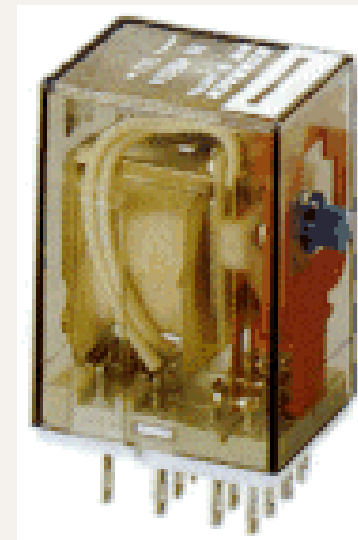
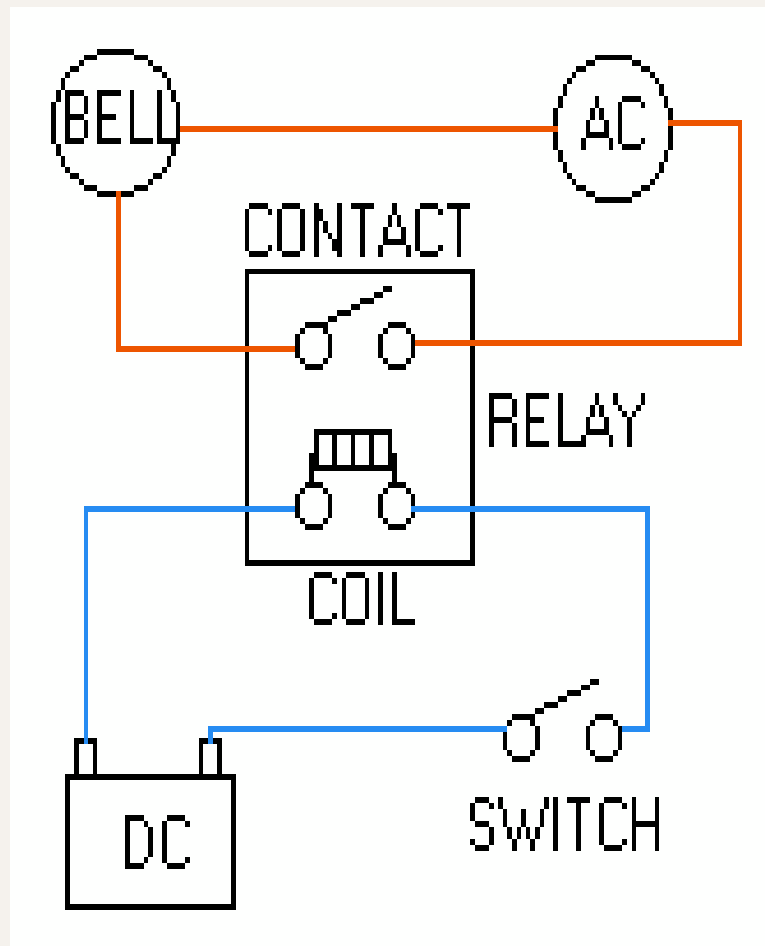


Programmable Logic Controller

Mat Nor Mohamad

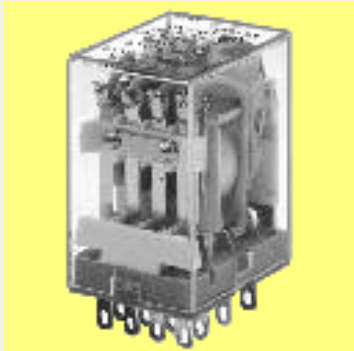


Relays



Electromagnetic Control Relays

The PLC's original purpose was the replacement of electromagnetic relays with a solid-state switching system that could be programmed.



The programmable controller was designed to replace physically small control relays that make logic decisions but are not designed to handle heavy current or high voltage.

