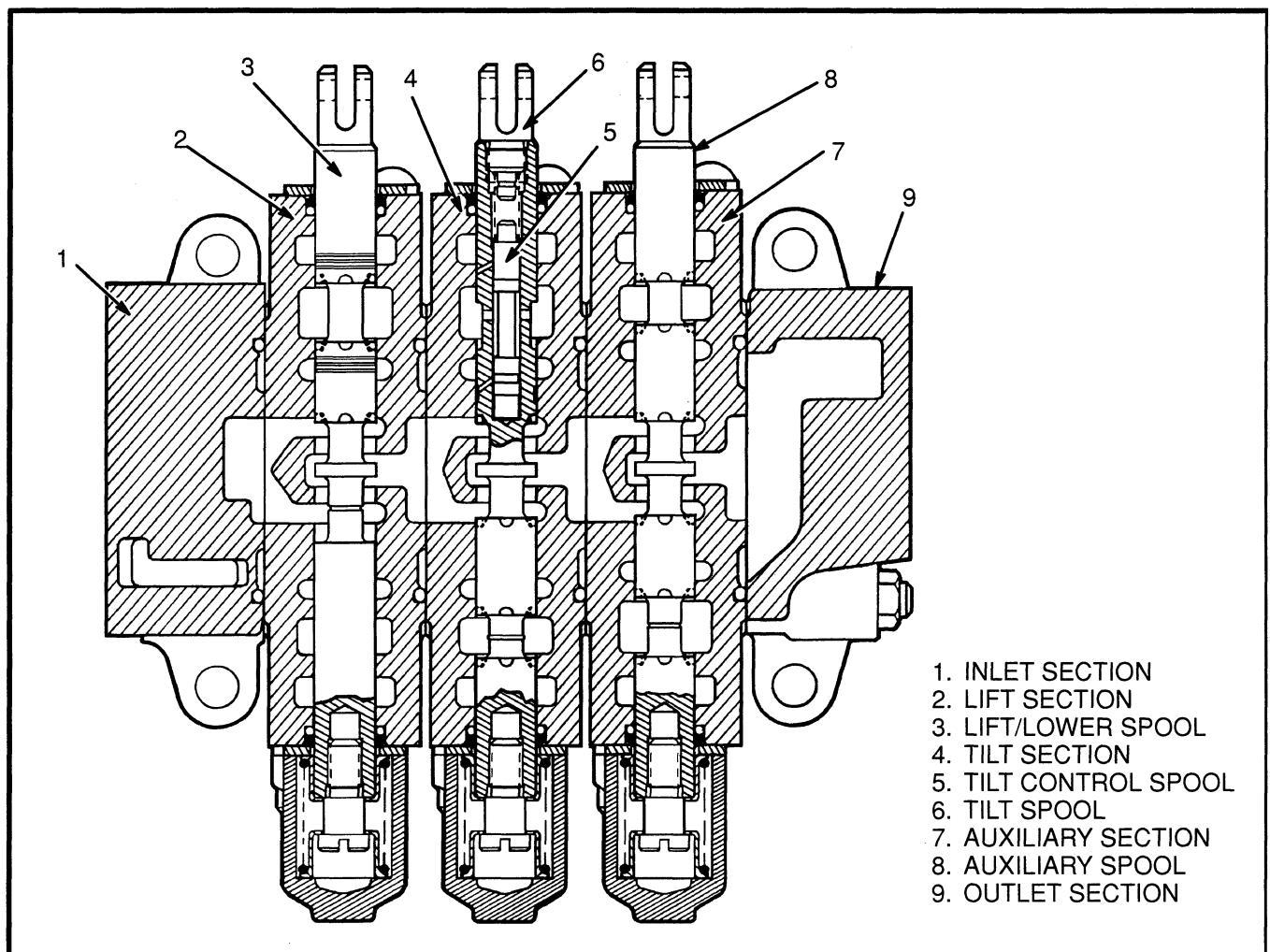


FIGURE 1. MAIN CONTROL VALVE

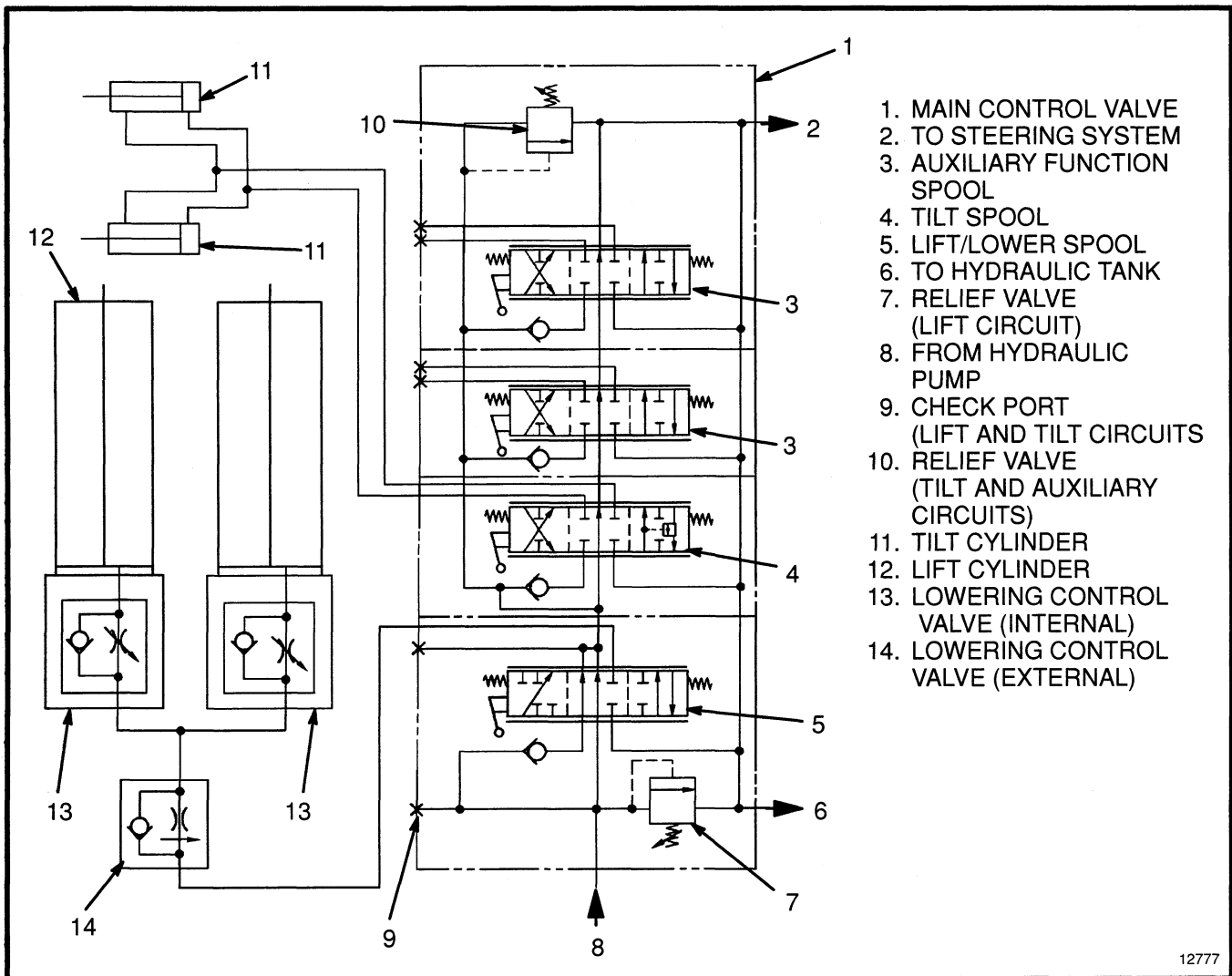


FIGURE 2. CONTROL VALVE SCHEMATIC

OPERATION

The main control valve is an open center, parallel circuit valve. When open center valve spools are in the neutral position, the hydraulic oil flows through the valve with minimum restriction. The oil returns through the drain passage and returns to the hydraulic tank. In a parallel circuit valve, each spool can be operated without preventing the flow of oil to another spool.

This valve has three parallel passages through the valve. See FIGURE 2. When the spools are in the neutral position, the oil flows through the open center passage. At the end of the valve, the oil returns through the drain passage and returns to the hydraulic tank. A spool makes a restriction in the open center passage when the spool is moved from the neutral position. This restriction causes an increase in pressure in the parallel passage. The par-

allel passage is common to all sections of the valve, but oil cannot flow freely through it. The increased pressure in the parallel passage causes the oil to flow through a check valve into a supply cavity in the valve body. The spool gives a path from the supply cavity to the hydraulic cylinder to do work.

The control valve can have three or four control levers. The first lever to the right of the operator controls the lifting and lowering of the mast. The second lever controls the tilt function. The third control lever is for attachments and has two methods of operation depending on the attachment.

- **Control Lever With Detent – Required For Attachments With a Clamp Action:** The lever is spring-loaded toward the operator. The lever is operated by moving it to the right, then forward or backward.

- **Control Lever Without a Detent – Attachments Without a Clamp Action:** The lever is operated by moving forward or backward.

