INTRODUCTION

GENERAL

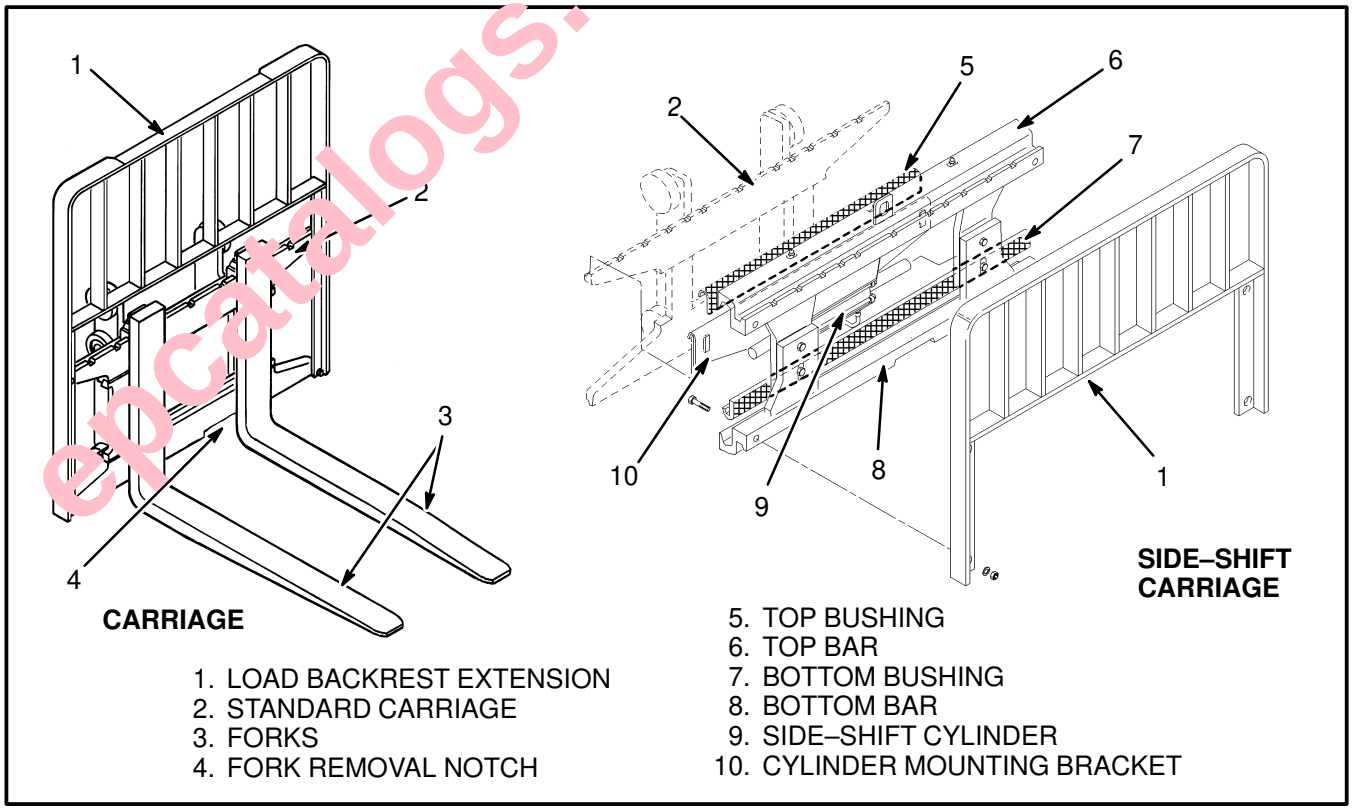
This section has the description and repair procedures for the Four–Stage, full free–lift (FFL) mast and the carriages. Checks and Adjustments and Troubleshooting information are at the end of this section.

The mast is used to lift a load vertically. The mast has two movements controlled by hydraulic cylinders: forward and backward tilt and the lifting and lowering of the mast weldments and carriage. The outer weldment can move on the pivot pins at the mast mounts. The operation of the tilt cylinders causes the mast to tilt forward and backward. The tilt cylinders are fastened between the frame of the lift truck and the outer weldment of the mast. Hydraulic lift cylinders are installed vertically on the mast weldments. The lift cylinders and lift chains raise and lower the weldments and the carriage. The hydraulic operation of the lift cylinders and tilt cylinders is described in the section **MAIN CONTROL VALVE**.

CARRIAGES (See FIGURE 1.)

