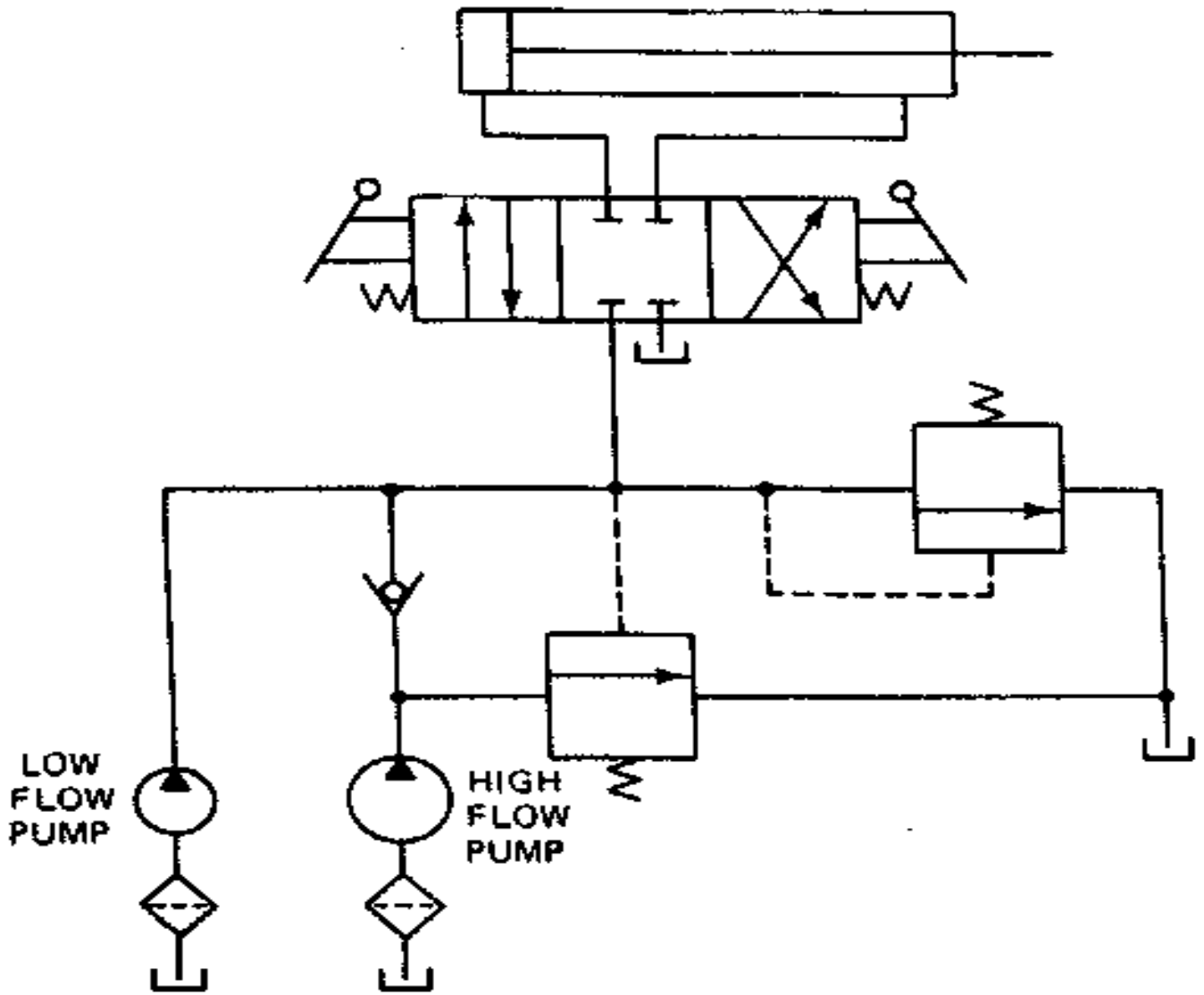