The fourth control lever has a detent and is spring-loaded toward the operator. The lever is operated by moving it to the right, then forward or backward.

Lift Section (See FIGURE 3.)

When the spool is moved to the Lift position, the spool makes a restriction in the open center passage. The increased pressure in the parallel passage causes oil to flow through the check valve to the supply cavity. The oil flows from the supply cavity through a section of the spool to the lift cylinder.

When the spool is in the Lower position, the spool opens a path from the lift cylinder to the drain cavity. The spool is made so that the oil flow through the open center passage is not stopped.

Tilt Section

The basic operation of the tilt spool is the same as the other spools in this control valve. The tilt control spool is inside the tilt spool and adds an additional sequence to the tilt forward function.

TILT BACKWARD (See FIGURE 4.)

When retracted past Neutral position the tilt spool causes a restriction of the oil flow through the open center passage. The increased pressure in the parallel passage causes the oil to flow through the check valve to the supply cavity. The oil flows from the supply cavity through a section of the spool to the tilt cylinders. The check valve prevents the movement of the load until the system pressure is great enough to control the load. Oil from the piston end of the tilt cylinder returns through the main control valve and to the hydraulic tank.

TILT FORWARD (See FIGURE 4.)

The tilt control spool that is inside of the tilt spool operates during the tilt forward function. The tilt control spool prevents cavitation in the piston end of the tilt cyl-

inders. Cavitation occurs when the available fluid does not fill the space in a closed system. The high vacuum cause some of the fluid to change to bubbles of gas. When cavitation occurs in the tilt cylinders, the tilt forward function is not smooth.

