

# Basics of hydraulics

**Autotronics Program**

**Section3**

# Cylinders

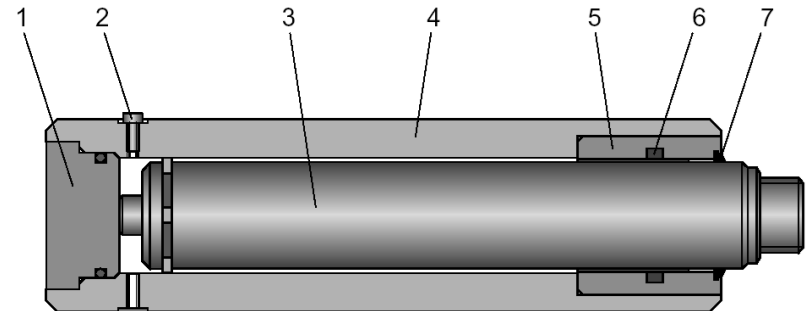
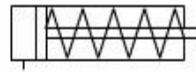
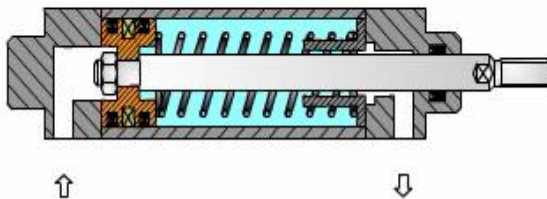
The hydraulic cylinder converts hydraulic energy into mechanical energy.

There are two basic types of hydraulic cylinder

- Single-acting and
- Double-acting cylinders.

## Single-acting cylinder:

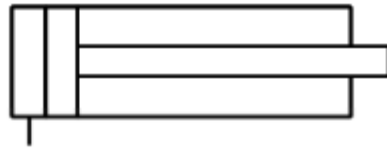
단동 실린더



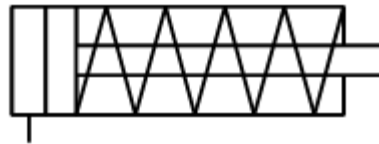
- |                   |                      |
|-------------------|----------------------|
| 1 Mounting screw  | 5 Piston rod bearing |
| 2 Vent screw      | 6 Piston rod seal    |
| 3 Piston rod      | 7 Wiper              |
| 4 Cylinder barrel |                      |

Fig & video: single-acting cylinder

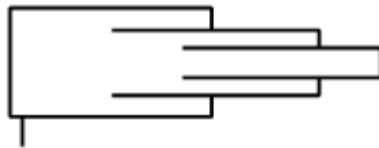
Single acting cylinders just have one port, i.e. only the full piston surface can be pressurized with hydraulic fluid. These cylinders are returned either by the effect of external forces – indicated by the symbol with the open bearing cap – or by a spring. The spring is then also drawn into the symbol.



Single acting cylinder,  
return by external force



Single acting cylinder,  
with spring return



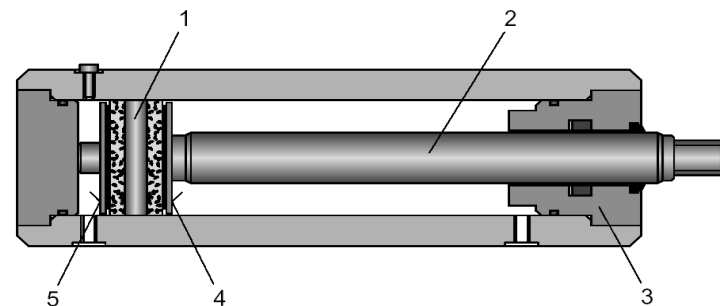
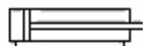
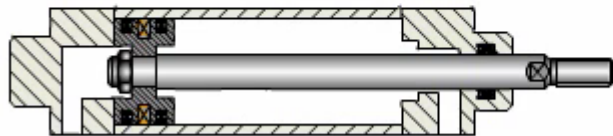
Single acting telescopic cylinder

Fig: Single acting cylinder

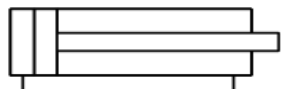
# Double acting cylinder

Double acting cylinders have two ports for supplying either side of the piston with hydraulic fluid.