The carriage is a part of the mast assembly and moves within the channels of the inner weldment. Forks or other types of load handling equipment are attached to the carriage. A load backrest extension is attached to the carriage and adds support for a load that has multiple pieces.

The side–shift carriage lets the operator move the forks and load from side–to–side. This function makes it easier for the operator to align the forks with a load or align the load with a stack. The side–shift carriage hangs on the fork bars of the standard carriage. Special bushings fit between the side–shift carriage and the fork bars. A side–shift cylinder is installed on a bracket that fits on the standard carriage. The side–shift cylinder moves the side–shift carriage on the standard carriage.



1. LOAD BACKREST EXTENSION
2. STANDARD CARRIAGE
3. FORKS
4. FORK REMOVAL NOTCH
5. TOP BUSHING
6. TOP BAR
7. BOTTOM BUSHING
8. BOTTOM BAR
9. SIDE–SHIFT CYLINDER
10. CYLINDER MOUNTING BRACKET

FIGURE 1. CARRIAGE AND FORKS

MAST MOUNTS (See FIGURE 13.)

The mast can tilt forward and backward. Tilt cylinders are fastened between the frame of the lift truck and the outer weldment of the mast to change the angle of the mast and forks. Pivot pins are installed in the drive axle hangers. The pivot pins rotate in bushings in the hangers. The outer weldment has mounts that fit on the pivot pins. Capscrews hold the mast to the pivot pins.

MAST

Description (See FIGURE 2.)

The full free–lift, four–stage mast has four weldments: outer, first intermediate, second intermediate and inner. Two single–stage main lift cylinders and a free–lift cylinder are used to raise the carriage and extend the mast weldments. It is called a full free–lift mast because the carriage can travel to the top of the inner weldment without extending the inner weldment.

The weldments are telescopic and use load rollers and strip bearings to keep them in alignment. The load rollers are installed at the top of the outer, first and second intermediate weldments. Load rollers are also used at the bottom of the first and second intermediate weldments and the inner weldment. These load rollers travel along the flanges of the weldments. The angle of the load rollers permits them to control the forces from the front, back and sides of the mast. The strip bearings are installed at the top of the outer, first and second intermediate weldments and help keep the correct clearance between the weldments. The load rollers and strip bearings are adjustable with shims.

The two main lift cylinders are installed at the back of the outer weldment. The base of each lift cylinder sits in a mount at the bottom crossmember of the outer weldment. The top of each main lift cylinder (cylinder rod) fits into a guide at the top crossmember of the first intermediate weldment. The free–lift cylinder is installed to the inner weldment. The free–lift and left–hand main lift cylinder has an internal (secondary) lowering control valve. A single external (primary) lowering control valve is connected by tubing and hoses to all of the lift cylinders.