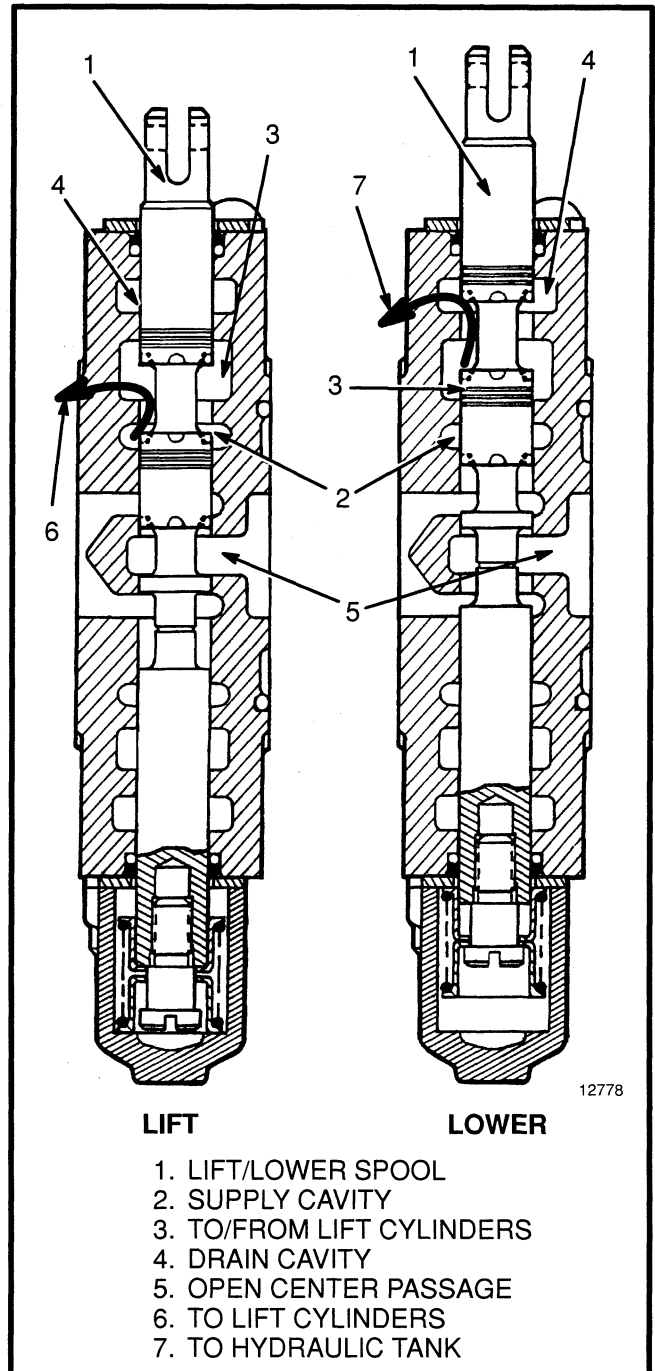


FIGURE 3. LIFT AND LOWER

The tilt control spool permits the regulation of the tilt speed by using the pressure from the hydraulic pump. The pressure must be 550 kPa (80 psi) on the piston ends of the tilt cylinders. The tilt control spool prevents oil

flow from the rod end of the tilt cylinder until the pressure is 550 kPa (80 psi). This action makes sure that a vacuum cannot occur at the piston ends of the tilt cylinders.