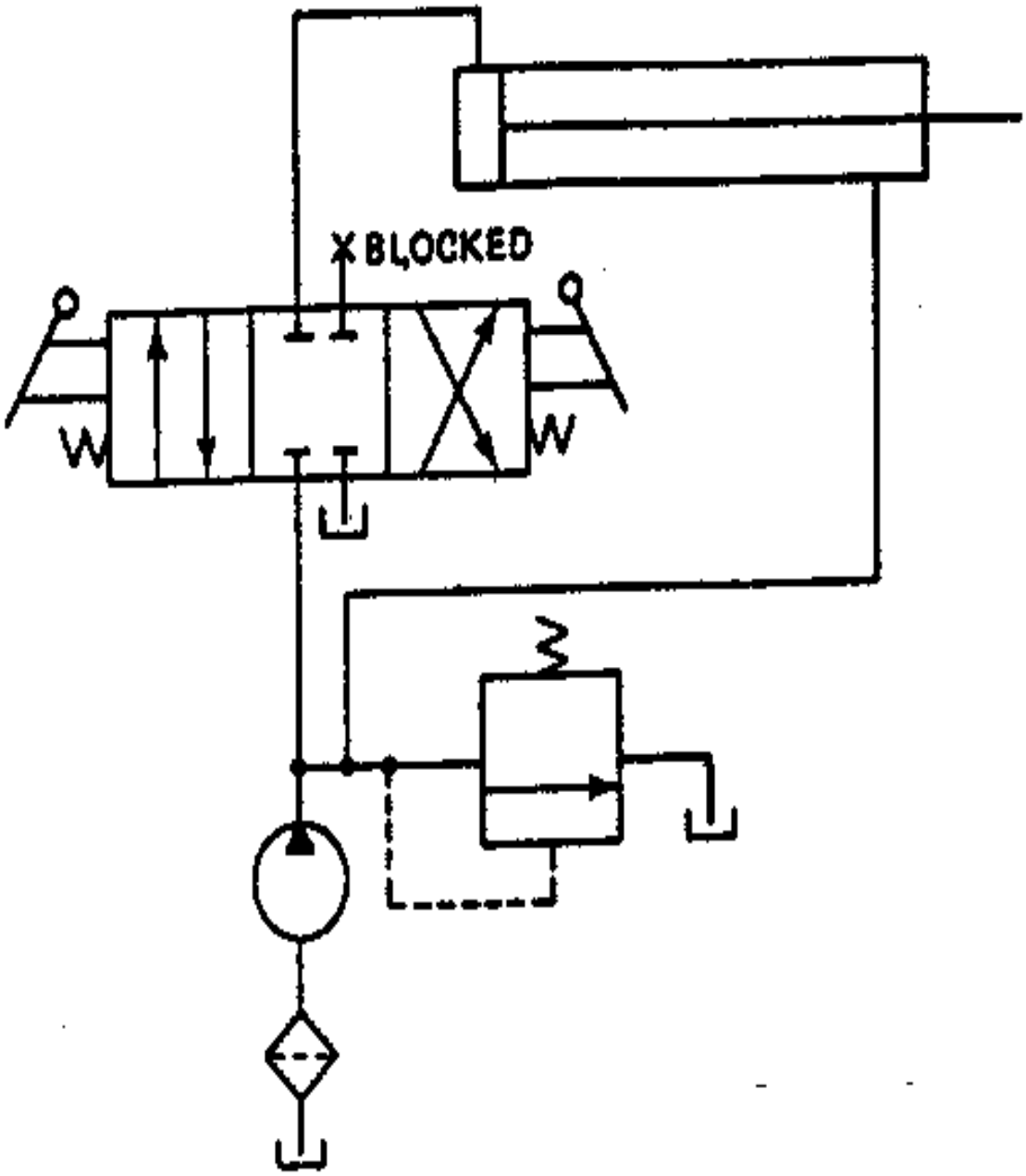
DOUBLE PUMP HYDRAULIC CIRCUIT

