About Hydraulic system 液压系统

Excavator hydraulic system function

- ✓ walk straight
- ✓ stick lock
- ✓ Stick cylinder oil return regeneration
- ✓ Bucket cylinder oil return regeneration
- ✓ boom lock
- ✓ Swing automatic brake delay
- ✓ Rotary anti-reverse
- ✓ instant boost
- ✓ boom priority
- ✓ Rotation Priority
- ✓ Walking pilot valve hydraulic damping
- ✓ Stick flow cut-off on level ground

Common Line Types and Symbols for Hydraulic System Schematic Diagrams

Thick solid line	main pipe and main oil passage.
Dotted lines	control lines and control oil passages.
Double-dot dash line	composed of components, which are generally closed.
Whether the oil circuit is connected or not	There are 3 ways to express it. (1)Dots and intersections; (2)Intersections and small arcs; (3)Dots and small arcs

Symbols and meanings

P	Pump pressure oil
A, B	working oil port of oil cylinder or motor
O, T, Dr	fuel tank

The hydraulic system consists of parts

Power element	convert mechanical energy into liquid pressure energy.
Actuator	converts liquid pressure energy into mechanical energy. Such as oil cylinders, oil motors, etc.
Control elements	various valves. Generally, there are pressure control valves, flow control valves, directional control valves, etc.
Auxiliary components	tanks, filters, lines, fittings, seals, coolers, accumulators, etc.

Hydraulic pump - gear pump	Hydraulic pumps - axial piston pumps
oil absorption A closed volume is always in a constant state of increasing	
Drain A closed volume is always in a state of ever-decreasing	

Hydraulic pumps and hydraulic motors are reversible in principle, but their structures are slightly different.

Basic performance parameters of hydraulic pumps	
Pressure P (unit Mpa, MPa)	The output pressure of the pump is determined by the load. Load ↑ pressure ↑, load ↓ pressure ↓. The safety valve limits the maximum pressure.
Displacement q (unit ml/r, ml/revolution)	The volume of hydraulic oil discharged per revolution of the pump. A pump with a fixed displacement is called a fixed pump; a pump with a variable displacement is called a variable pump.
Flow Q (unit L/min, liter/minute)	The volume of output hydraulic oil per unit time. $Q=q\times n$ (do not consider the unit conversion coefficient, the same below) where n is the speed of the pump in rpm, rev/min
Pump power N (unit Kw, kilowatt)	$N=P\times Q$
Displacement q (unit ml/r, ml/rev)	The volume of liquid displaced by a hydraulic motor per revolution. The fixed displacement motor is called the fixed displacement motor, and the variable displacement motor is called the variable displacement motor.
Output torque M (in NM, Nm)	$M=\triangle P \times q \times \eta$ Among them, ΔP is the pressure difference between the inlet and outlet of the motor, and η is the mechanical efficiency of the motor.
Output speed n (in rpm, rev/min)	$n=Q \times \eta/q$ where η is the volumetric efficiency of the motor.

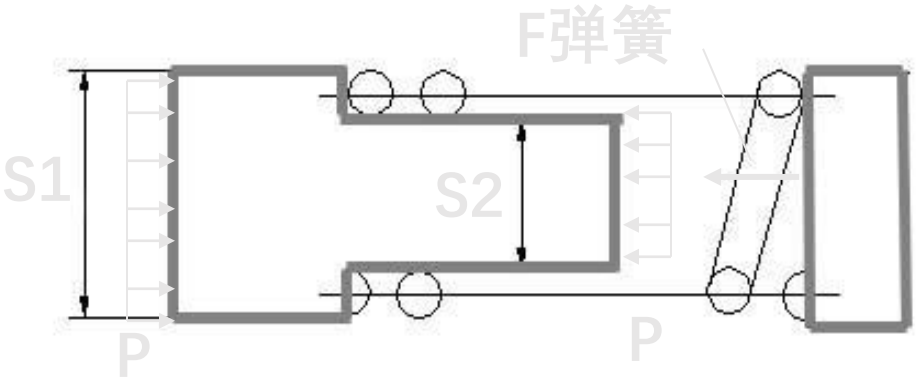
Differential principle

Valve stem force balance equation:

