Electro hydraulic circuits

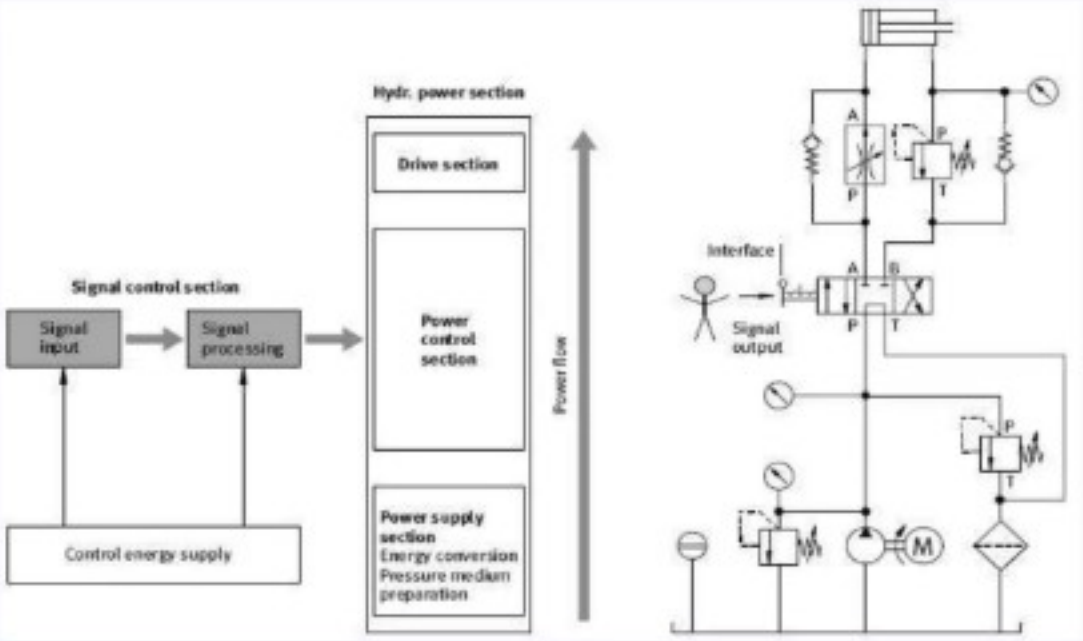
Parts of a Hydraulic System

Signal control section

The Signal section is divided into signal input (sensing) and signal processing (processing).

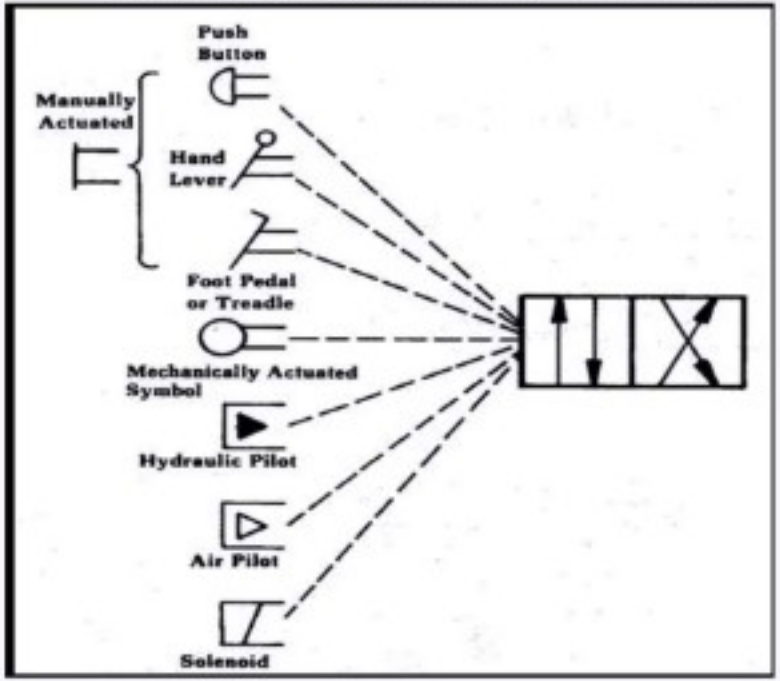
Signal input can be:
- Manual
- Mechanical
- Contactless

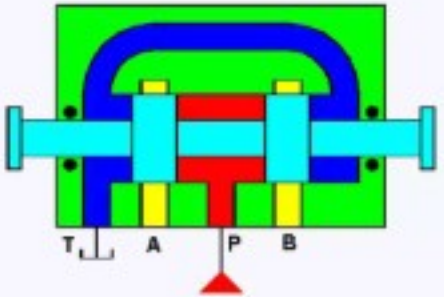
Signal can be processed by:
- Operator
- Electricity
- Electronics
- Pneumatics
- Mechanics
- Hydraulics