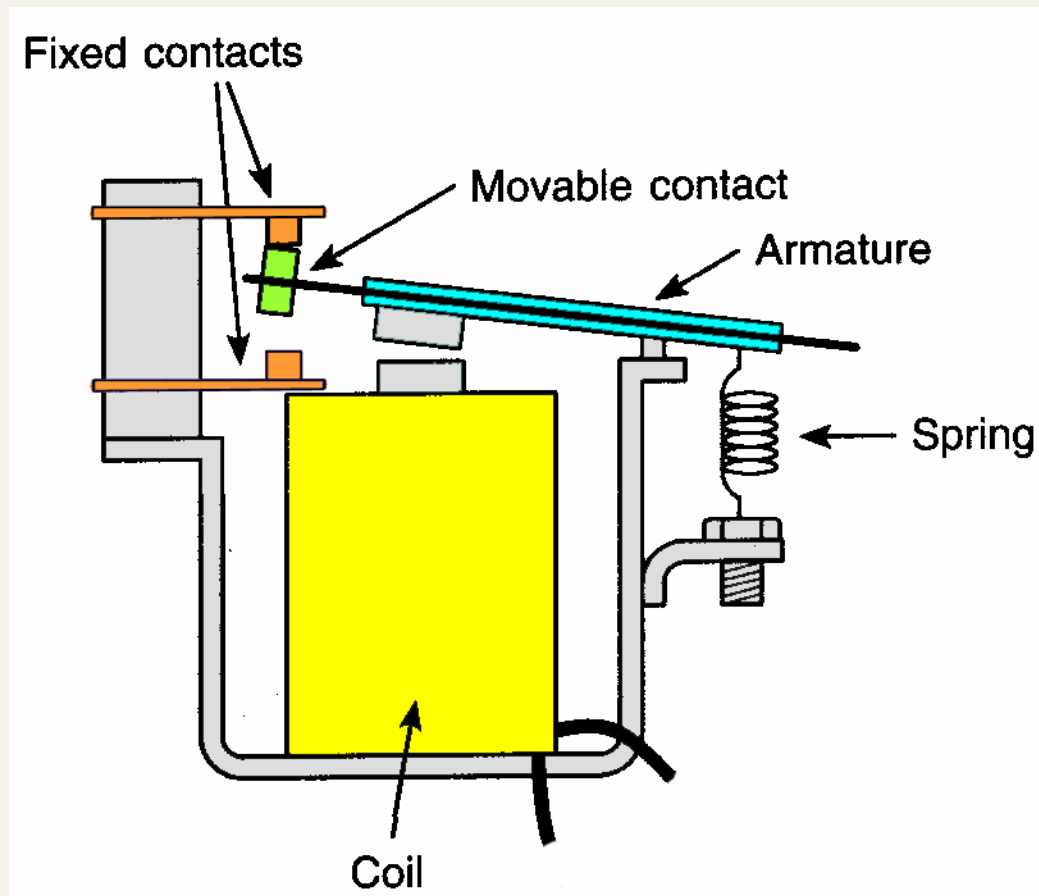


Electromagnetic relays, such as the lighting contactor shown, are still used as auxiliary devices to switch I/O field devices.



