Hydraulic Power Brake Systems for Forklifts

By Sean D. Ross
International Sales Manager
MICO, Incorporated

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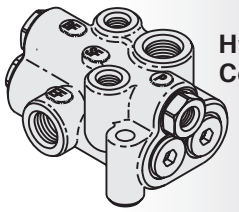
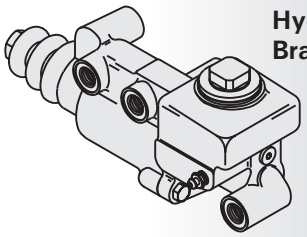
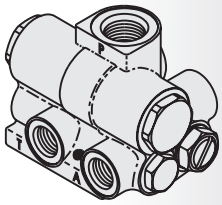


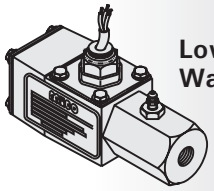
Hydraulic Flow Control Valve



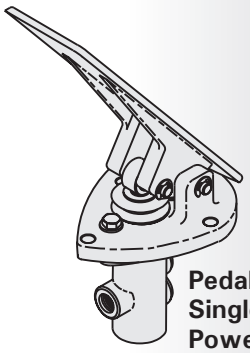
Hydraulic Power Brake Actuator



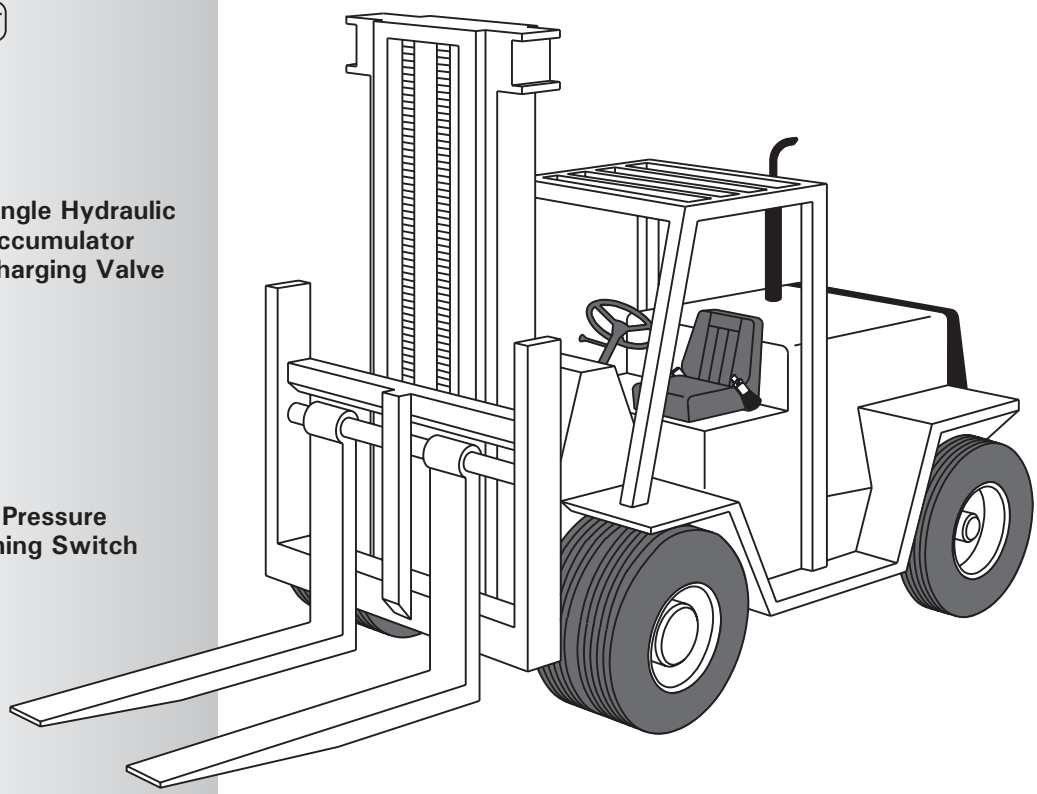
Single Hydraulic Accumulator Charging Valve



Low Pressure Warning Switch



Pedal Actuated Single Hydraulic Power Brake Valve



MICO designs, manufactures and sells hydraulic components and systems for heavy duty, off-road vehicles and equipment.