Hydraulic Components Symbols

- Direction Control Valves (DCV) – Method of Actuation



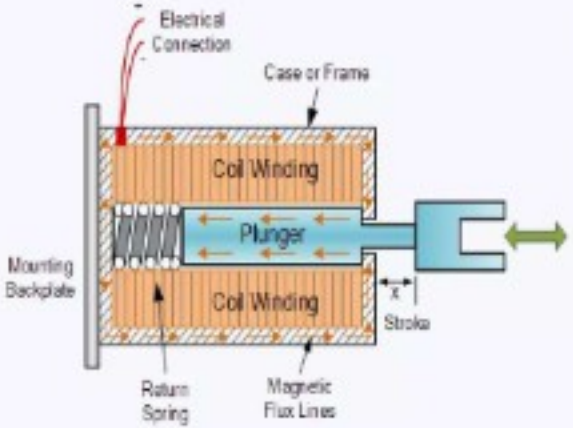


Solenoid valve

❑A solenoid valve is a type of valve that uses an electrical current to actuate or shift a spool or cartridge consisting of a solenoid coil and tube assembly.

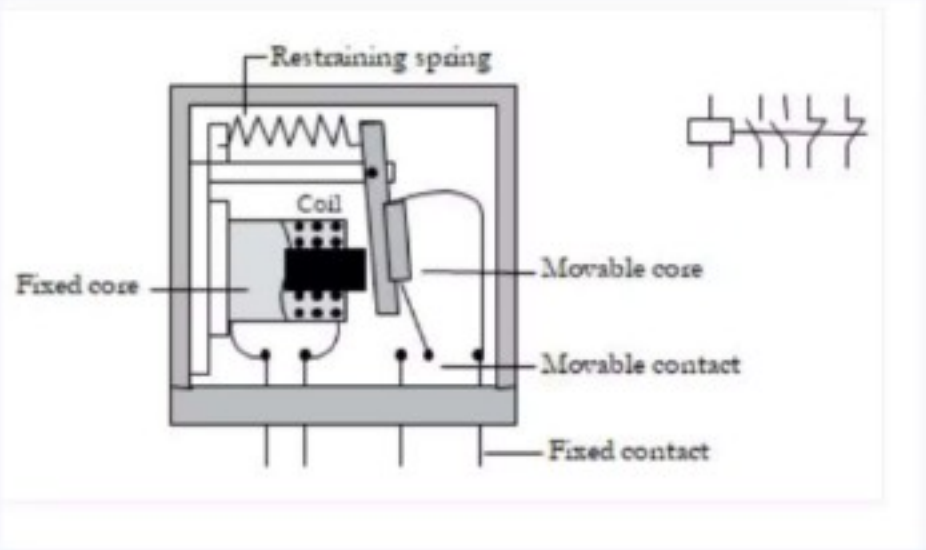
Basically, this valve type uses an electric current to shift a pin to perform simple A/B tasks such as open/close valve spools.

The designation "solenoid" means that the valve operation is electrical not manual.



❑Maybe the easiest way to describe a solenoid valve is by thinking about an automatic car lock. The electric current get triggered, the pin gets pushed up and the doors are unlocked. A reverse current gets triggered, the pin gets pushed down, and the doors are locked.

The relay mainly consists of a coil and a number of independent contact sets. Each contact set consists of a stationary contact and a movable contact. It also includes a stationary core and a movable core to confine the magnetic field. The movable contacts are coupled to the movable core.



A **solenoid valve** is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas.

Advantageous of Solenoids

fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, Low control power and compact design.

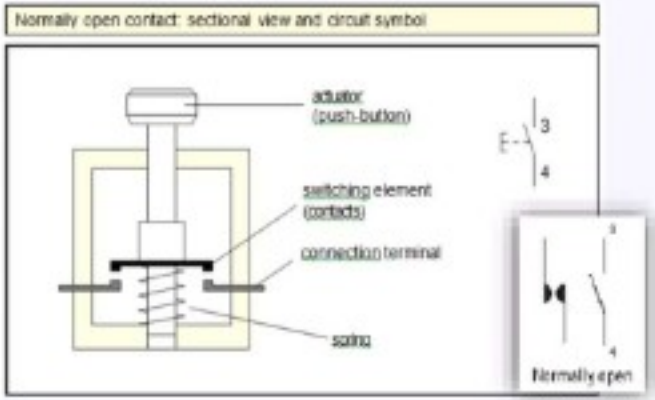
Electrical Control of hydraulic circuits