Electromagnetic Relay Operation

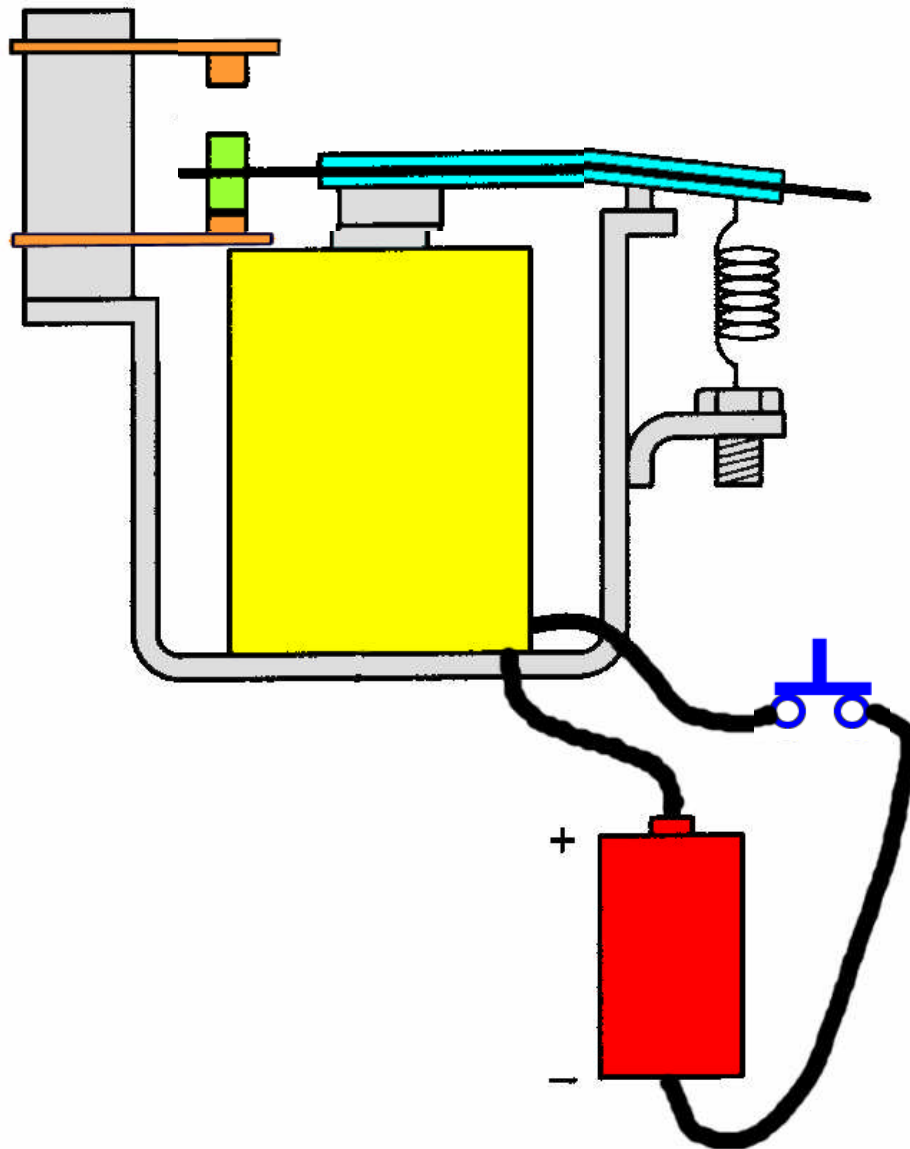
An electromagnetic relay is a magnetic switch. It uses electromagnetism to switch contacts.



A relay will usually have only one coil but may have any number of different contacts.



Electromagnetic Relay Operation

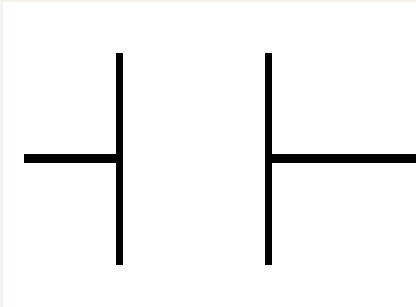


With no current flow through the coil (coil de-energized), the armature is held away from the core by spring tension.

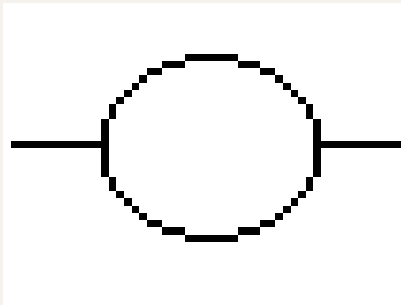
When the coil is energized, the electromagnetic field moves the armature causing the contact points of the relay to open or close.