In most hydraulic circuits, when the flow requirements are high, the pressure requirements are low, and when the pressure requirements are high, the flow requirements are low. For example, during extension or retraction of an actuator, flow requirements are high but pressure requirements are low. However, when the actuator pushes against something at the end of its stroke, the reverse is true. As shown in the sketch, one could use two pumps to supply hydraulic oil: one pump would deliver high pressure at low flow and the other would deliver high flow at low pressure. This is less expensive than a single high pressure high flow pump. When the actuator is extending or retracting, the high flow pump controls the pressure in the flow lines. When the actuator pushes against something at the end of its stroke, the high pressure pump controls the pressure. This pressure could damage the high flow pump. A one way valve isolates it from the high pressure. Relief valves are used to limit pressure that can be generated by each pump.


LOW
FLOW
PUMP
HIGH
FLOW
PUMP

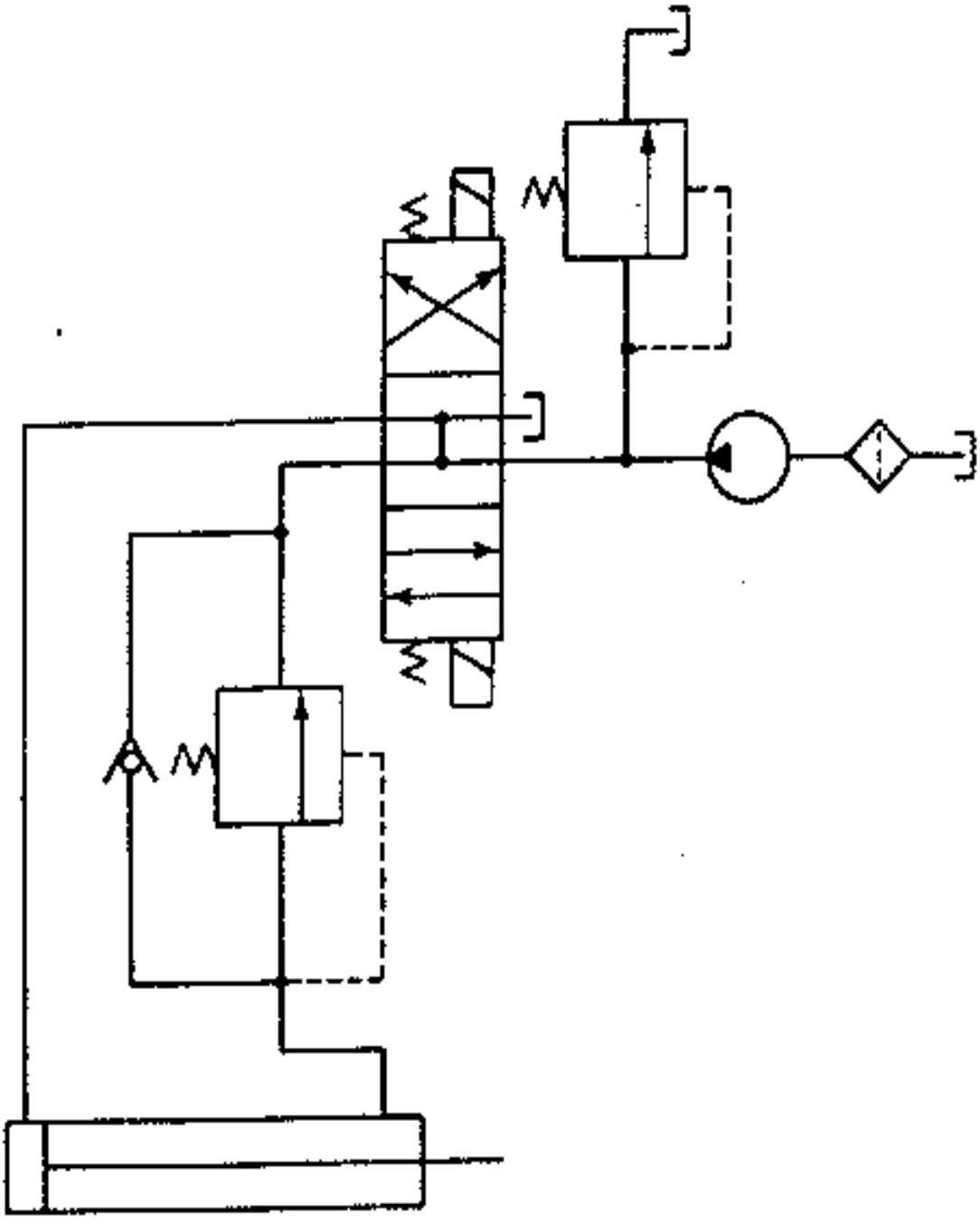
REGENERATIVE HYDRAULIC CIRCUIT

Usually, during extension or retraction of an actuator, high speed is important because a slow actuator wastes time. A regenerative circuit can make an actuator move very fast. When the flow paths on the left are moved to the center, the actuator moves very fast to the right. The pressure is approximately the same on both sides of the piston. Because of the rod on the right, the area over which pressure acts is slightly greater on the left. This is why the actuator moves to the right. The hydraulic oil that is expelled from the right side of the actuator joins with that from the pump and enters the left side of the actuator. Geometry considerations show that the flow that enters the left side can be many times that from the pump. In fact, in the limit as rod diameter goes to zero, flow and speed tend to infinity. However, inertia and friction would counteract this.