Forklift Hydraulic Power Brake Systems

by Sean D. Ross

Hydraulic power brake systems provide safe, reliable braking for forklifts and other vehicles in the materials handling industry. Sean D. Ross of MICO Incorporated, USA, discusses the configuration and operation of the two main types which are in common use today.

Hydraulic power brake systems provide safe, reliable braking for forklifts and other vehicles in the material handling industry. These systems are normally found in forklift trucks above 2.0 ton capacity. Above 2.0 ton capacity, a regular "automotive-type" master cylinder cannot provide pressure and fluid volume to the brakes within a reasonable pedal force and stroke. There are two types of hydraulic power brake systems commonly in use: boosted hydraulic brake systems and full power hydraulic brake systems. While both systems use a hydraulic pump to provide power for braking, their designs and applications are quite different.

Boosted Hydraulic Brake System

A boosted hydraulic brake system is found on forklift trucks from 2.0 to 10.0 ton capacity (Figure 1). This system uses a hydraulic power brake actuator which consists of a hydraulic boost section coupled to a master cylinder. The hydraulic boost section includes a boost piston, variable flow restriction, and boost relief valve. When the boost section is actuated, system flow passing across the boost piston is restricted. This restriction creates a pressure drop across the boost piston. The resulting force is transferred to the master cylinder piston. Brake line pressure increases until the boost relief valve opens. Once the boost relief valve opens, brake pressure increases only by direct mechanical input force to the master cylinder. A hydraulic power brake actuator reduces the operator input force required to generate brake pressure. The circuit for a boosted hydraulic brake system with a hydraulic power brake actuator, hydraulic flow control valve, and load sensing steering is shown in Figure 2.

Full Power Hydraulic Brake System

Brake systems for forklifts over 10.0 tons normally require more volume and higher pressure than are available through the boosted