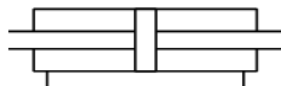
복동 실린더



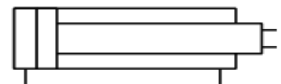
- 1 Piston
- 2 Piston rod
- 3 Piston rod bearing
- 4 Annular piston surface
- 5 Piston surface



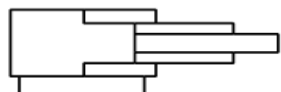
Double-acting cylinder  
With single piston rod



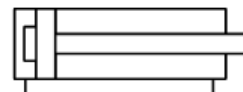
Double-acting cylinder,  
with through piston rod



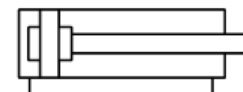
Differential cylinder



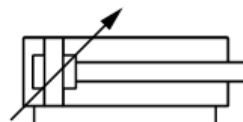
double-acting telescopic cylinder



double-acting cylinder  
with single end position cushioning



double-acting cylinder  
with end position cushioning at both  
ends



double acting cylinder  
with adjustable end position cushioning

Fig & video : Double-acting cylinder

# Electrical Components

## 1- Power supply unit

## 2- Electrical input elements

- **Push-button:** A push-button only opens or closes a current circuit for a short time.
- **Normally open contact:** In this contact, the circuit is open when the push-button is in the normal position; i.e. not pressed. The circuit is closed when the control stem is actuated; current then flows to the consuming device. When the control stem is released, the push-button is returned to its original position by spring pressure.

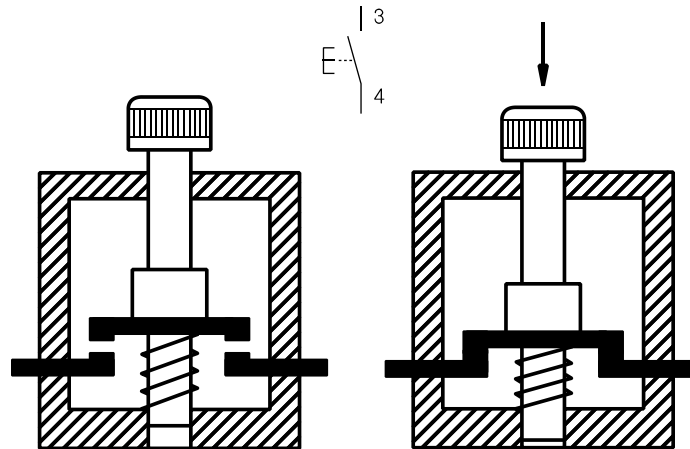


Fig : Normally open contact: sectional view and circuit symbol

- **Normally closed contact**

In this contact, the circuit is closed when the push-button is in normal position. The spring action ensures that the contacts remain closed until the push-button is pressed. When the push-button is pressed, the switching contact is opened against the spring pressure.

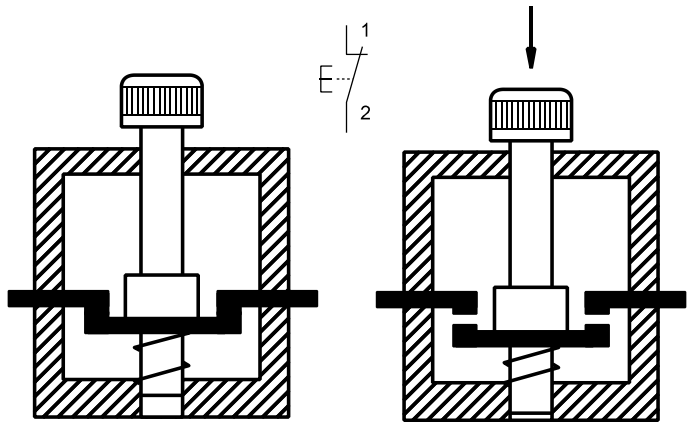


Fig: Normally closed contact: sectional view and circuit symbol

- **Changeover contact**

These contacts combine the functions of normally closed and normally open contacts in one unit. Changeover contacts are used to close one circuit and simultaneously open another.