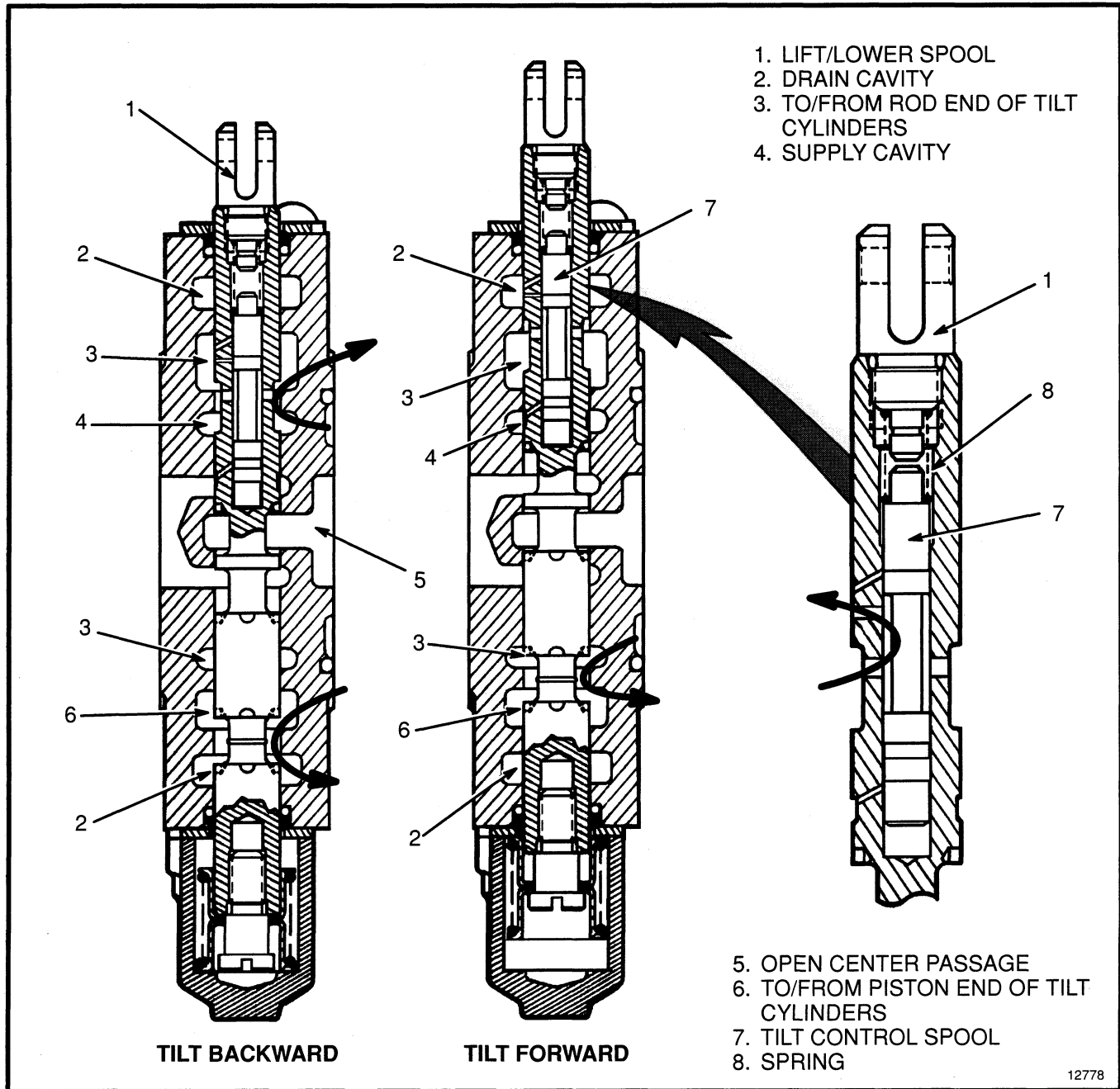


FIGURE 4. TILT SPOOL OPERATION

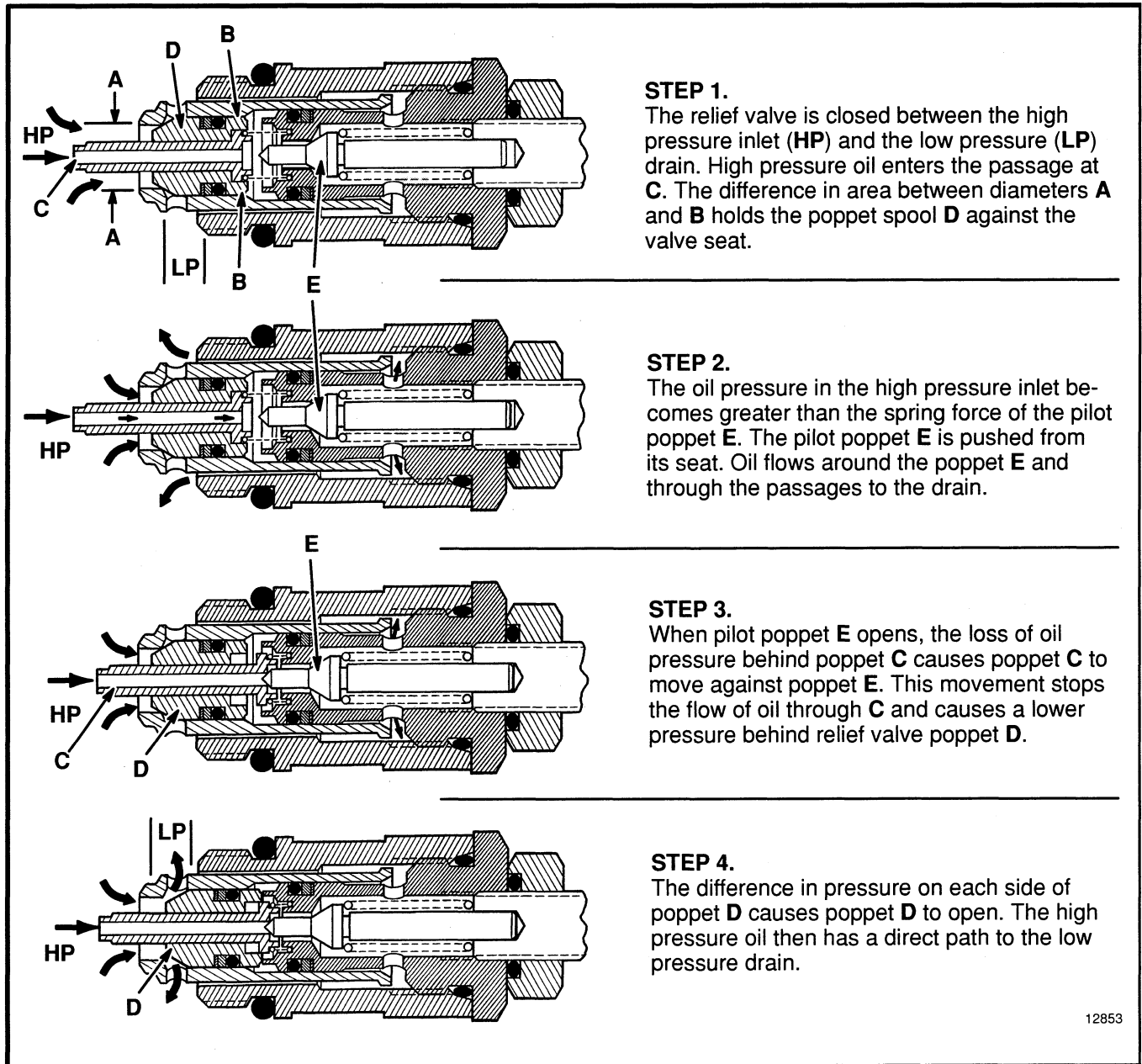


FIGURE 5. OPERATION OF THE RELIEF VALVE

Relief Valve (See FIGURE 5.)

The two relief valves in the control valve control the maximum pressure within the hydraulic system. See FIGURE 10. The primary relief valve is installed in the inlet section of the control valve and is for the lift circuit. The secondary relief valve is for the tilt and auxiliary circuits and is installed in the outlet section of the control valve. Both relief valves are the same in description

and operation. When the pressure in one of the hydraulic circuits reaches the relief valve setting, the relief valve opens a path between the inlet and drain circuits.

The relief valve is a poppet valve that is pilot operated. There are three poppet spools in this valve. Spools C, D and E are used for pressure relief. This relief valve gives almost constant relief pressure over the range of the hydraulic pump flow. The sequence of operation is described in FIGURE 5.

REPAIRS

MAIN CONTROL VALVE

Removal (See FIGURE 6.)

WARNING

Before making repairs to the control valve, fully lower all parts of the mast and tilt it fully forward. This action will prevent the mast from lowering suddenly when hydraulic lines are disconnected.

1. Remove the cowl cover from the right side of the engine compartment. Remove the cover tray (16) from around the control levers.

2. Remove the cotter pins (13) and link pins (12) that connect the control levers to the spools. Remove the bolts that hold the end plates (7) to the control valve mount. Remove the linkage as a unit.

3. Disconnect the lines at the control valve. See FIGURE 9. Put caps on the open lines.

4. See FIGURE 7. Remove the mount plate (2) at the top of the control valve. Remove the side strut (6) from the frame. Remove the bolts that hold the main control valve to the frame bracket.