FIGURE 1
Boosted Hydraulic Brake System

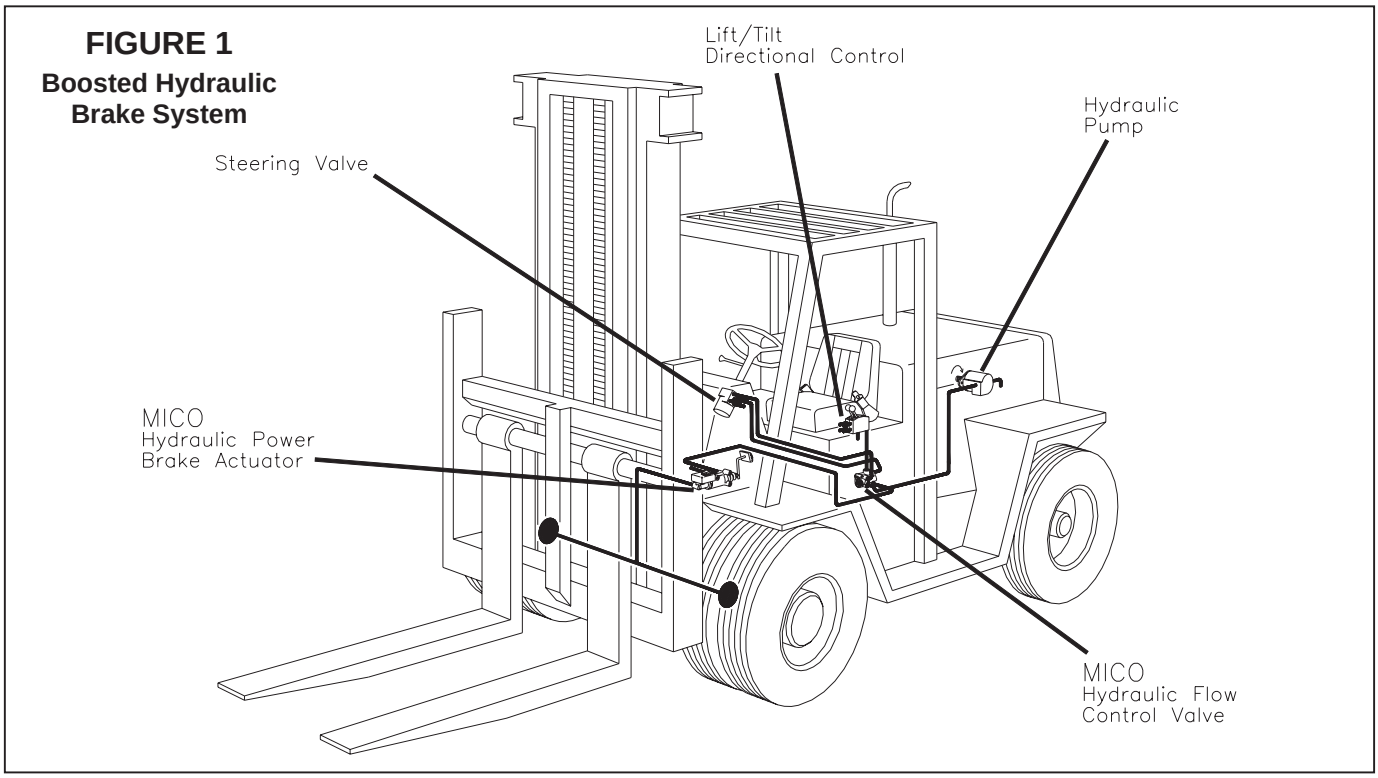


Figure 1: Layout of a boosted hydraulic brake system

system. These vehicles require a full power hydraulic brake system. This system uses a hydraulic accumulator(s), accumulator charge valve, a pedal actuated single hydraulic power brake valve, and a low pressure warning switch. The accumulator charge valve maintains pressure in the accumulator(s) within a pre-set range. The accumulator(s) stores hydraulic energy for actuating the brakes. The pedal actuated single hydraulic power brake valve regulates pressure to the brakes with a hydraulic feedback feature for positive operator "feel". The low pressure warning switch alerts the operator when accumulator pressure falls below the accumulator charge valves pre-set limits, (ie. in the event of pump failure, etc.). The high and low pressure settings of the accumulator charge valve, and accumulator volume is selected for the required number of "power-on" (accumulator pressure between charge valve high and low pressure settings) and "power-off" (accumulator pressure between charge valve low pressure setting and maximum required brake pressure) brake applications. In full power hydraulic brake systems fluid volume is not limited by a master cylinder. Therefore, with the appropriate accumulator, a number of brake applications are available at full brake pressure after engine shutdown or pump failure. The circuit for a full power hydraulic brake system with single open center accumulator charge valve, single pedal actuated hydraulic power brake valve, open center steering, and low pressure warning switch is shown in Figure 3.

Both boosted hydraulic and full power hydraulic brake systems are normally integrated into the rest of a machine's hydraulic functions (steering, implement, pilot controls, etc.). So when deciding whether to use a boosted or full power hydraulic brake system, engineers must evaluate the parameters of the vehicle's hydraulic system and the applicable brake standards to ensure vehicle safety. ■