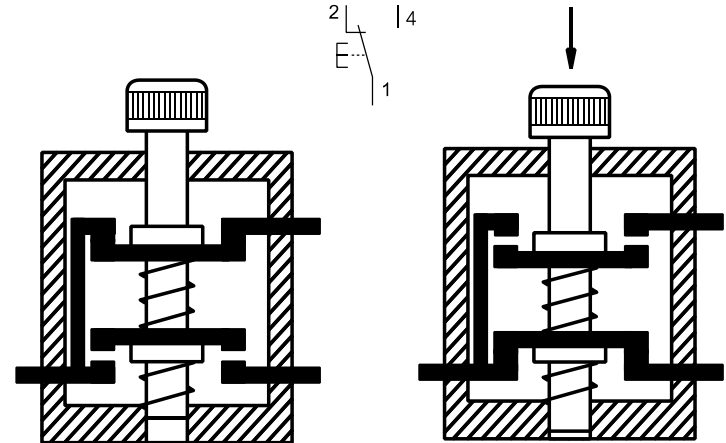


Fig 10.7 Changeover contact: sectional view and circuit symbol

### 3- Sensors

The sensors may provide an accurate and complete view of how a hydraulic system performs. In short, sensors in a hydraulic system can be used for regulation, control and monitoring of the system performance.

#### Types of Sensors in Hydraulics

- **Pressure sensors:** It can be found in different industries like the automotive industry. When the pressure reaches the sensing element, the sensing element reacts to that pressure and then create an output signal.
- **Level sensors:** These sensors are used for monitoring and regulating the level of fluid within a contained space. They are very useful for detecting fluid leakages.
- **Flow sensors:** They are used to monitor and regulate the fluid flow rate through the hydraulic system. Flow sensors are also referred to as flow switches or current sensors or flow meters.
- **Temperature sensors:** Increase in temperature above a threshold value will damage the hydraulic system. Temperature sensors are used in hydraulic circuits to detect the temperature in the hydraulic system.
- **Contamination sensors:** These sensors can effectively and accurately monitor the contamination or particle present in the fluid medium and then displays it in a digital or analog monitor.



Fig 10.8 Sensors



**4- Limit switch:** Limit switches are normally equipped with changeover contacts capable of performing closing, opening or changeover of circuits.



Fig : Limit switch with 4mm safety socket and mounting clamp

**5- Pressure switch:** They can be used to open, close or change between circuits when a preset pressure is reached.



Fig :Pressure switch

## 6- Relay

Relays are electromagnetically actuated switches. They consist of housing with electromagnet and movable contacts. An electromagnetic field is created when a voltage is applied to the coil of the electromagnet. This results in attraction of the movable armature to the coil core. The armature actuates the contact assembly. This contact assembly can open or close a specific number of contacts by mechanical means. If the flow of current through the coil is interrupted, a spring returns the armature to its original position.

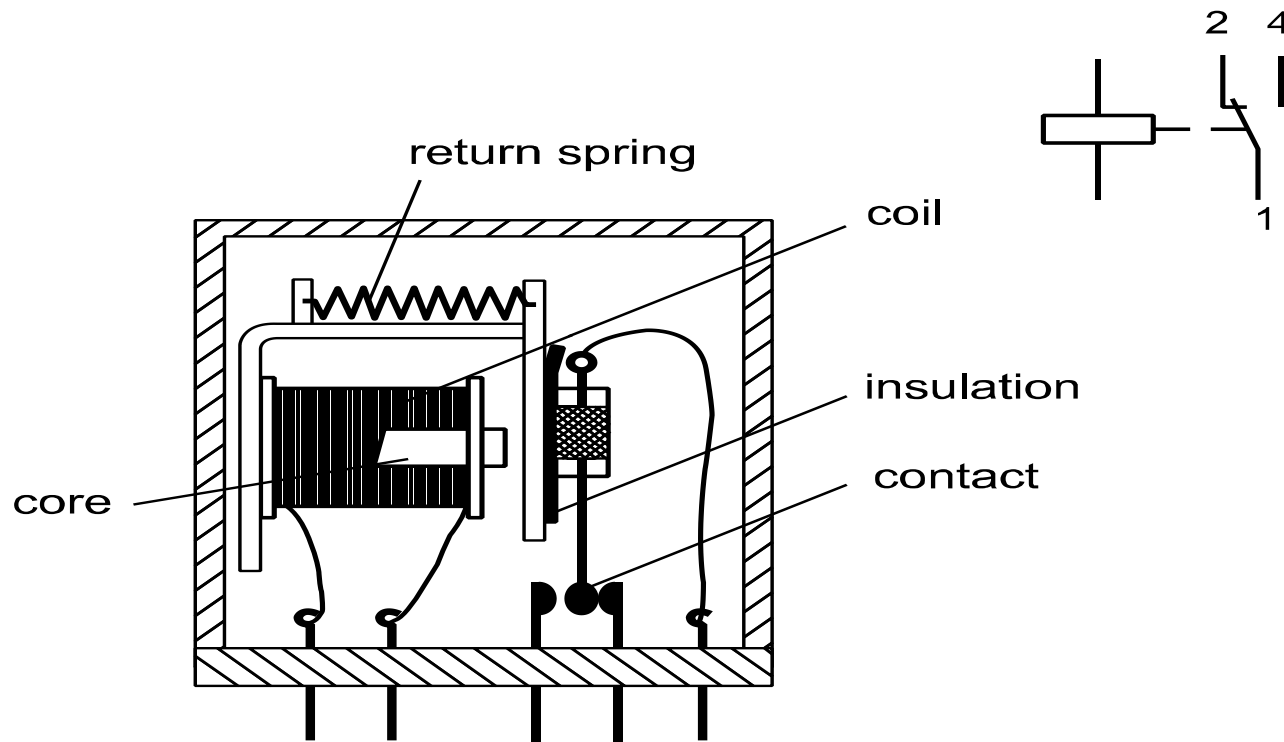
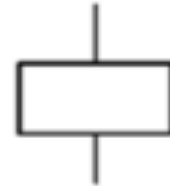