Input and Output Symbols



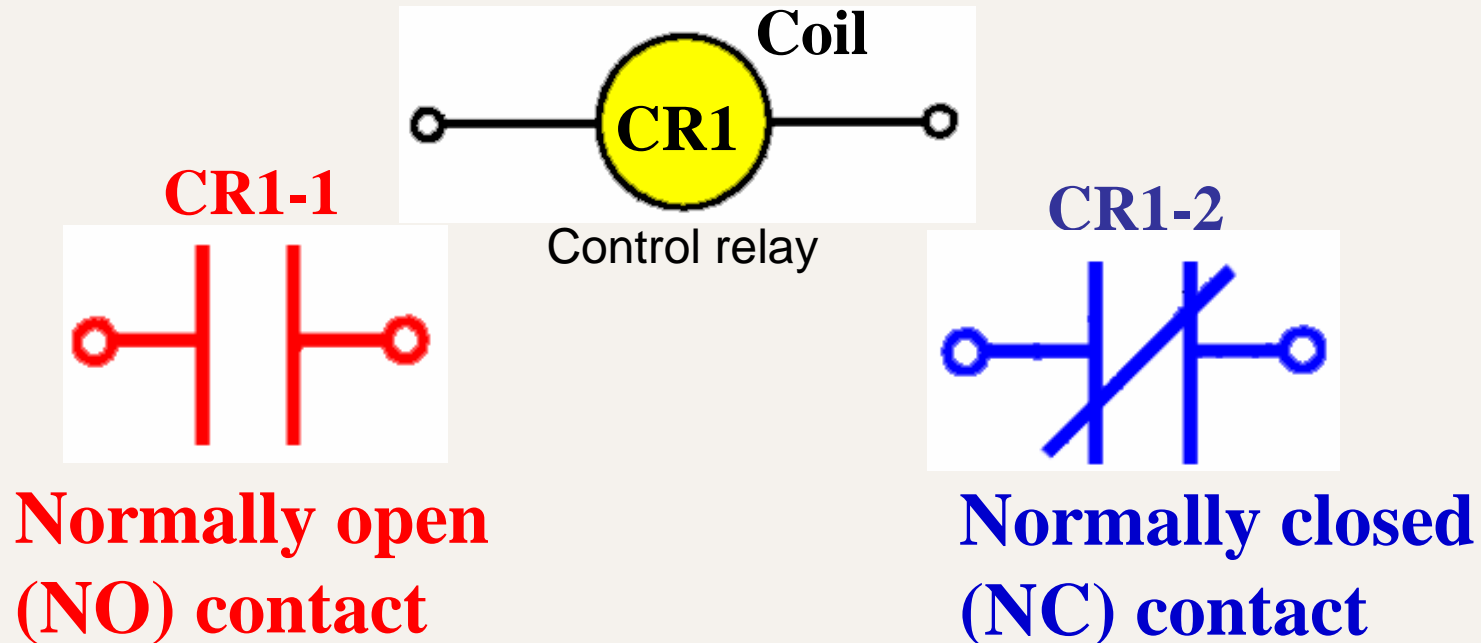
Input or contact
symbol



Output or coil
symbol



Relay Symbol

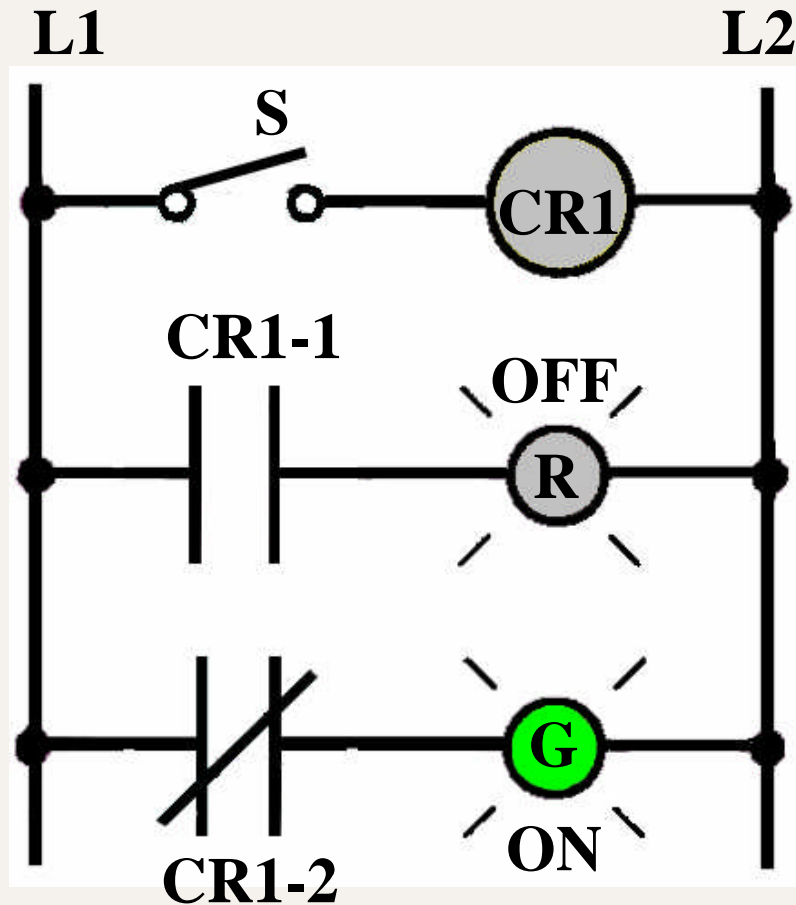


Contacts are open when no current flows through the coil but close as soon as the coil is energized.

Contacts are closed when no current flows through the coil but open as soon as the coil is energized.