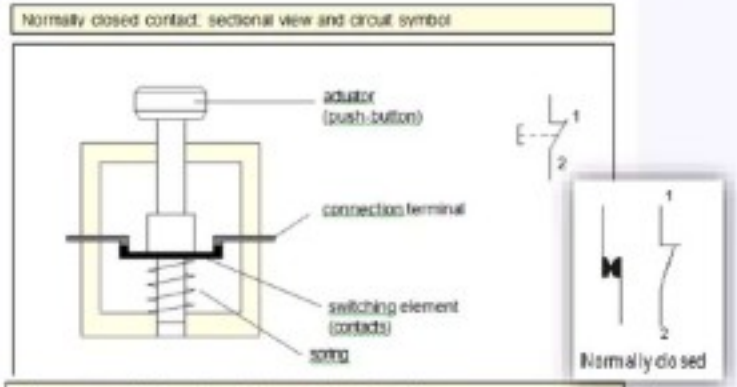
5.1 Control Power Supply

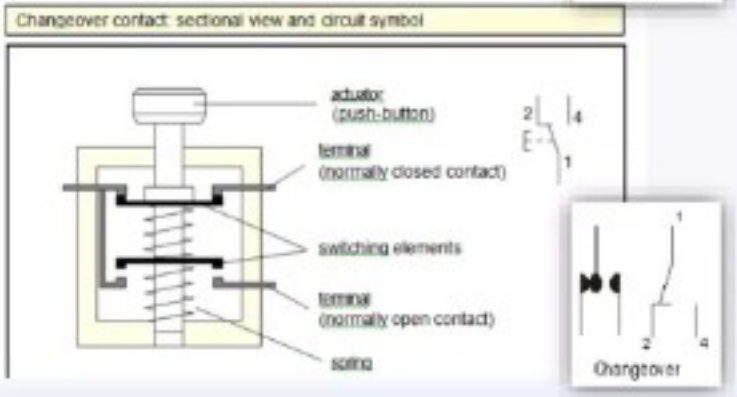
- Usually 24 V DC.

5.2 Push Button and Switches

- Normally open contact
- Normally closed contact
- Change over contact



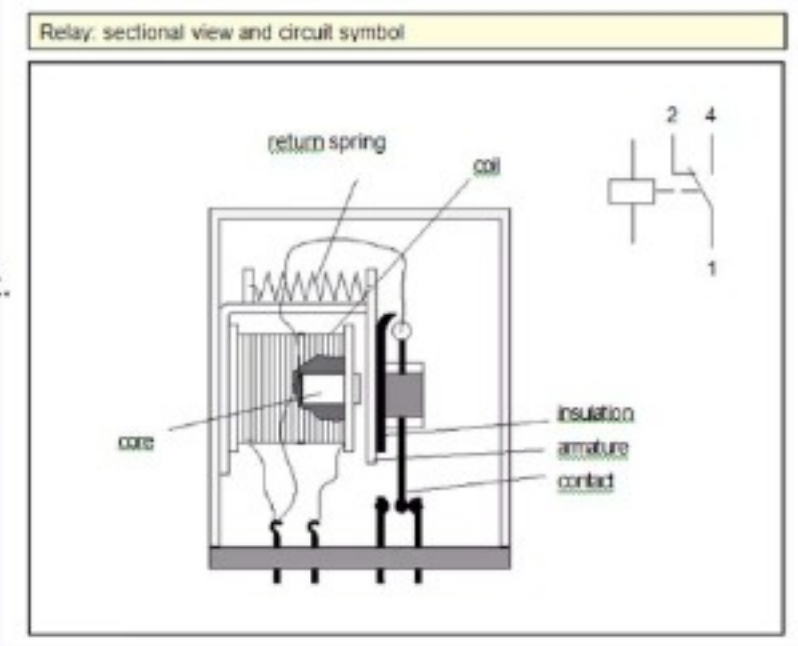




Electrical Control of hydraulic circuits

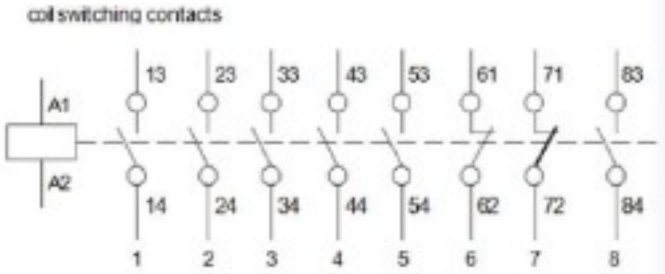
5.3 Relays and Relay Contacts

- Relays are designated K1, K2, K3 etc.
- Coil terminals are designated A1 and A2.
- Contacts switched by the relay are also designated K1, K2, resp., etc. in circuits