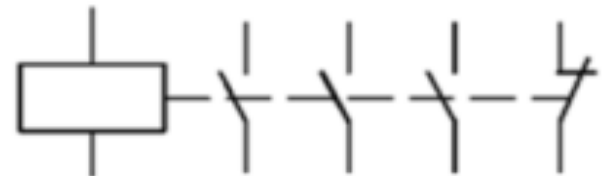
Fig : Relay: sectional view and circuit symbol

# Electrical Symbols

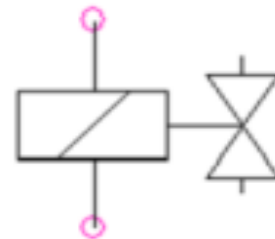
relay, contactor



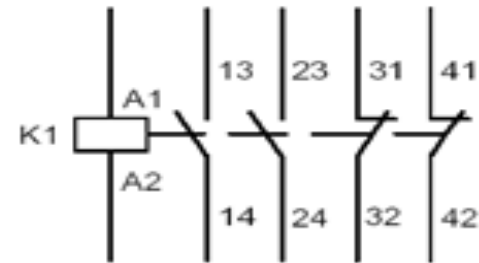
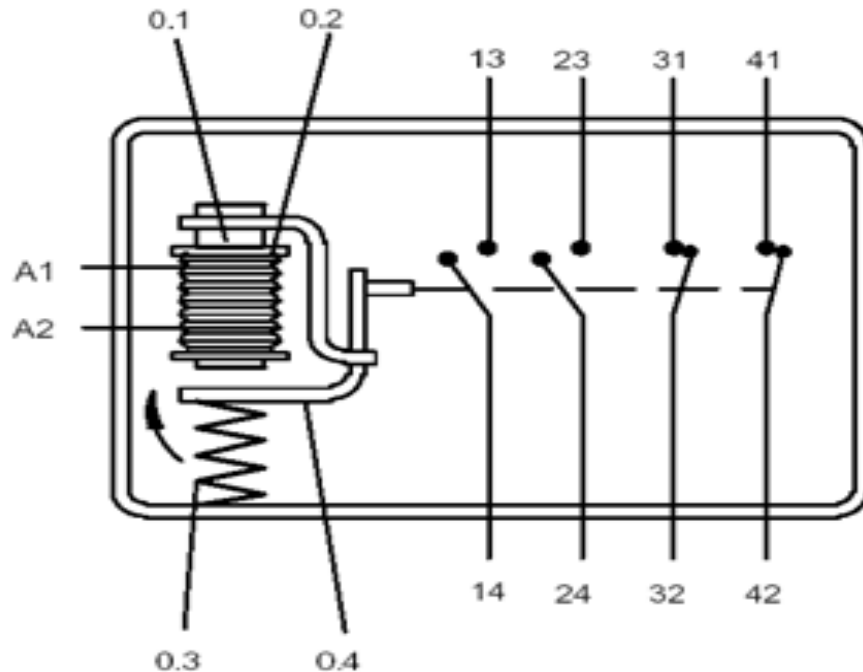
relay with three normally open contacts and one normally closed contact

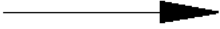


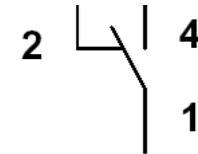
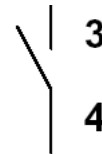
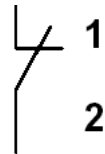
Solenoid



# Electrical Symbols



  
 actuation direction



normally closed  
contact

normally open  
contact

changeover  
contact

Relay with A, B, and C contacts

## 7- Solenoids

Hydraulic solenoids are primarily used in hydraulic pumps and valves. These solenoids can be designed to perform push, pull, or push/pull actuation functions.