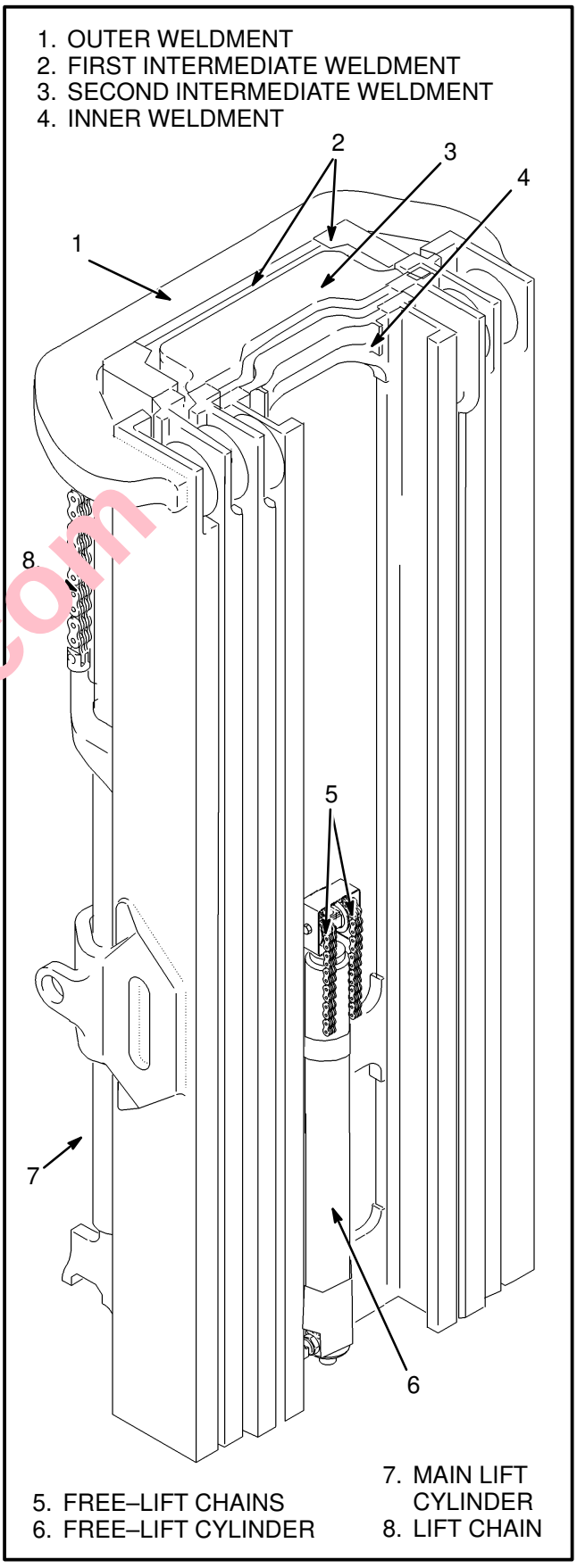
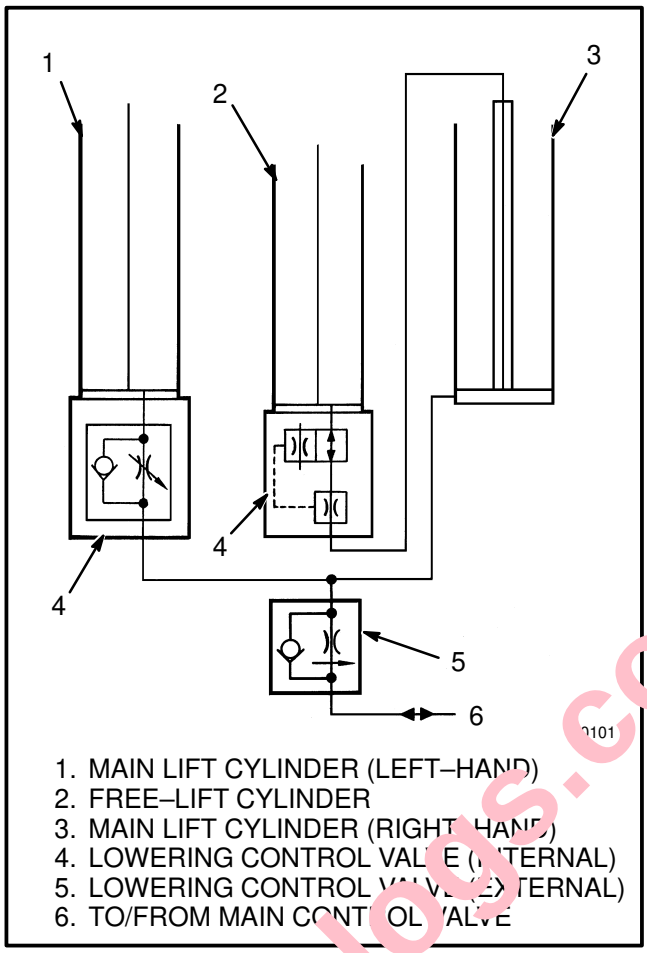


FIGURE 2. FOUR–STAGE MAST



1. MAIN LIFT CYLINDER (LEFT–HAND)
2. FREE–LIFT CYLINDER
3. MAIN LIFT CYLINDER (RIGHT–HAND)
4. LOWERING CONTROL VALVE (INTERNAL)
5. LOWERING CONTROL VALVE (EXTERNAL)
6. TO/FROM MAIN CONTROL VALVE

FIGURE 3. HYDRAULIC SCHEMATIC

One set of lift chains is connected to mounts that are near the top of the outer weldment. The lift chains then go over sheaves at the top of the first intermediate weldment and fasten at the bottom of the second intermediate weldment.

Another set of lift chains is connected to mounts that are near the top of the first intermediate weldment. The lift chains then go over sheaves at the top of the second intermediate weldment and fasten at the bottom of the inner weldment.

The free–lift chains connect at one end to the crossmember for the free–lift cylinder. Two chain sheaves are installed on a crosshead on the cylinder rod of the free–lift cylinder. The chains then go over sheaves on the crosshead and connect to the carriage.