X BLOCKED

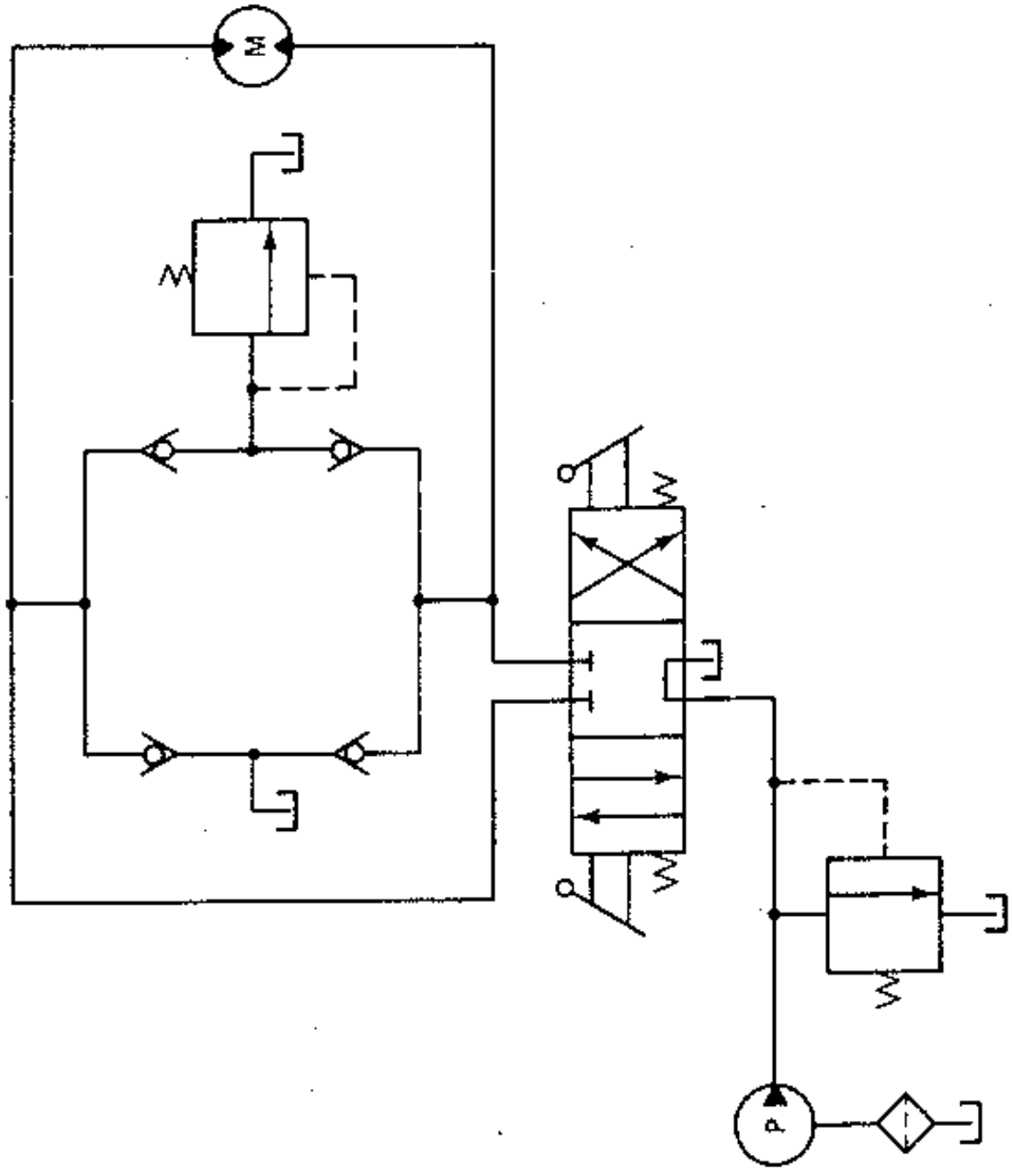
COUNTERBALANCE HYDRAULIC CIRCUIT

Sometimes, power failures can cause hydraulic pistons with heavy loads to become unsupported and fall under gravity. This could cause damage to equipment or people. A counterbalance circuit protects against this. Such a circuit is shown to the right of the actuator. With the flow paths as shown, the pressure relief valve traps the hydraulic oil directly below the piston. Its operating pressure is greater than the pressure required to support the piston load. So, the piston does not fall. When the flow paths on the right are active, the pressure below the piston becomes high and opens the relief valve and the piston moves downward. When the flow paths on the left are active, oil bypasses relief valve through check valve and the piston moves upward.