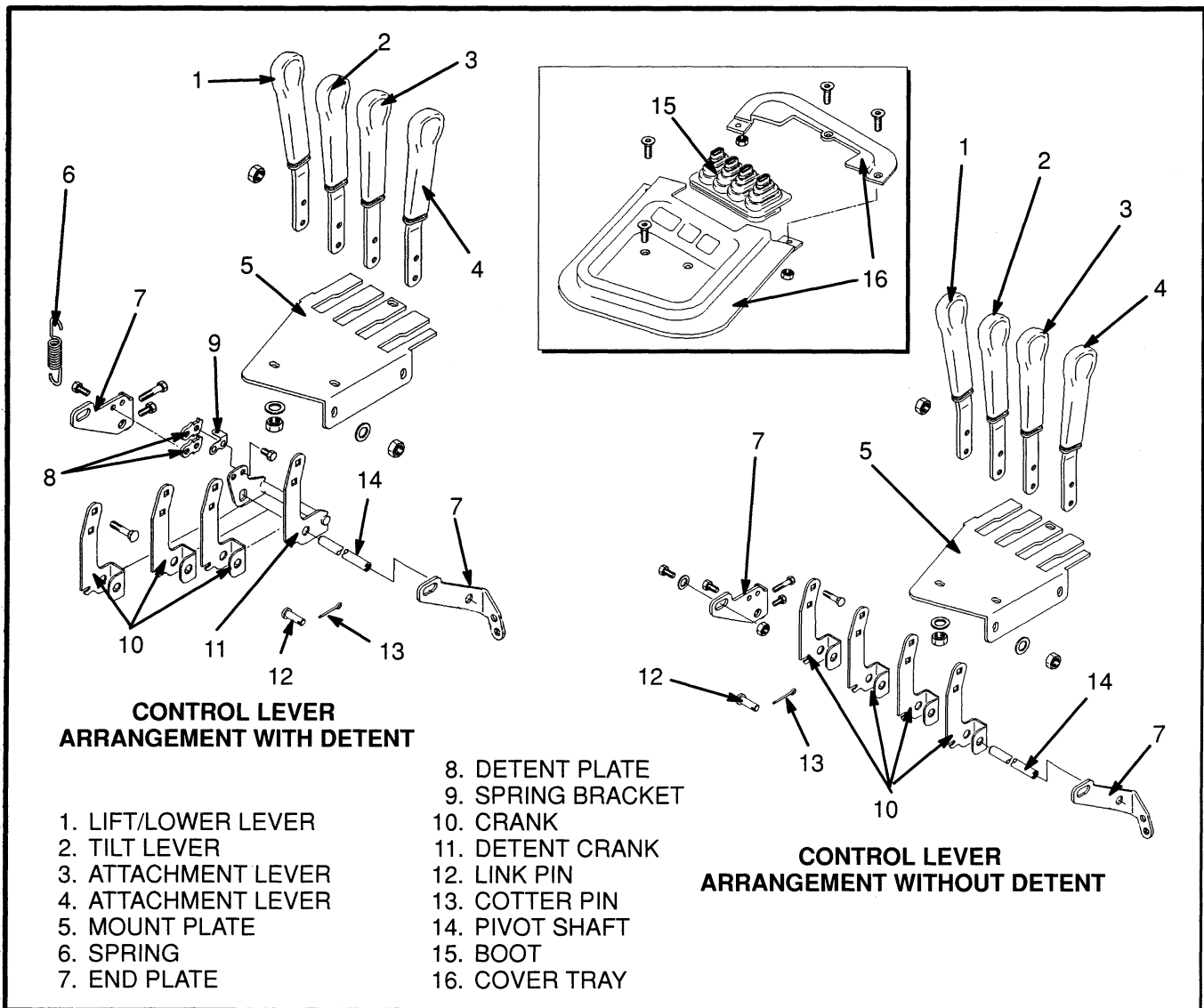


FIGURE 6. LINKAGE FOR CONTROL LEVERS

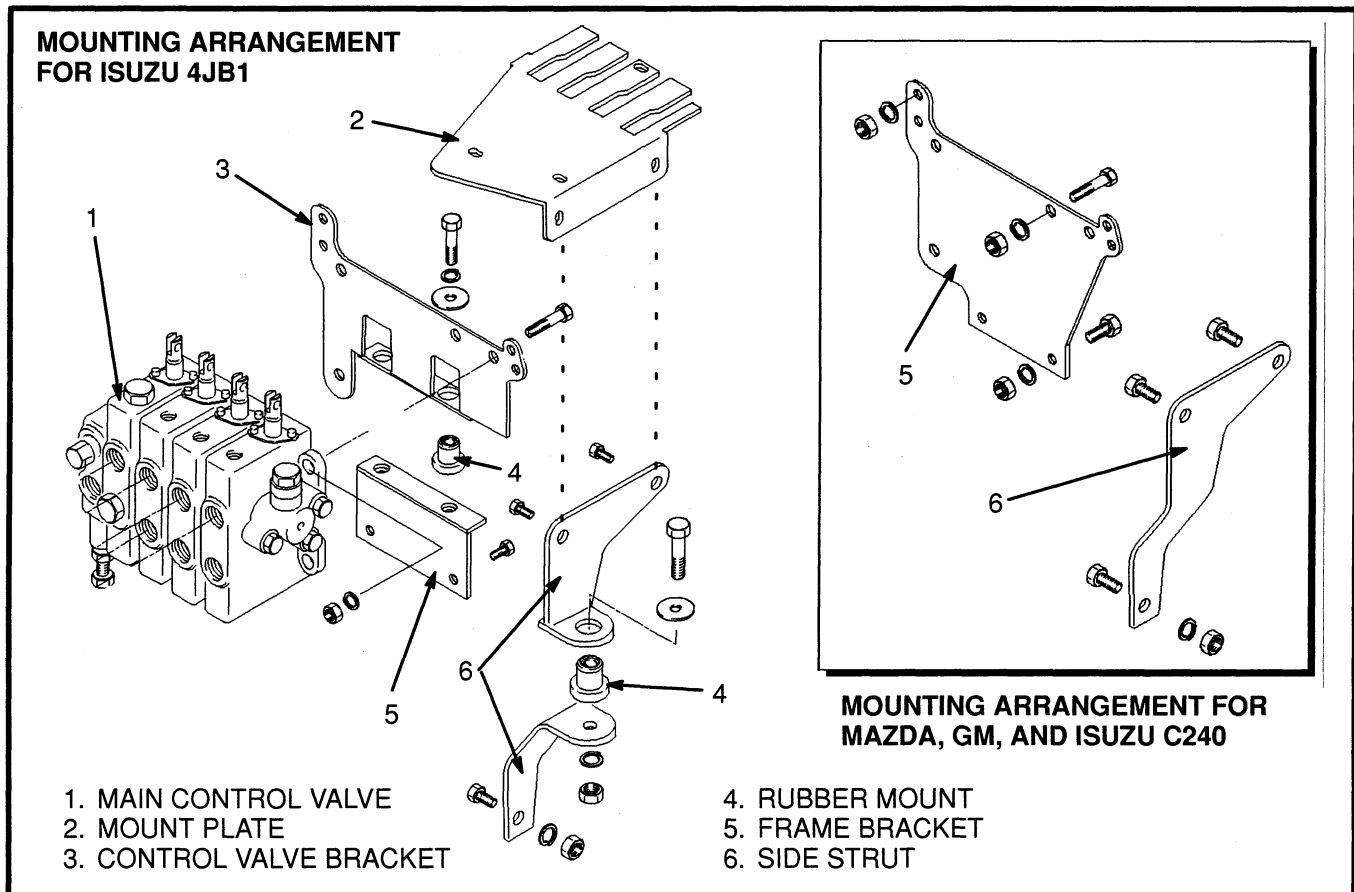


FIGURE 7. CONTROL VALVE MOUNTING

Disassembly

NOTE: Disassemble the main control valve as necessary for repairs. Most repairs to the main control valve are for the replacement of O-rings and seals to stop leaks. The passages in the tilt spool are small and can need cleaning if the hydraulic oil becomes dirty. The section normally must be replaced if the spool or valve section is damaged.

1. Remove the end cap from the valve section. Carefully pull the spool from the valve section. Do not remove the spring retainers unless a spring must be replaced.
2. The valve sections can be separated when the three through bolts are removed. The check valves are held in the valve body by the next section.
3. Remove the tilt control spool by removing the end of the tilt spool.

Carefully remove the tilt control spool from the tilt spool.

4. The relief valve is normally replaced if it is damaged.

Cleaning And Inspection

WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the solvent manufacturer's recommended safety procedures.

Clean all parts of the control valve with solvent.

1. Check the spools and bores for wear or damage. If a spool or bores have damage, then the control valve section must be replaced. Make sure that the spools move freely in the bores.
2. Check the check valves and relief valve for damage. Replace the parts as necessary.
3. Check the parts of the linkage for the control valve levers. Replace worn parts as necessary.