**Hydraulic pumps** convert mechanical energy into hydraulic energy. They create the flow and pressure of fluid in a hydraulic circuit. A hydraulic solenoid can be used in pumps like a Variable Displacement Axial Piston Pump to control the volume of the hydraulic fluid output.

**Hydraulic valves** control the flow of hydraulic fluid by opening, closing, or partially obstructing pathways. Solenoids can be used as actuators in valves designed to control the flow, limit system pressure, or control direction.

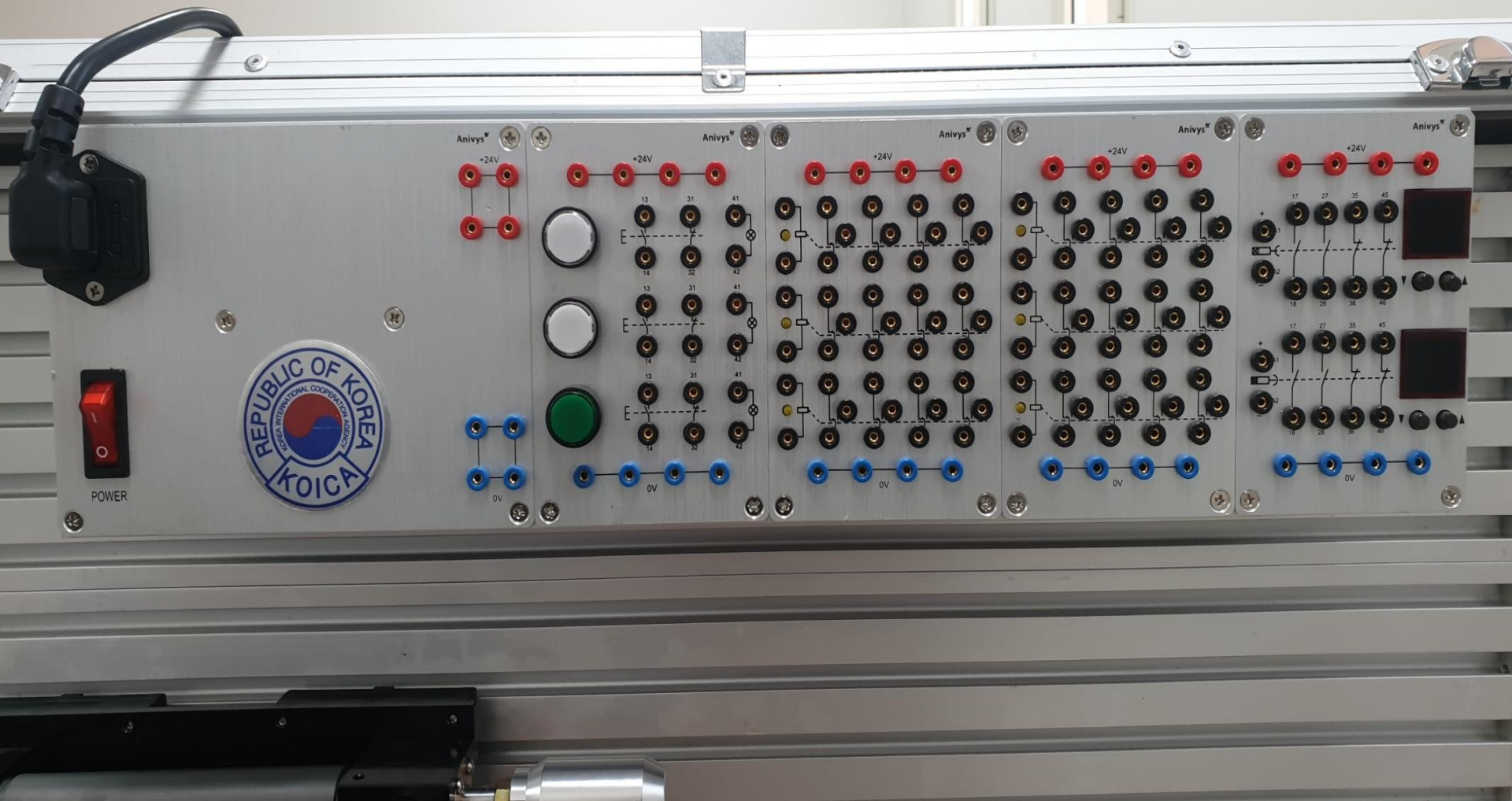
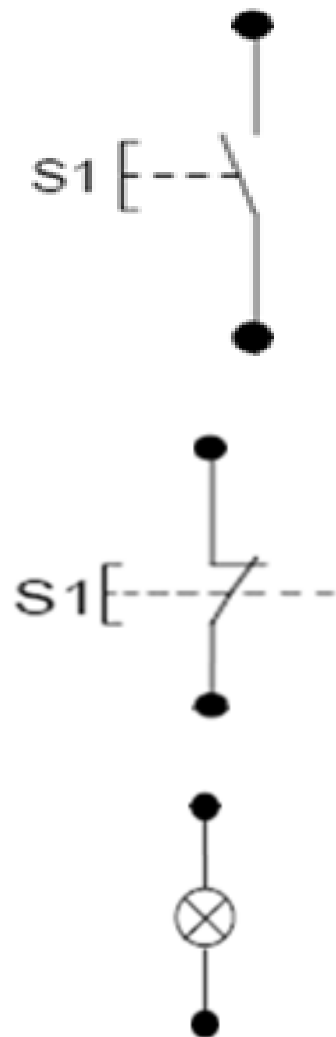