Electrical Control of hydraulic circuits

Circuit symbols and terminal designations of a relay



Function numbers for relays

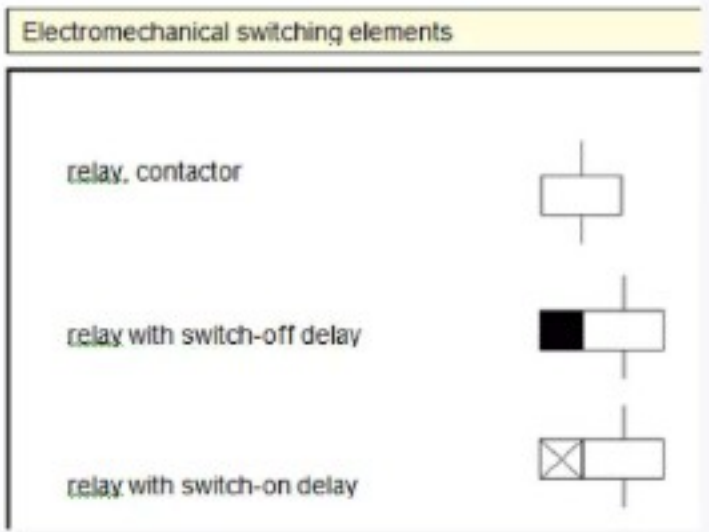
1	2		normally closed contact
3	4		normally open contact
5	6		normally closed contact, time delay
7	8		normally open contact, time delay
1	2	4	changeover contact
5	6	8	changeover contact, time delay

Terminals of the auxiliary contacts (relay contacts) are designated by two digit numbers:

- the first digit is the ordinal(position) number
- the second digit is the function number

Electrical Control of hydraulic circuits

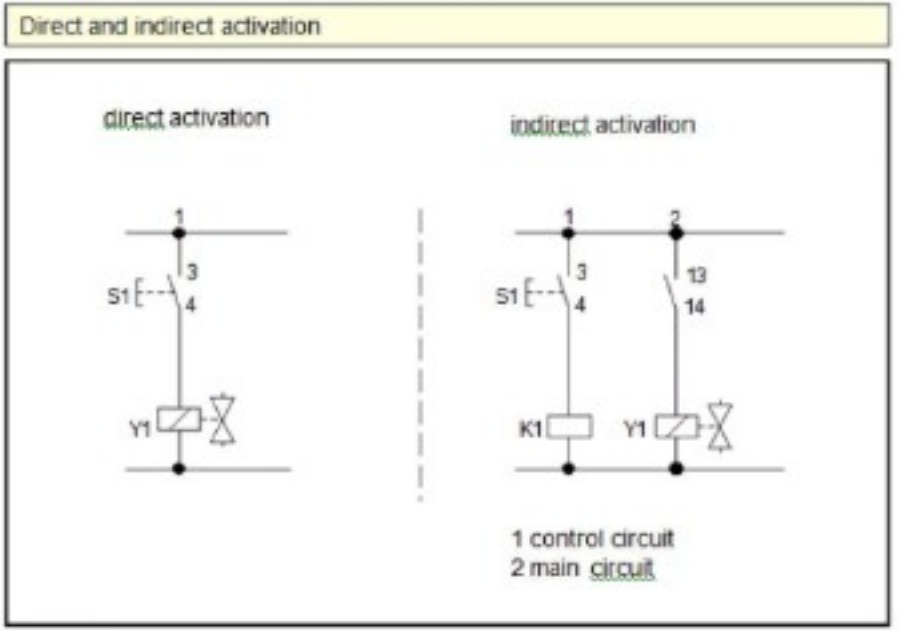
5.4 Relay operation types



5.5 Representation of solenoid operated direction control valve

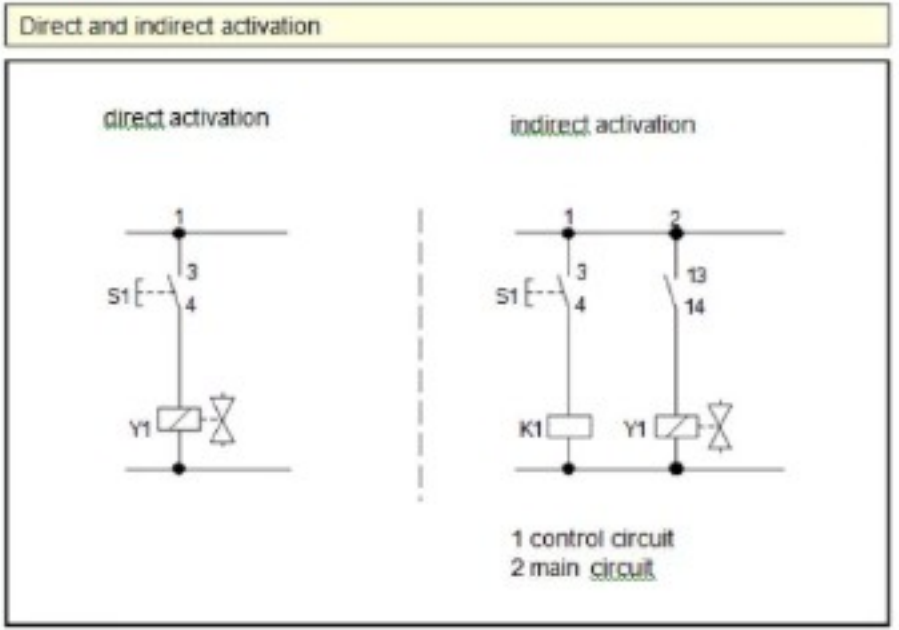
Electrical Control of hydraulic circuits