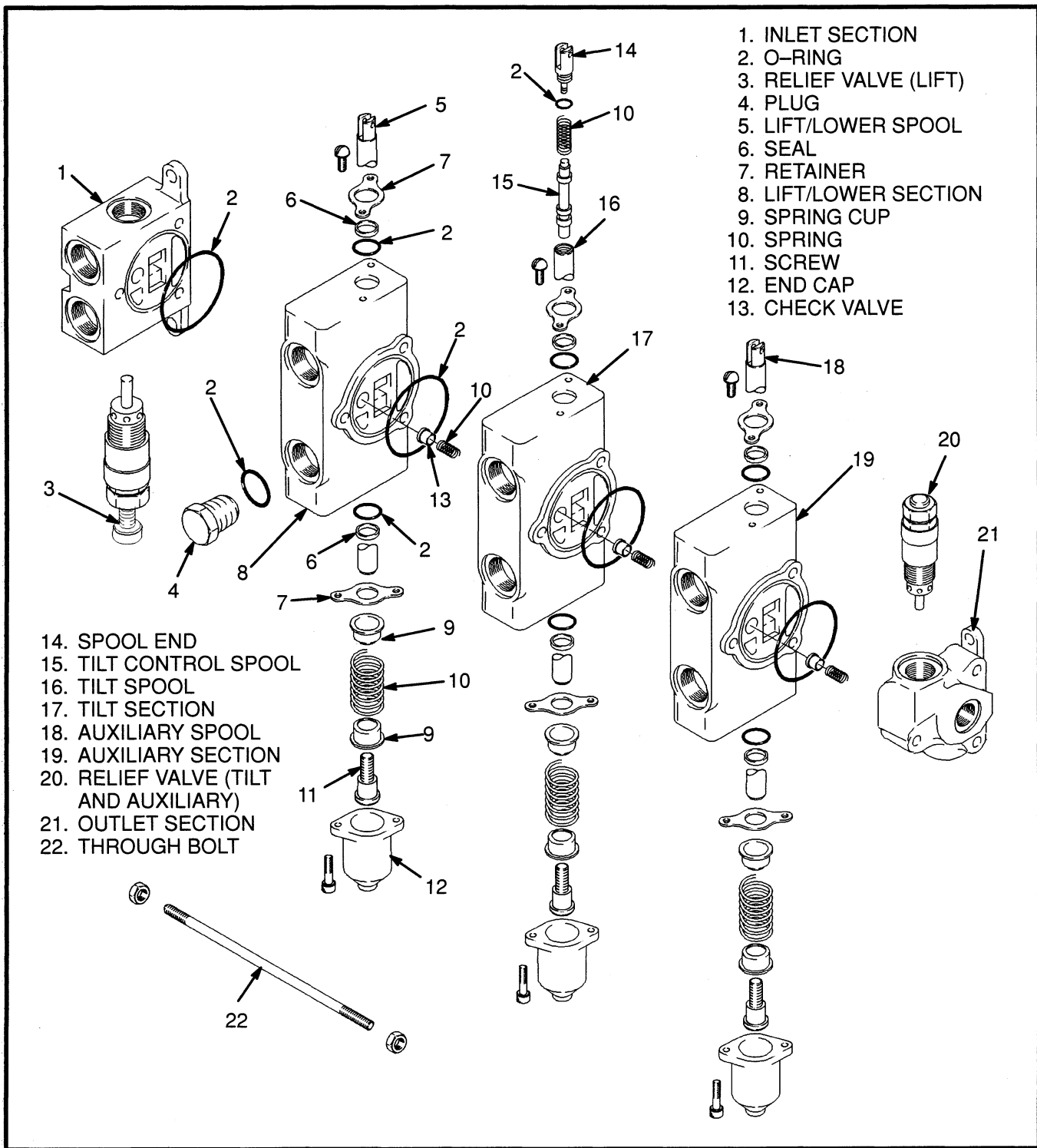


FIGURE 8. CONTROL VALVE

Assembly (See FIGURE 8.)

CAUTION

Before installing the parts into the valve body, make sure all parts are clean. Replace all the seals and the

O-rings. Lubricate the moving parts with clean hydraulic oil during assembly.

1. Install new seals in the bores of the sections. Install new O-ring seals between the sections. Install the check

valves and springs and assemble the sections. Tighten the nuts on the 5/16 inch through bolts to 20 Nm (15 lb_f ft).

2. If the return springs were removed from the control spools, install the spring retainers. During assembly, use new O-rings for the parts of the tilt control spool. Do not damage the O-rings during installation.

3. Lubricate the spools with clean hydraulic oil. Make sure that dirt does not get on any of the parts. Carefully install the spools in the valve body. Install the seal retainers and the covers for the return springs.

4. Install the relief valves. Adjust the relief settings for the hydraulic system as described in CHECKS AND ADJUSTMENTS.

Installation

1. See FIGURE 7. Install the control valve on the frame bracket. Install the bracket and control valve on the frame of the lift truck. Install the side strut to the frame.

2. Install the link pins and cotter pins in the control valve spools.

3. See FIGURE 6. Install the linkage assembly and the mount plate (5). Connect the mount plate to the side strut and end plates (7). Install the spring (6) for the control lever with the detent. Check the operation of the levers. Make sure the levers operate as described at the front of this section.

4. See FIGURE 9. Connect the hydraulic lines to the control valve.

5. See FIGURE 6. Install the cover tray (16) to the mount plate (5). Make sure the cover trays fit over the

edges of the boot (15). Adjust the cover trays as necessary so that they fit in the opening of the hood.

6. Add the hydraulic oil to the tank. See the section **PERIODIC MAINTENANCE** for the correct specifications.

7. Operate the system and check for leaks and correct operation. Adjust the relief valves as described in CHECKS AND ADJUSTMENTS.

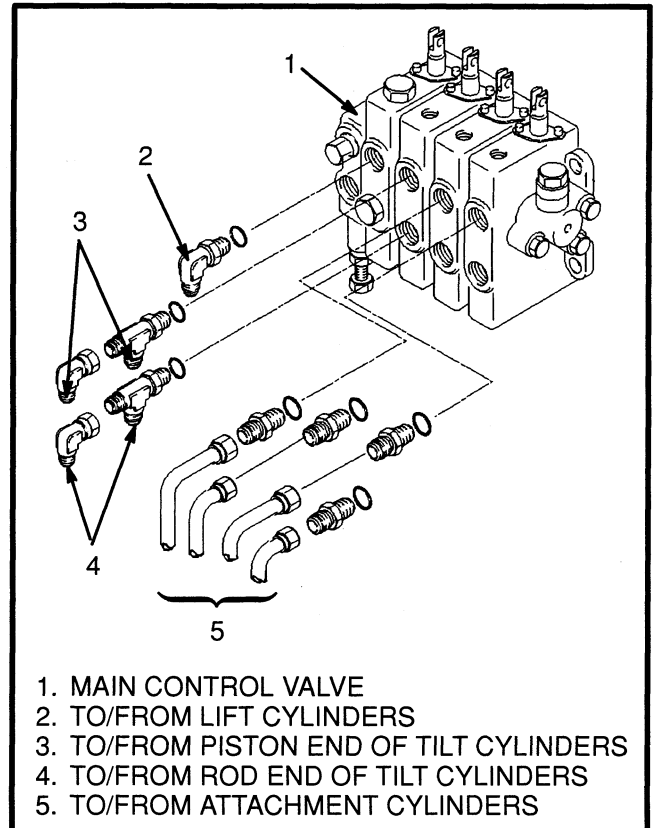


FIGURE 9. HYDRAULIC LINE ARRANGEMENT

CHECKS AND ADJUSTMENTS

PRESSURE RELIEF VALVES

NOTE: The control valve has two relief valves, a primary relief valve and a secondary relief valve. The primary relief valve is in the inlet section of the control valve. The secondary relief valve is on the outlet section.

Primary Relief Valve (See FIGURE 10.)

1. Connect a 0 to 25 MPa (0 to 3500 psi) gauge to the test port at the inlet section of the control valve..

2. Loosen the jam nut.

3. Start the engine and operate the hydraulic system to warm the oil temperature to 55 to 65°C (130 to 150°F).

Run the engine at approximately 2000 rpm when making pressure checks.