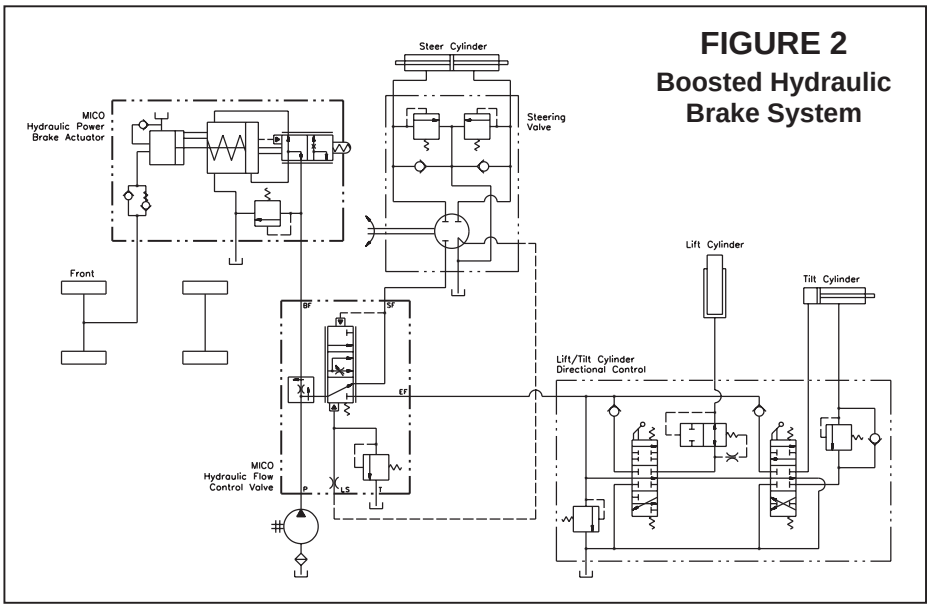


Figure 2: Hydraulic circuit of a boosted system

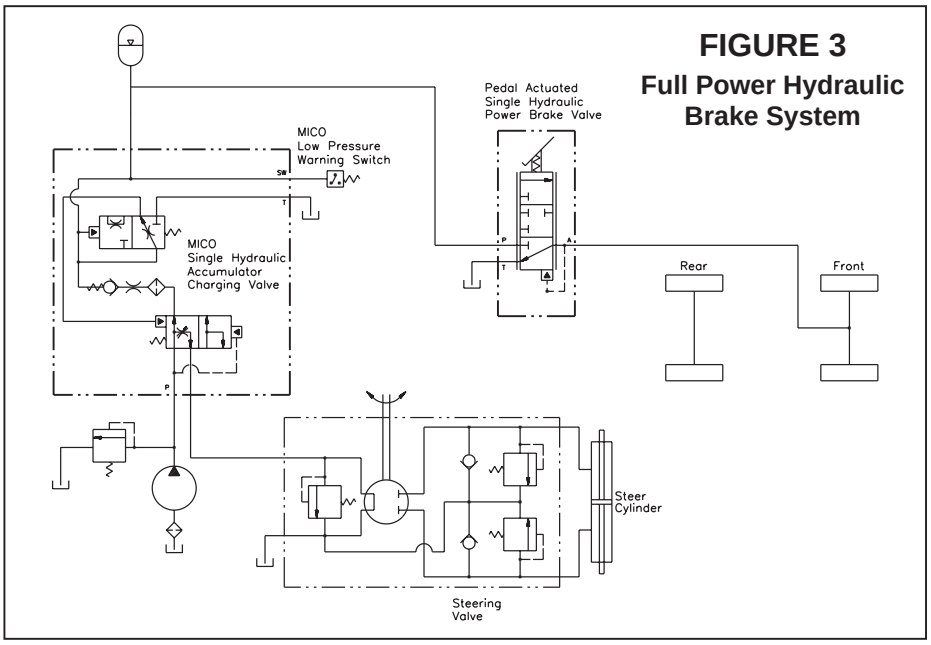


Figure 3: Hydraulic circuit of a full-power system

Sean D. Ross is the International Sales manager for MICO, Incorporated in North Mankato, Minnesota, USA. He has a B.S. degree in Mechanical Engineering from the State University of New York at Stonybrook and has been certified by the Fluid Power Society as a Fluid Power Specialist.

MICO, Incorporated
1911 Lee Boulevard (Zip Code 56003-2507)
P.O. Box 8118 / North Mankato, MN U.S.A. 56002-8118
☎ 507.625.6426 **Facsimile** 507.625.3212

MICO West Division
701 East Francis Street (Zip Code 91761-5514)
P.O. Box 9058 / Ontario, CA U.S.A. 91762-9058
☎ 909.947.4077 **Facsimile** 909.947.6054

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