Relay Circuit Operation

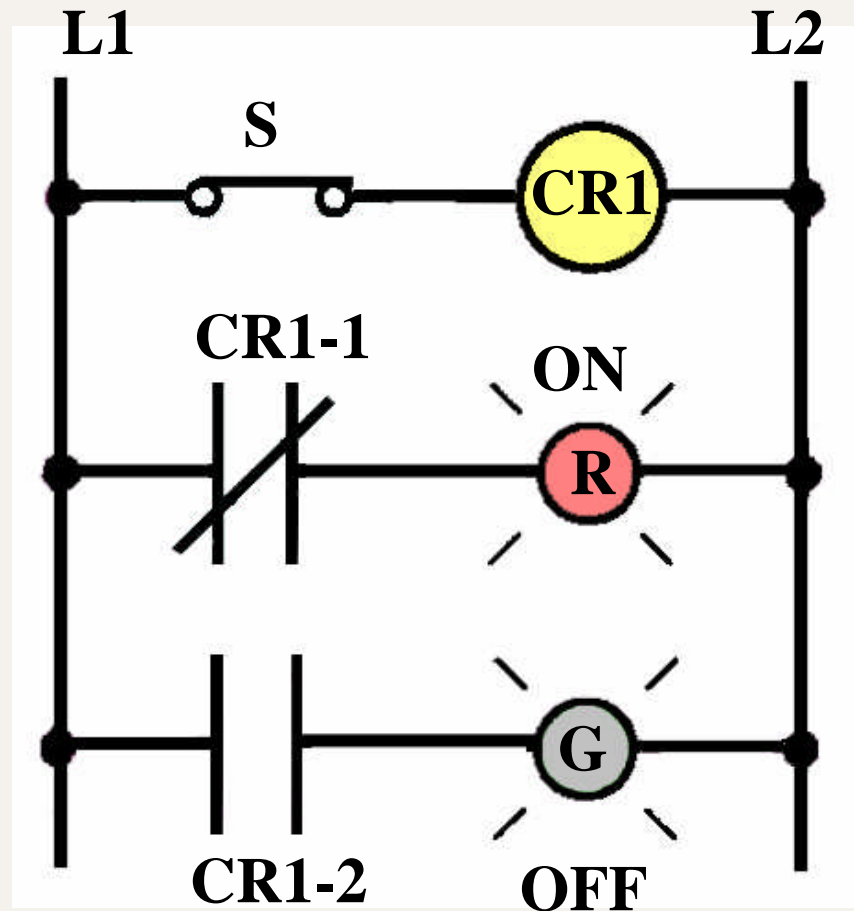


With switch S open:

- coil CR1 is de-energized
- contacts CR1-1 are open
- light R is off
- contacts CR1-2 are closed
- light G is on



Relay Circuit Operation



With switch S closed:

- coil **CR1** is energized
- contacts **CR1-1** are closed
- light **R** is on
- contacts **CR1-2** are open
- light **G** is off