P×S1 = P ×S2 + F spring

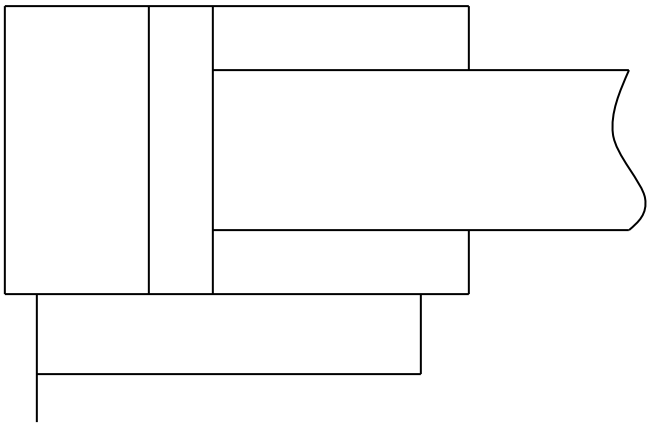
P×（S1－S2） = F spring

differential stem



double acting cylinder

differential cylinder



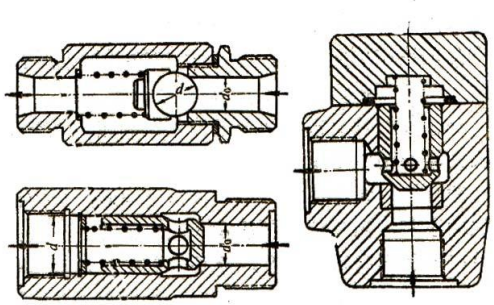
Hydraulic control valve

flow control valve	It mainly controls the flow through the pipeline, and can also have a certain influence on the pressure of the circuit through the control of the flow. Note that throttling has losses. 1) Throttle valve (orifice) After the hydraulic oil passes through structural elements such as small holes, gaps, and narrow grooves, the flow rate is reduced and a pressure drop △P (damping) is generated. Note that flowing hydraulic oil has the above properties. If the hydraulic oil is in a static state, then according to the principle of the connector, the front and rear pressures are equal.
pressure control valve	1) Safety valve limit the maximum pressure of the system and protect system components from being damaged by high pressure. a) Direct-acting type: medium and low pressure system b) Pilot type: high pressure system 2) Overload valve: limit the maximum pressure of the closed pipeline. 3) Pressure reducing valve One pump supplies two or more circuits with different pressures at the same time. a) Direct-acting type: medium and low pressure system b) Pilot type: high pressure system
directional control valve	It is mainly used to control the direction, and the opening of the valve can also be used to moderately control the flow and pressure of the circuit. 1) One-way valve: only allows hydraulic oil to pass through in one direction. 2) Selector valve: Automatically select the direction of hydraulic oil passage according to the pressure in the circuit. 3) Globe valve: One position is closed, the other position is passed. 4) Hydraulically controlled reversing (hydraulic pilot control) 5) Solenoid valve control reversing 6) Two way cartridge valve