Operation (See FIGURE 3., through FIGURE 6.)

The three hydraulic cylinders are connected by hoses and tubing as shown in FIGURE 3. To extend the mast, oil from the main control valve flows to all cylinders at the same time. The free–lift cylinder extends first because it lifts the least amount of weight. The free–lift cylinder raises the carriage to the top of the inner weldment. After the free–lift cylinder reaches the end of its stroke, the main lift cylinders begin to extend. As the main lift cylinders extend, the first intermediate weldment is raised by the lift cylinders. The second intermediate and inner weldments are raised by the lift chains.

The left–hand lift cylinder has a small amount of oil below the piston. The free–lift cylinder has a small amount of oil above the piston. This oil provides a hydraulic cushion during operation. See FIGURE 5. and FIGURE 6.

During lowering, the main lift cylinders lower first because they have a greater load. After the main lift cylinders have retracted, the free–lift cylinder lowers. All oil from the lift cylinders flows through the lowering control valves to the hydraulic tank.

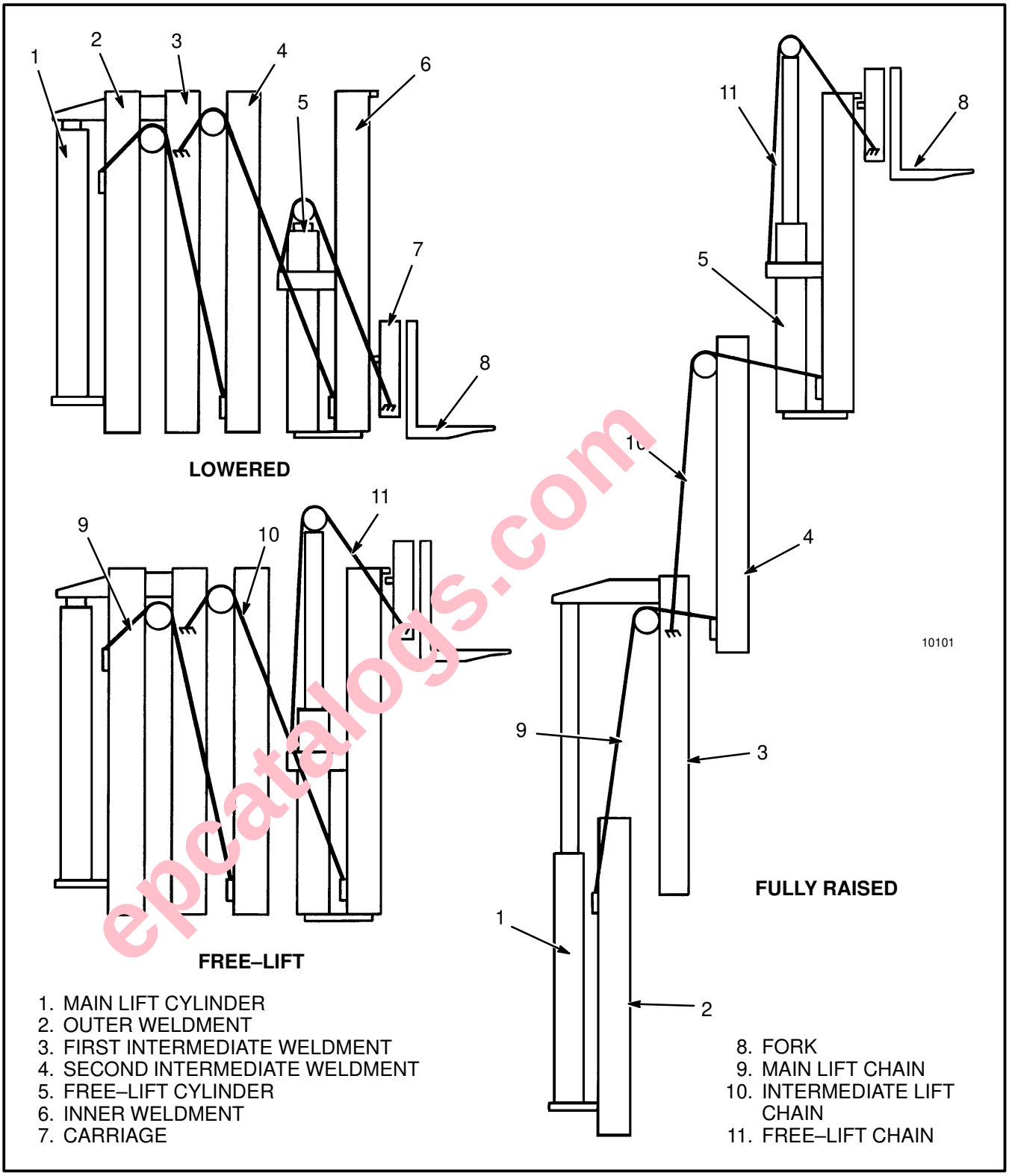
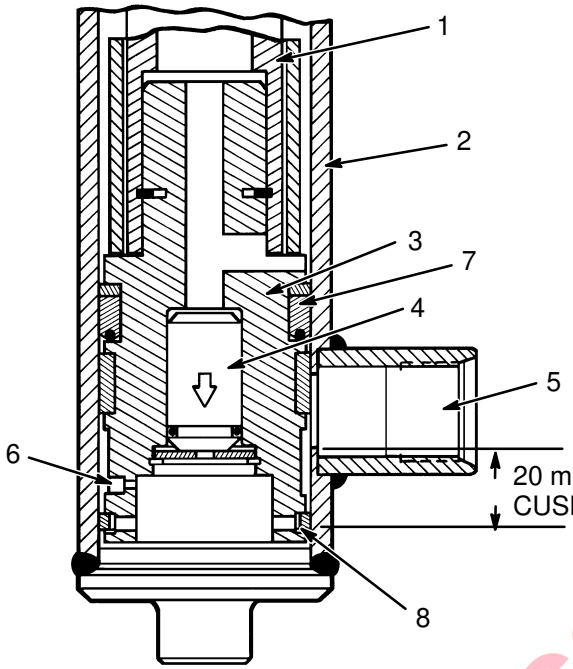