5.4 Electrical control circuit illustration

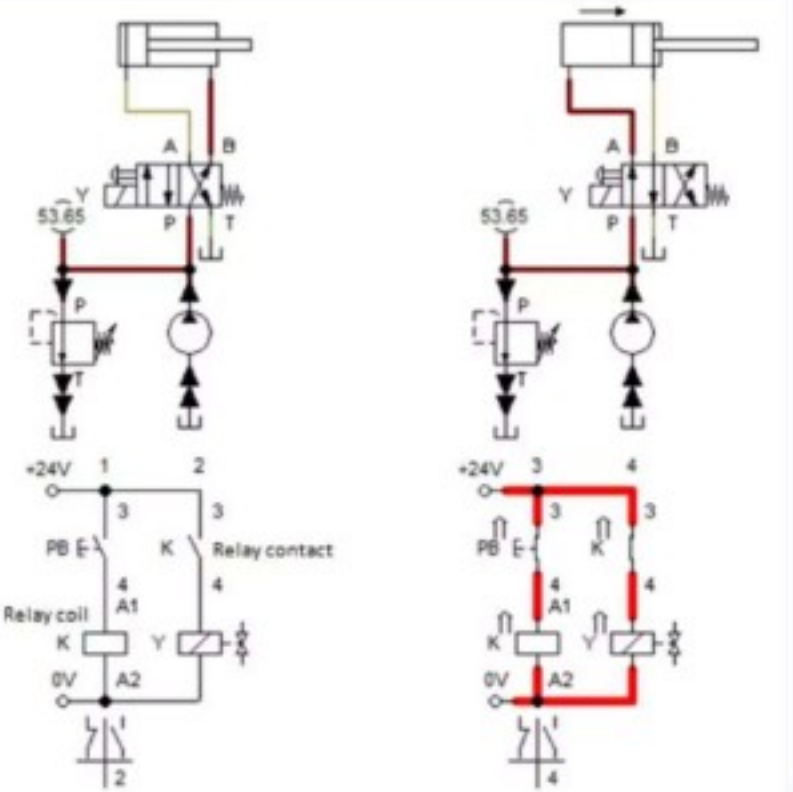


Electrical Control of hydraulic circuits

5.4 Electrical control circuit illustration



Indirect control of a double-acting hydraulic cylinder using a relay

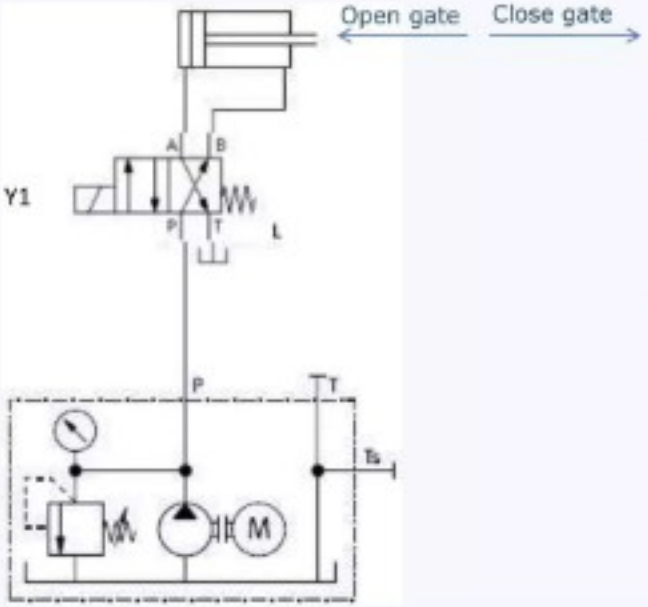


Two positions of a self-explanatory electro-hydraulic circuit for the indirect control of a double-acting hydraulic cylinder are given below.