Magnetic Contactor

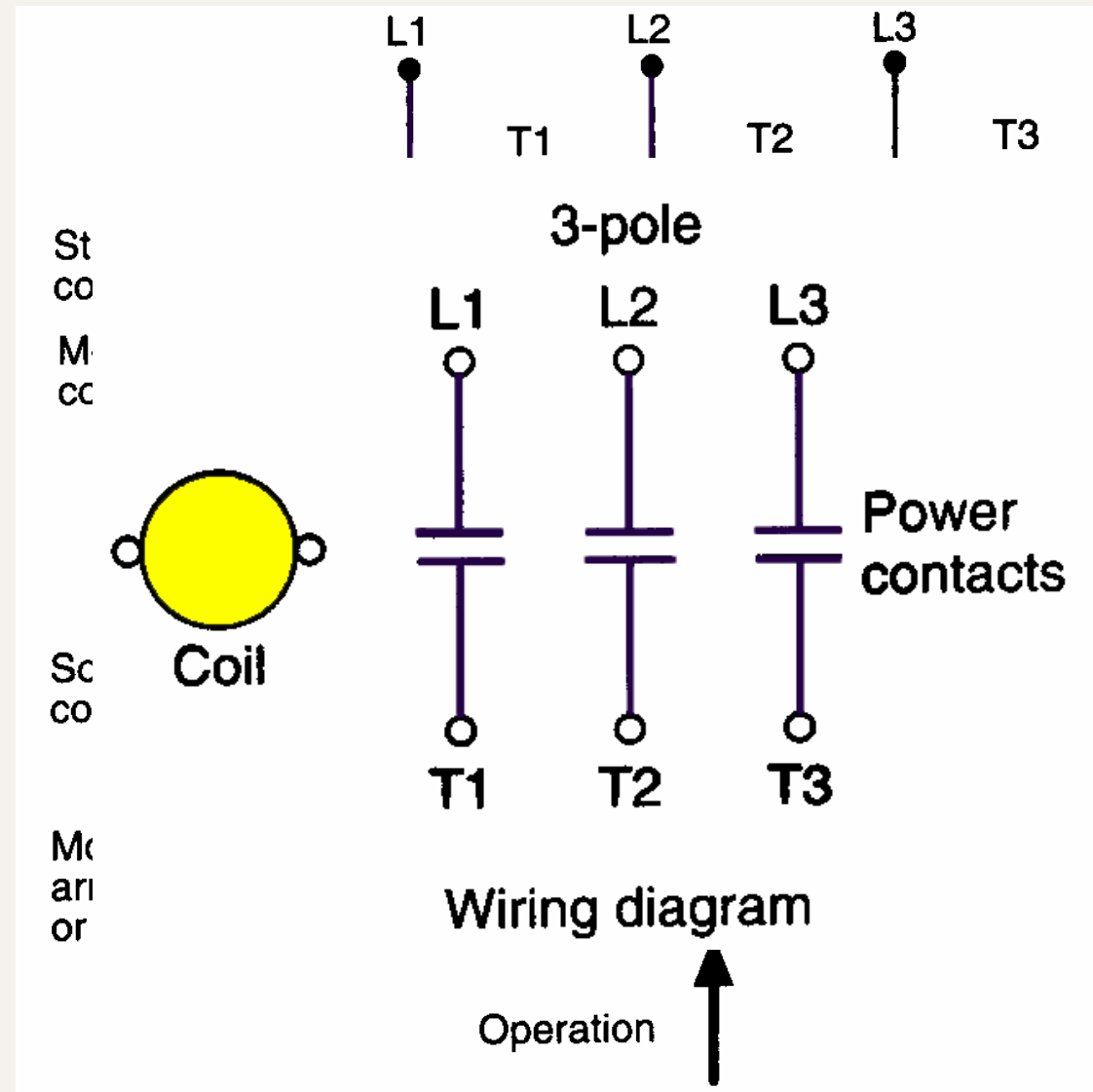
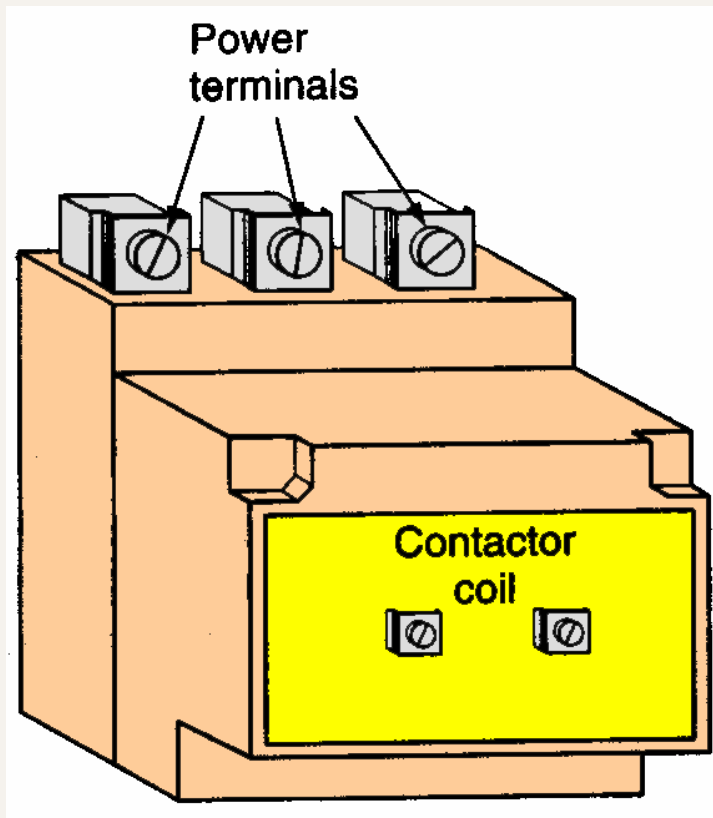
A contactor is a special type of relay designed to handle heavy power loads that are beyond the capability of control relays.