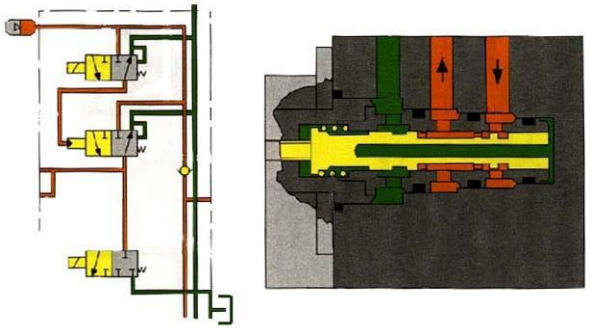
Hydraulic control valve

flow control valve	It mainly controls the flow through the pipeline, and can also have a certain influence on the pressure of the circuit through the control of the flow. Note that throttling has losses. 1) Throttle valve (orifice) After the hydraulic oil passes through structural elements such as small holes, gaps, and narrow grooves, the flow rate is reduced and a pressure drop △P (damping) is generated. Note that flowing hydraulic oil has the above properties. If the hydraulic oil is in a static state, then according to the principle of the connector, the front and rear pressures are equal.
pressure control valve	1) Safety valve limit the maximum pressure of the system and protect system components from being damaged by high pressure. a) Direct-acting type: medium and low pressure system b) Pilot type: high pressure system 2) Overload valve: limit the maximum pressure of the closed pipeline. 3) Pressure reducing valve One pump supplies two or more circuits with different pressures at the same time. a) Direct-acting type: medium and low pressure system b) Pilot type: high pressure system
directional control valve	It is mainly used to control the direction, and the opening of the valve can also be used to moderately control the flow and pressure of the circuit. 1) One-way valve: only allows hydraulic oil to pass through in one direction. 2) Selector valve: Automatically select the direction of hydraulic oil passage according to the pressure in the circuit. 3) Globe valve: One position is closed, the other position is passed. 4) Hydraulically controlled reversing (hydraulic pilot control) 5) Solenoid valve control reversing 6) Two way cartridge valve

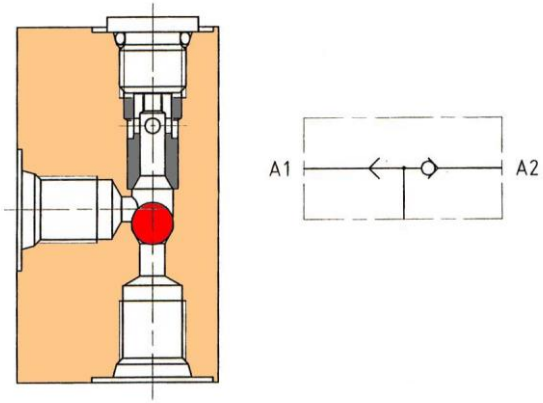
check valve



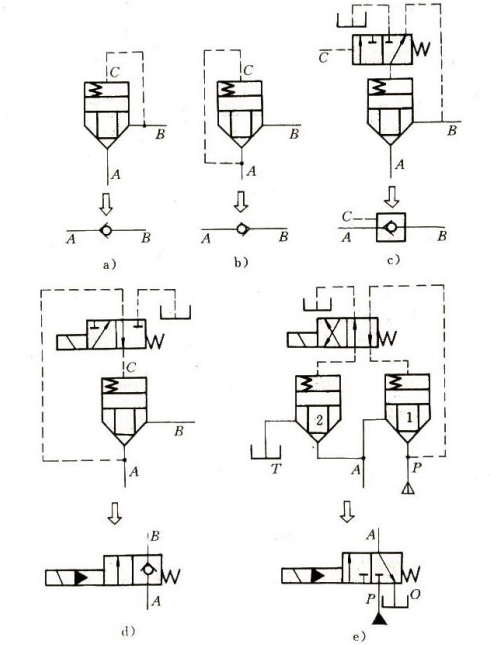
Reversing valve



Selector valve
(shuttle valve)