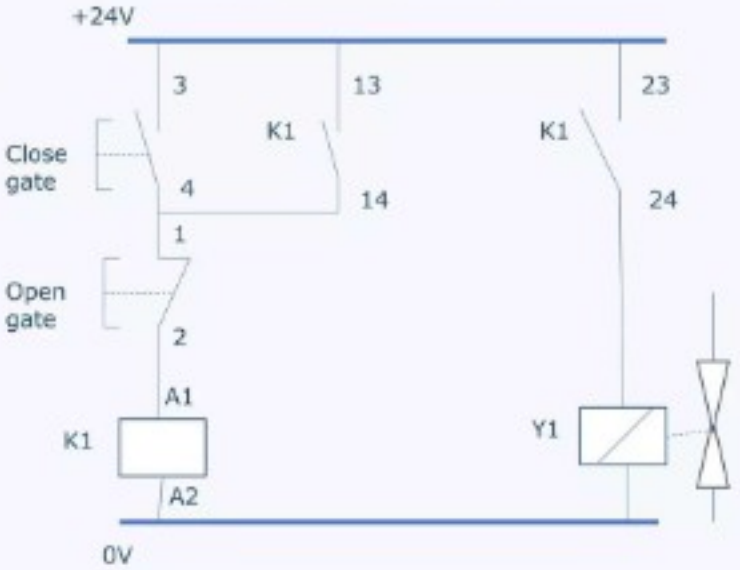
Electro-hydraulic Circuit illustration

5.3 Electro hydraulic circuit for operating a hydropower gate for water intake canal

- Hydraulic circuit



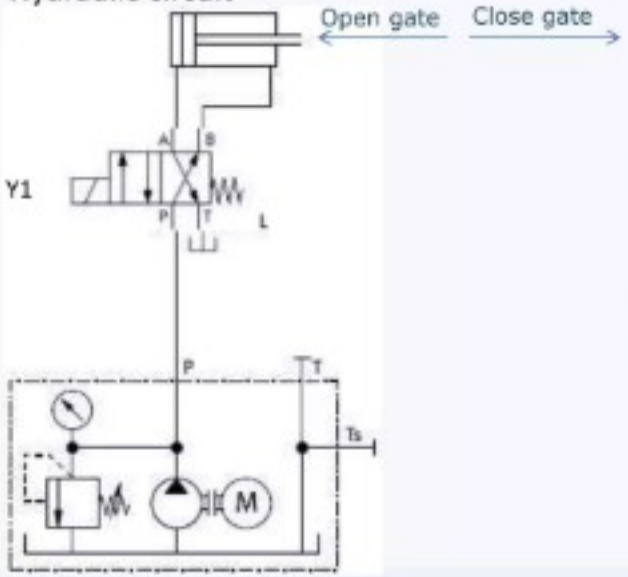
- Electrical control circuit



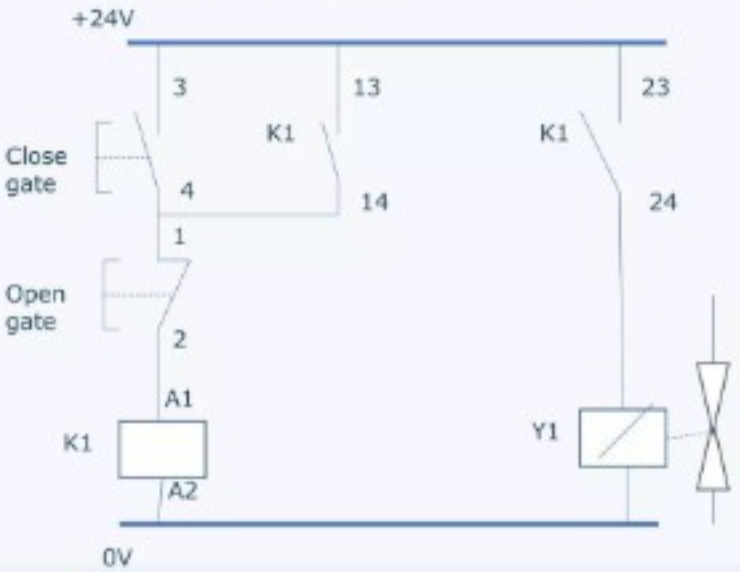
Electro-hydraulic Circuit illustration

Exercise: Reproduce and simulate the provided Electro hydraulic circuit for hydropower gate operation using the FESTO software and ascertain that the circuit will operate as intended.