FIGURE 4. OPERATION

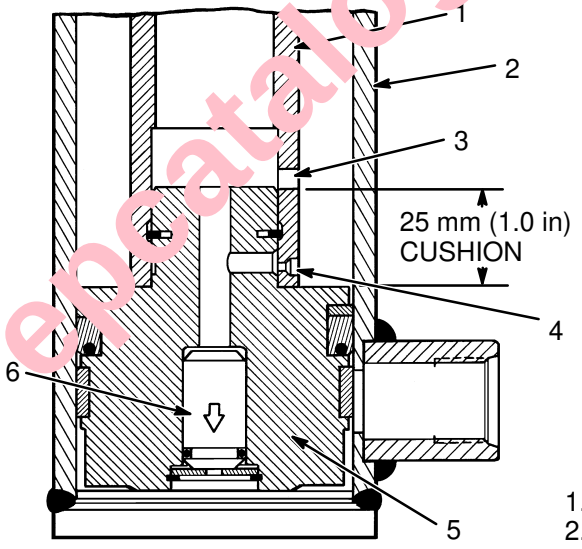


LEFT–HAND LIFT CYLINDER

As the main lift cylinders retract, hydraulic oil flows out of the cylinders through the hydraulic port (5). During the last 20 mm (0.8 in) of the stroke, the hydraulic oil must flow out through the small orifice (6). This action causes the cylinder rod to move much more slowly at the end of the stroke. This cushion effect prevents a sudden stop at the end of the lowering sequence, making a smoother lowering operation.

1. CYLINDER ROD
2. CYLINDER SHELL
3. PISTON
4. INTERNAL CHECK VALVE
5. HYDRAULIC PORT
6. ORIFICE
7. PISTON SEAL
8. CUSHION RING

FIGURE 5. OPERATION, MAIN LIFT CYLINDER



There is hydraulic oil on the rod side of the piston. There are two orifices in the cylinder rod, one larger than the other, items (3) and (4). As the cylinder rod extends, the hydraulic oil on the rod side flows to the base of the cylinder through the larger orifice (3) and the internal check valve (6). When the cylinder rod extends to the last 25 mm (1.0 in) of its stroke, the retainer at the top of the cylinder closes the larger orifice (3). Now, the remainder of the hydraulic oil must flow through the small orifice (4) to the internal check valve (6). This action increases the hydraulic pressure so that the main lift cylinders begin to extend.

At the end of the free–lift stroke the oil flow through the small orifice gives a cushion effect for the free–lift cylinder.

1. CYLINDER ROD
2. CYLINDER SHELL
3. LARGE ORIFICE
4. SMALL ORIFICE
5. PISTON
6. INTERNAL CHECK VALVE

FIGURE 6. OPERATION, FREE–LIFT CYLINDER