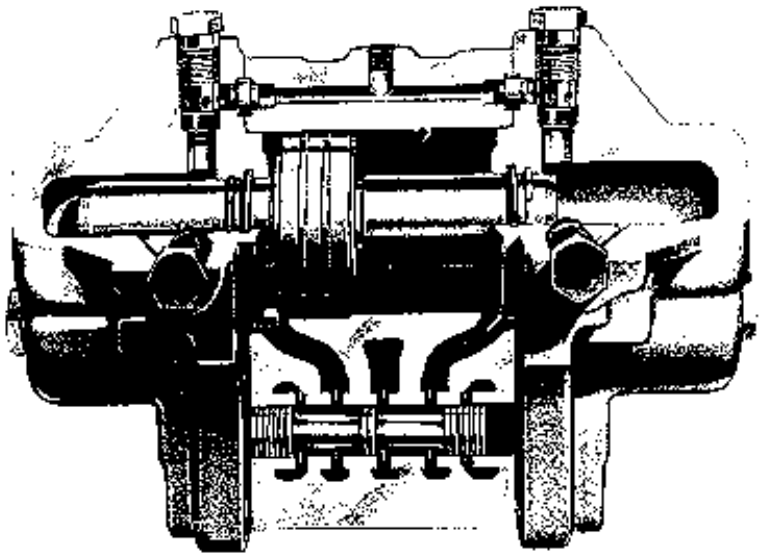
HYDRAULIC BRAKE CIRCUIT

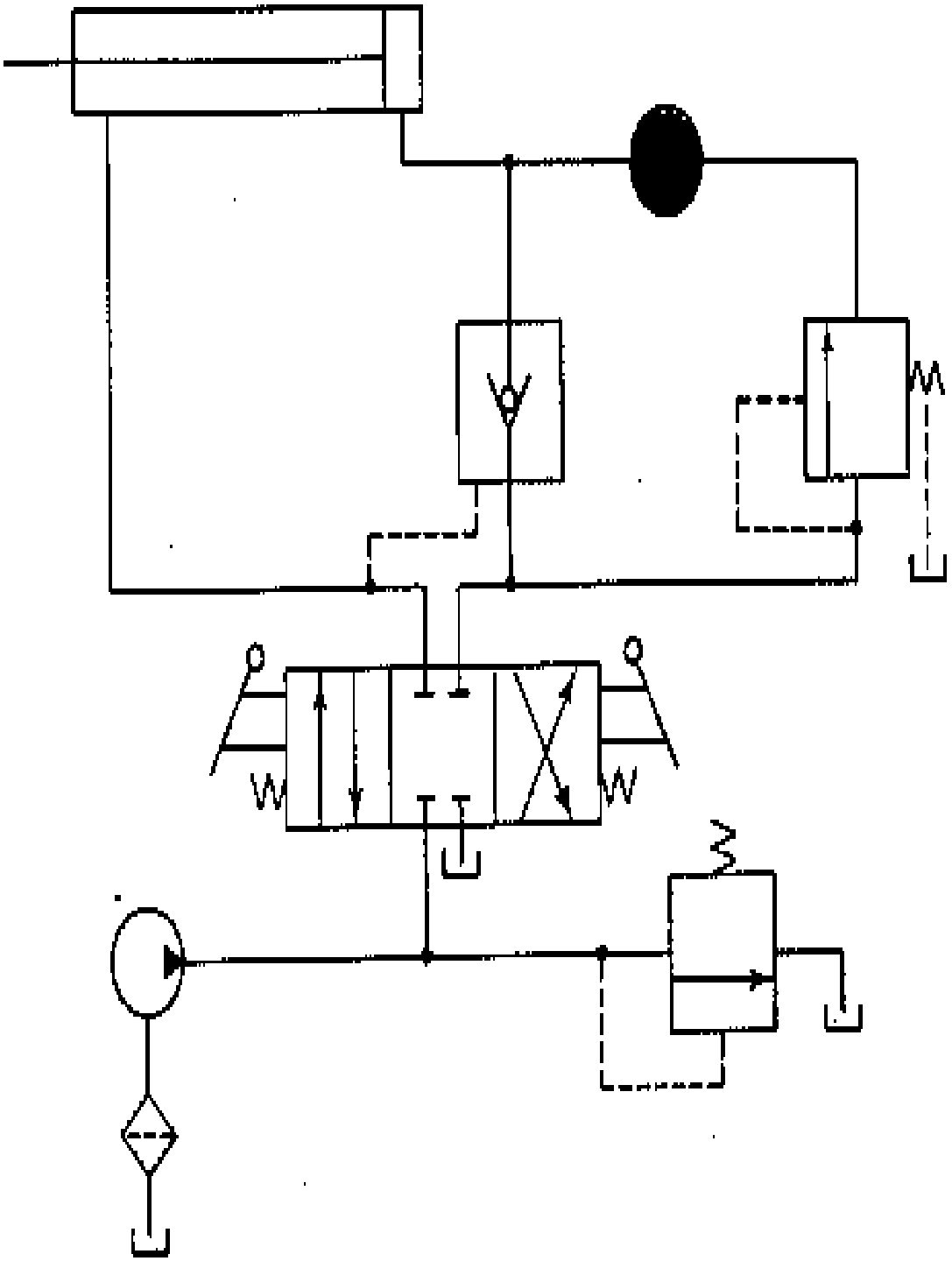
Sometimes, hydraulic pumps are used to operate hydraulic motors. Imagine that the flow paths on the left were operating but because of a power failure the neutral paths suddenly took over. Because of its inertia, the hydraulic motor could act as a pump and generate high pressure one side of it and low pressure the other side of it. Both could damage the hydraulic lines. The circuit to the left of the motor protects the lines from such pressures. If hydraulic oil was moving down through the motor at the moment of failure, it would generate pressure below that would open the relief valve and allow oil to escape to the sump. It would also suck oil from the sump through the top check valve on the left: this would prevent collapse due to suction. Because the motor is acting as a pump, it would gradually lose its energy to the oil. The oil would act as a brake.