- Hydraulic circuit



- Electrical control circuit



Logic Controls, Electric

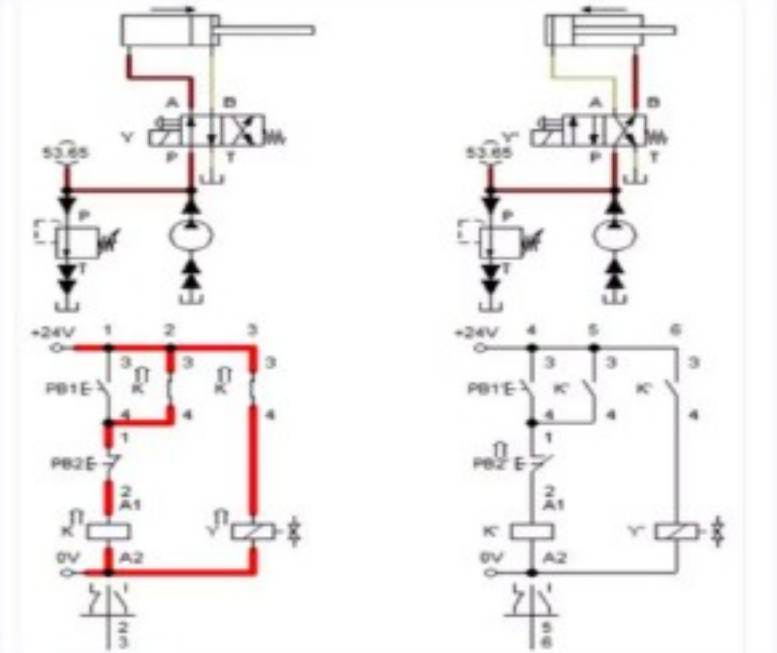
Logic controls are used to start or stop various operations in hydraulic systems based on the satisfaction of certain conditions in these systems. Two of the most important logic functions are 'AND' and 'OR'. These functions are used to logically combine signals representing certain conditions in a system. In the AND logic function, the output is produced when all the inputs are present. In the OR logic function, the output is produced when one or more (≥1) inputs are present.

Memory Function

A circuit/device with a memory function 'remembers' its last output state even after the input signal from an input device responsible for this output has been removed. A memory function can be implemented in electro-hydraulic circuits by using an electrical latching circuit or by using a double solenoid valve.

Latching Circuit, Electric

The electrical latching circuit is given in its latched and unlatched positions.

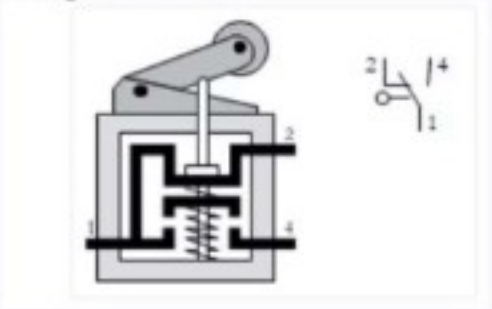


Sensors

Sensors can detect the presence of objects. A sensor can work either by the actual physical contact with an object or by the movement of the object in its proximity. Accordingly, the sensors are classified as contact-type sensors (e.g. limit switch) and contactless-type sensors (e.g. proximity sensors).

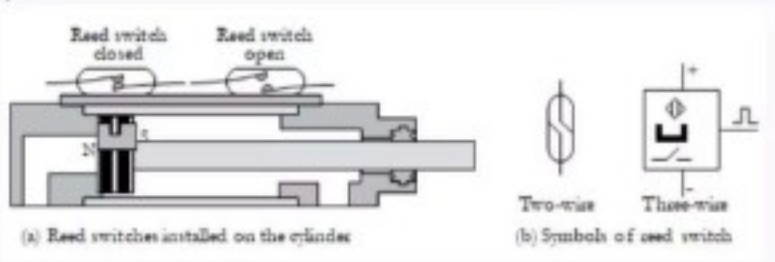
Limit Switch

A limit switch is a contact-type sensor comprising a set of switching contacts (NO/NC/CO type), a roller-operated plunger, and return springs. The roller lever is mechanically linked to the contacts. It is usually actuated mechanically by a moving element, such as a cylinder piston, in the associated machine to indicate a particular position of the moving element.



Reed Switch

A reed switch consists of two metal strips (reeds) acting as switching contacts. It is hermetically sealed in a glass tube filled with an inert gas to prevent the corrosion of its contacts. This unit is further encapsulated in epoxy resin casing. It is designed to mount on a cylinder. It reacts to the magnetic fields of the permanent magnets provided on the cylinder piston.