Fig: Hydraulic kit







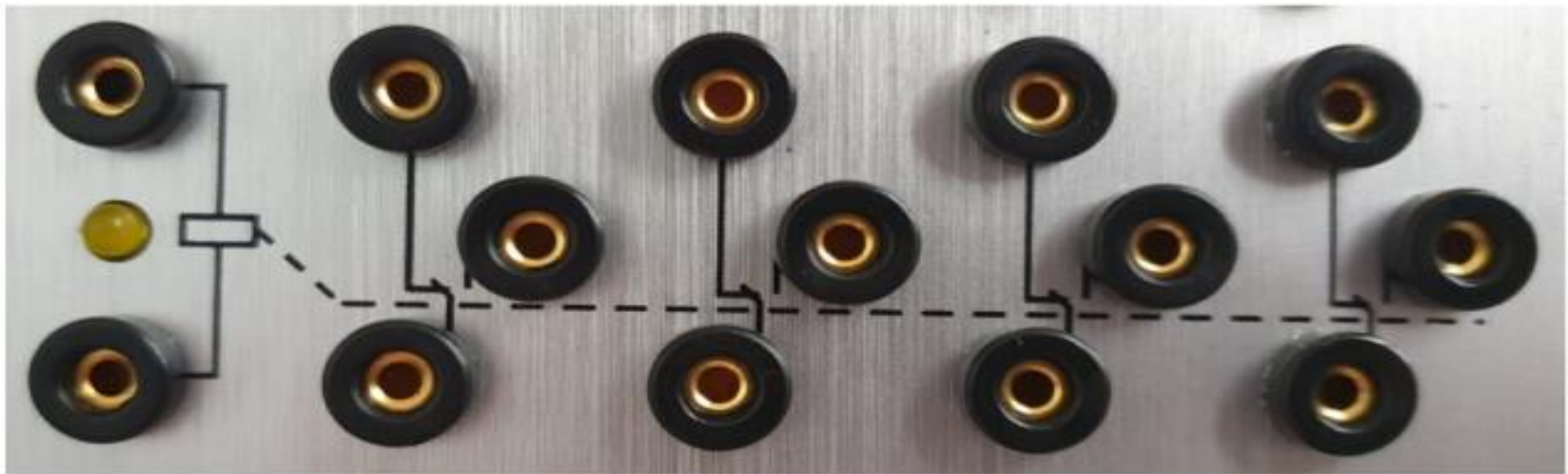
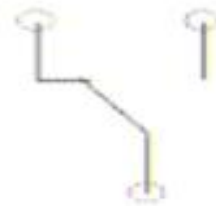
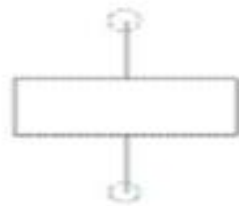


Fig : Relay with 4 changeover contacts



Fig : Directional control valve actuated by a solenoid

**Thank you  
for  
your attention**