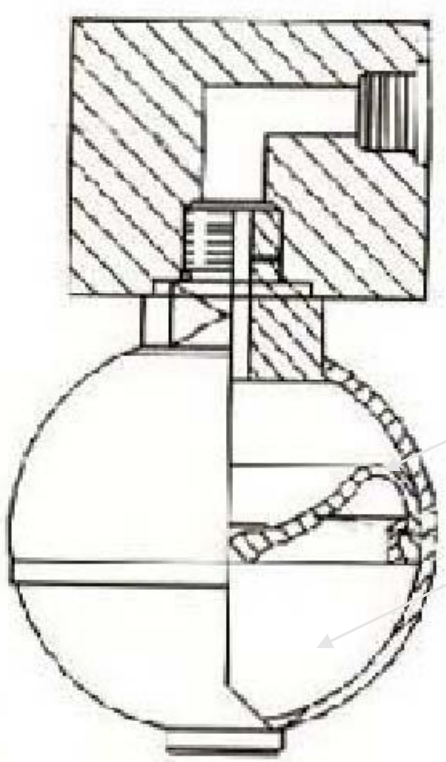


Two way cartridge valve

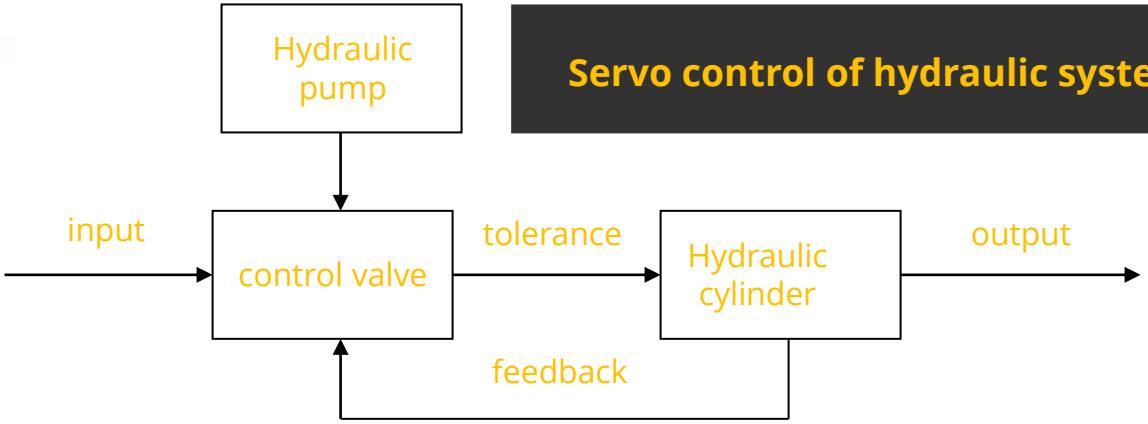


Hydraulic accumulator

Principle: Gas is compressed to store energy.Function: absorb hydraulic vibration and shock and can be used as emergency energy.



Servo control of hydraulic system



Unique Features of the Main Control Valve

Walk in a straight line	When the excavator is running in a straight line, regardless of any movement of the driver's control of the slewing or the working device, the straight-line travel valve stem will keep the excavator in a straight line, or keep the relative flow into the two travel motors unchanged.Basic principle: After deducting the flow required by other actions, the oil output of the two pumps is merged through the linear travel valve stem and redistributed to the two travel motors.
Instant boost	Increase the pressure of the safety valve of the hydraulic system in a short time, lasting about 8 seconds. Use this feature when digging with large rocks or tree roots
priority (relative to stick)	1) Swing priority: When the swing and stick are operated at the same time, the swing motor takes more oil, and the stick cylinder takes less oil; 2) Boom priority: When the boom and stick are operated at the same time, the boom cylinder will receive more oil, and the stick cylinder will receive less oil; Why use priority function? It is to make the combined action of the excavator more coordinated and work more efficient. Why is it generally preferred over sticks? Because the stick cylinder is the confluence of two pumps, the flow into the stick cylinder is very large, that is to say, the movement speed of the stick cylinder is faster than other parts.
Median lock	There are boom center lock and stick center lock. When the excavator needs to be fixed for a long time (for example, when hoisting a welded pipeline), because the cylindrical valve stem will always have a small amount of leakage, it is unreliable to rely solely on the central position of the main valve to lock (when the cylinder has no internal leakage). Therefore, a hydraulic lock valve must be installed between the main valve and the oil cylinder, relying on this valve to ensure the long-term positioning of the boom cylinder and stick cylinder.
Oil return regeneration (referred to as regeneration)	Oil return regeneration of split boom cylinder, oil return regeneration of stick cylinder and oil return regeneration of bucket cylinder. The role of regeneration: speed up the movement of these cylinders and increase productivity. The principle of regeneration: When oil is fed into the large cavity of these oil cylinders, if the oil in the large cavity is too fast and the oil supply of the pump is insufficient, the oil in the small cavity can be directly supplied to the large cavity through the one-way valve.

About Changsha Part Sea Co., Ltd.

www. partssea.com