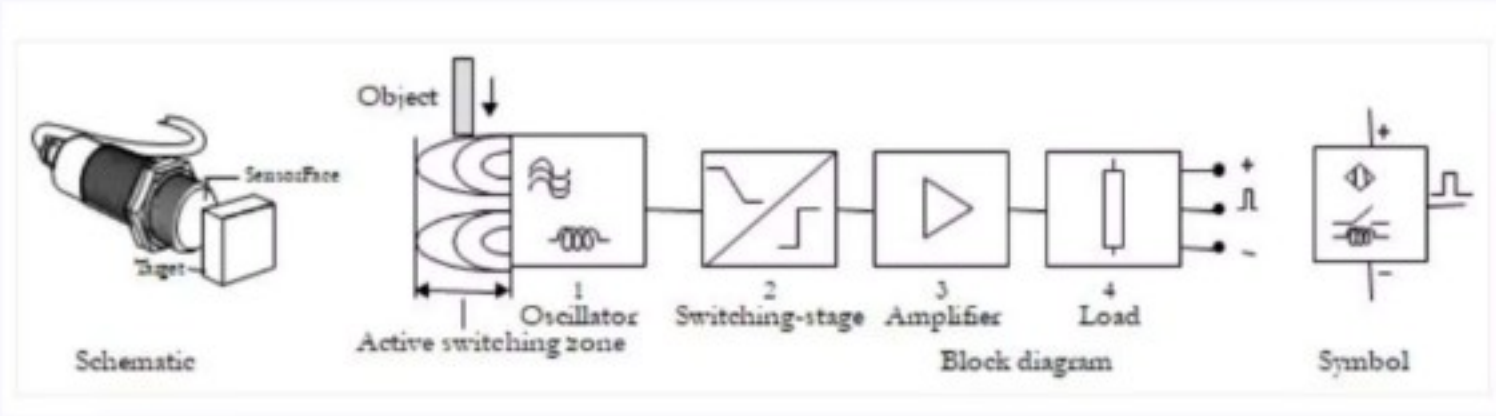


Proximity Sensors

A proximity sensor is a contactless-type sensor that detects the presence of an object using a detection system and converts this information into a corresponding electrical signal. One type of detection system uses the eddy currents that are generated in a metallic sensing object by the interaction of the detection system and the object. Another type detects the changes in the electrical capacity of the capacitor in the detection system when an object approaches the sensor. Yet another type detects objects through a variety of optical properties. Accordingly, there are three basic types of proximity sensors. They are (1) Inductive-type sensors, (2) Capacitive-type sensors, and (3) Optical-type sensors.

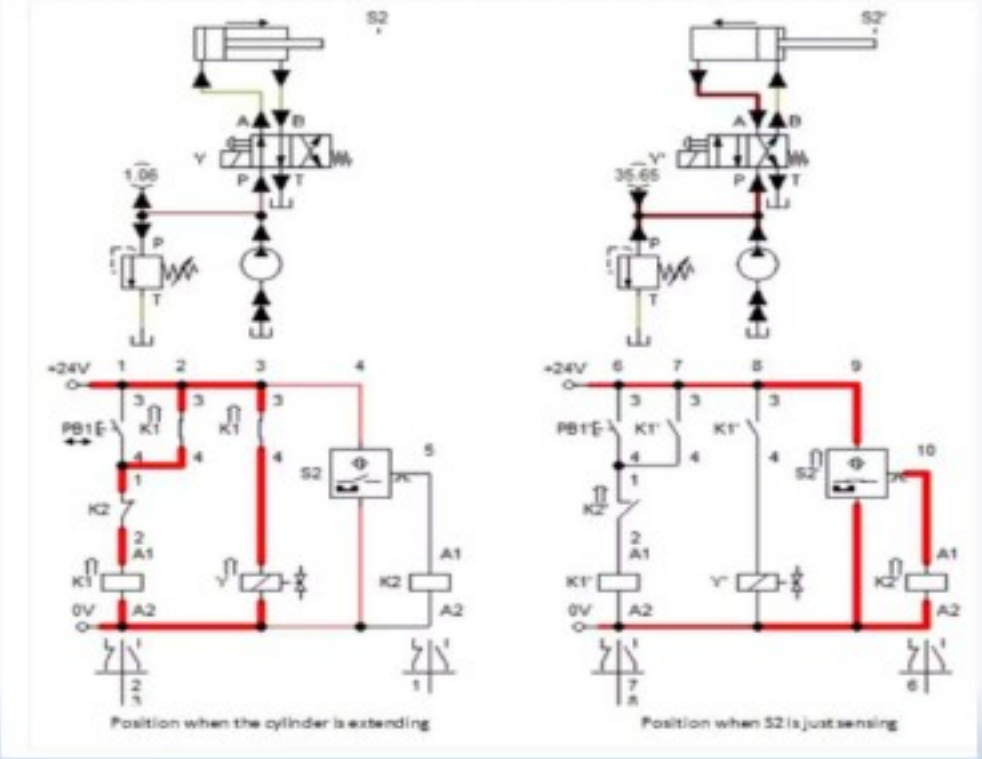
Inductive Proximity Sensor

Inductive proximity sensors are widely used in modern high-speed industrial and process control systems for the detection of metallic objects. An inductive proximity sensor consists of the following blocks (1) an oscillator circuit, (2) a switching circuit, (3) an amplifier, and (4) an output stage, all housed in a resin-encapsulated body.



Semi-automatic operation of a double-acting hydraulic cylinder using a sensor

The hydraulic part and the electrical part of the circuit for the semi-automatic operation of a double-acting hydraulic cylinder using a proximity sensor (S2) are given in the Figure below which is self explanatory.



Time-delay Relays (Timers)

A time-delay relay (or timer) is a control device, used to obtain a specified time delay between the work operations in an industrial system. There are two basic types of timers. They are (1) On-delay timer and (2) Off-delay timer. **On-delay Timer**: An on-delay timer delays the operation of its contacts for, say 't' seconds, when the coil is energized (ON), but the timer brings back its contacts immediately to their normal positions when the coil is de-energized (OFF).