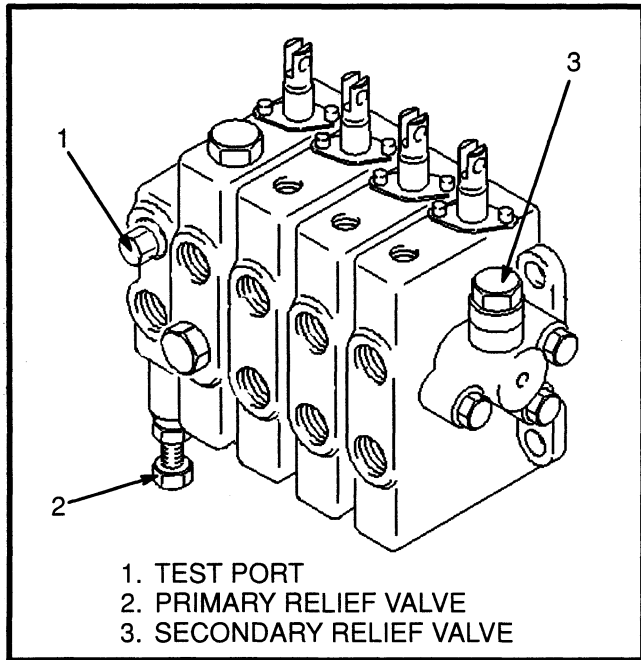


FIGURE 10. RELIEF VALVE LOCATIONS

Turn the adjustment screw as necessary to change the setting. The correct setting is 21.37 ± 0.5 MPa (3100 \pm 75 psi). Tighten the jam nut when the adjustment is correct.

5. Remove the gauge when the checks are complete.

Secondary Relief Valve (See FIGURE 10.)

1. Connect a 0 to 20 MPa (0 to 3000 psi) gauge to the test port at the inlet section of the control valve.

2. Loosen the jam nut on the relief valve.

3. Start the engine and operate the hydraulic system to warm the oil temperature to 55 to 65°C (130 to 150°F). Run the engine at approximately 2000 rpm when making pressure checks.

5. Tilt the mast backward until it stops. Hold the lever and check the reading of the gauge when the relief valve opens. Turn the adjustment screw as necessary to change the setting. The correct setting is 15.5 ± 0.5 MPa (2250 \pm 75 psi). Tighten the jam nut when the adjustment is correct.

4. Raise the mast until it stops. Hold the lever and check the reading of the gauge when the relief valve opens.

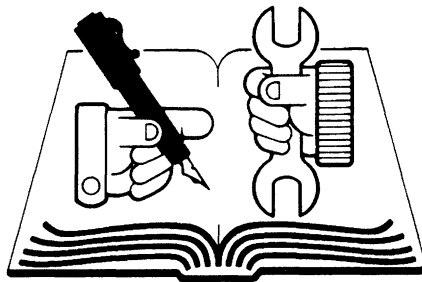
7. Remove the gauge when the checks are complete.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Slow or no movement of cylinders.	<ol style="list-style-type: none"> Air is in the hydraulic system. The hydraulic pump is worn or damaged. Restriction in the hydraulic lines. Cylinder seals are damaged. Load is greater than capacity. Linkage is disconnected or damaged. Pressure relief valve(s) is not adjusted correctly or is damaged. Large leaks between spool and bore. Spool is not fully extended or retracted. 	<ol style="list-style-type: none"> Remove air from hydraulic system. Repair or replace hydraulic pump. Repair hydraulic lines. Repair cylinders. Reduce load. Repair and adjust linkage for control levers. Repair or adjust relief valve(s). Replace valve section. Adjust linkage to spool.
Oil leaks at the end of a spool.	<ol style="list-style-type: none"> Seal for spool is damaged. Spool is damaged. Valve body is damaged. 	<ol style="list-style-type: none"> Replace seal. Replace valve section. Replace valve section.
Spool will not move or is difficult to move.	<ol style="list-style-type: none"> Linkage is disconnected or damaged. Return spring is damaged. The spool or bore is damaged. 	<ol style="list-style-type: none"> Repair and adjust linkage. Replace spring. Replace valve section.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Spool will not return to NEUTRAL.	<ol style="list-style-type: none"> 1. Linkage is disconnected or damaged. 2. Return spring is damaged. 3. Dirt between spool and the bore. 4. Spool is bent or damaged. 	<ol style="list-style-type: none"> 1. Repair and adjust linkage. 2. Replace spring. 3. Clean valve. 4. Replace valve section.
Hydraulic pressure is above specifications.	<ol style="list-style-type: none"> 1. Pressure relief valve(s) is not adjusted correctly or is damaged. 2. Restriction in return line. 	<ol style="list-style-type: none"> 1. Repair or adjust relief valve(s). 2. Clean or replace return line or filter.
Tilt cylinders extend when the tilt spool is in the NEUTRAL position.	<ol style="list-style-type: none"> 1. Cylinder seal have leaks. 2. Oil leaks between control valve spool and bore. 3. Hydraulic lines have leaks. 	<ol style="list-style-type: none"> 1. Repair tilt cylinders. 2. Replace valve section. 3. Repair or tighten lines or fittings.
Tilt cylinders extend suddenly when the tilt spool is moved to BACK TILT position.	<ol style="list-style-type: none"> 1. Check valve for tilt spool is damaged. 	<ol style="list-style-type: none"> 1. Replace check valve.
Tilt cylinders extend suddenly when the tilt spool is moved to FORWARD TILT position.	<ol style="list-style-type: none"> 1. Tilt control spool inside the tilt spool is damaged. 	<ol style="list-style-type: none"> 1. Replace valve section.
Lift cylinders retract when the lift spool is in the NEUTRAL position.	<ol style="list-style-type: none"> 1. Check valve for the lift spool is damaged. 2. Cylinder seals have leaks. 3. Hydraulic lines have leaks. 4. Leaks between the lift spool and the bore. 	<ol style="list-style-type: none"> 1. Replace check valve. 2. Repair lift cylinders. 3. Repair or tighten lines or fittings. 4. Replace valve section.



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