M
P

PRESSURE INTENSIFIER CIRCUIT

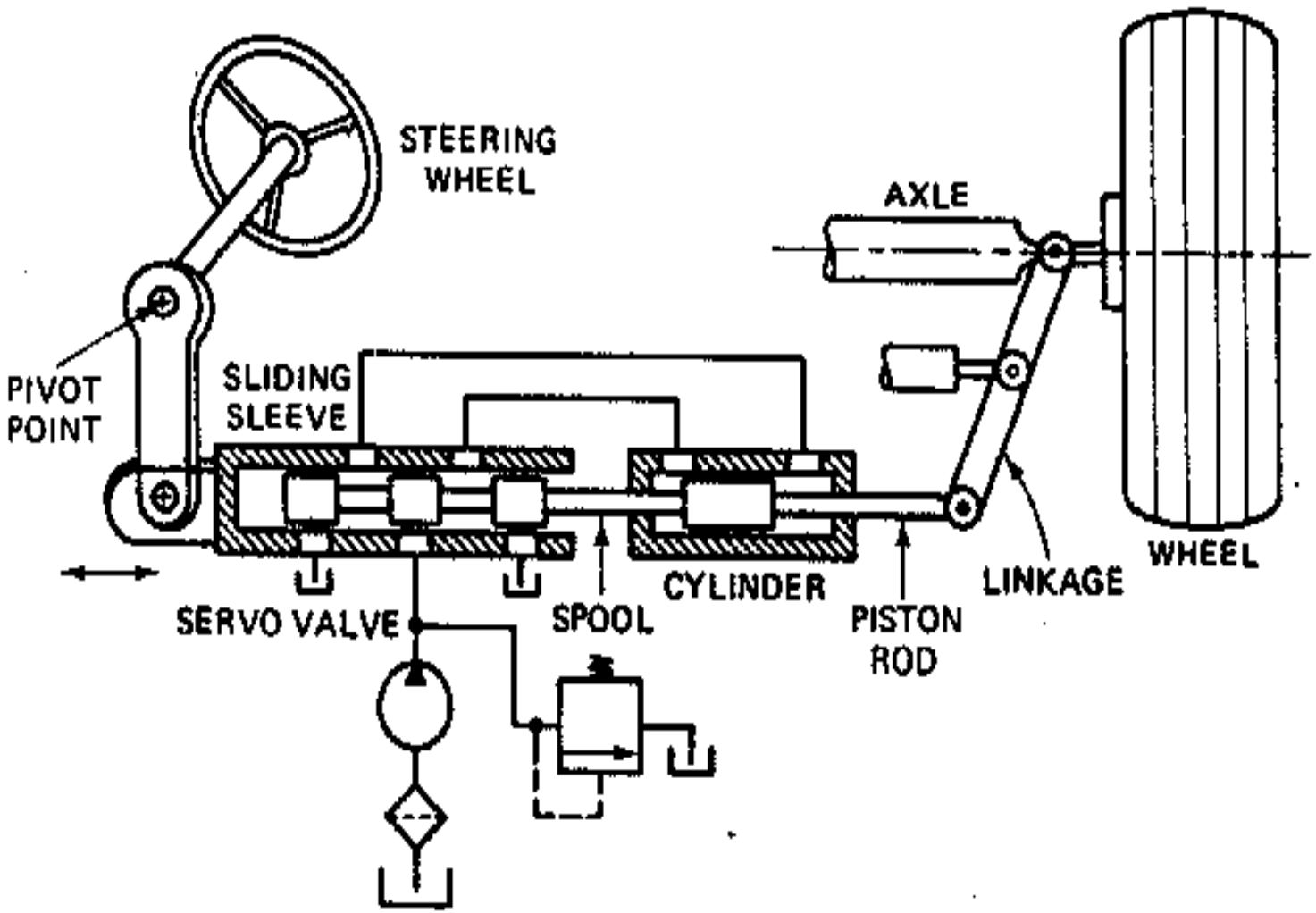
Punch presses require high pressure when they are pressing something. One could use a double pump circuit to get such pressures. However, one could also use just a high flow pump and a pressure intensifier. Essentially, a pressure intensifier is a piston that has a larger area on one side than on the other. During a press operation, the larger area side feels low pressure oil from the high flow pump. The other side pressurizes oil in the press actuator. Only a limited amount of oil can be pressurized so the movement of the actuator piston must be small.





POWER STEERING HYDRAULIC CIRCUIT

When the steering wheel rotates clockwise, it moves the sliding sleeve to the left. This creates a flow passageway from high pressure to the right side of the cylinder and from low pressure to the left side of the cylinder. This moves the piston to the left and rotates the wheel clockwise. As the piston moves, it gradually closes the flow areas opened up by the movement of the sliding sleeve. When the areas are closed, the piston stops. So, a certain amount of steering wheel rotation clockwise generates a certain amount of wheel rotation clockwise. When the steering wheel rotates counter clockwise, the wheel also rotates counter clockwise.


STEERING
WHEEL
AXLE
PIVOT
POINT
SLIDING
SLEEVE
WHEEL
CYLINDER
LINKAGE
SERVO VALVE
SPOOL
PISTON
ROD