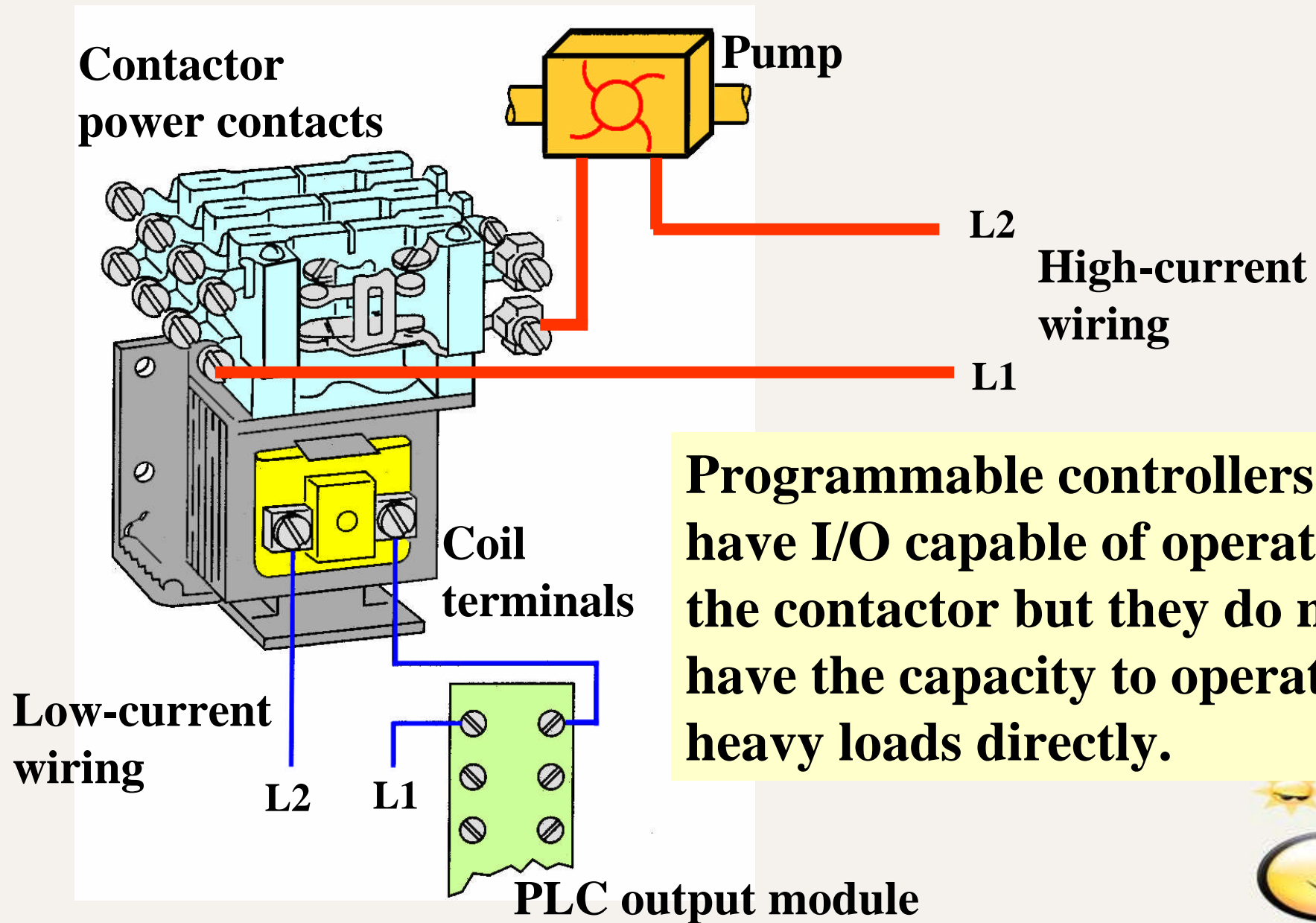
Contactors are designed to operate such loads as lights, heaters, transformers, capacitors, and electric motors for which overload protection is provided separately or not required.



Magnetic Contactor



PLC Used In Conjunction With A Contactor



Magnetic Motor Starter

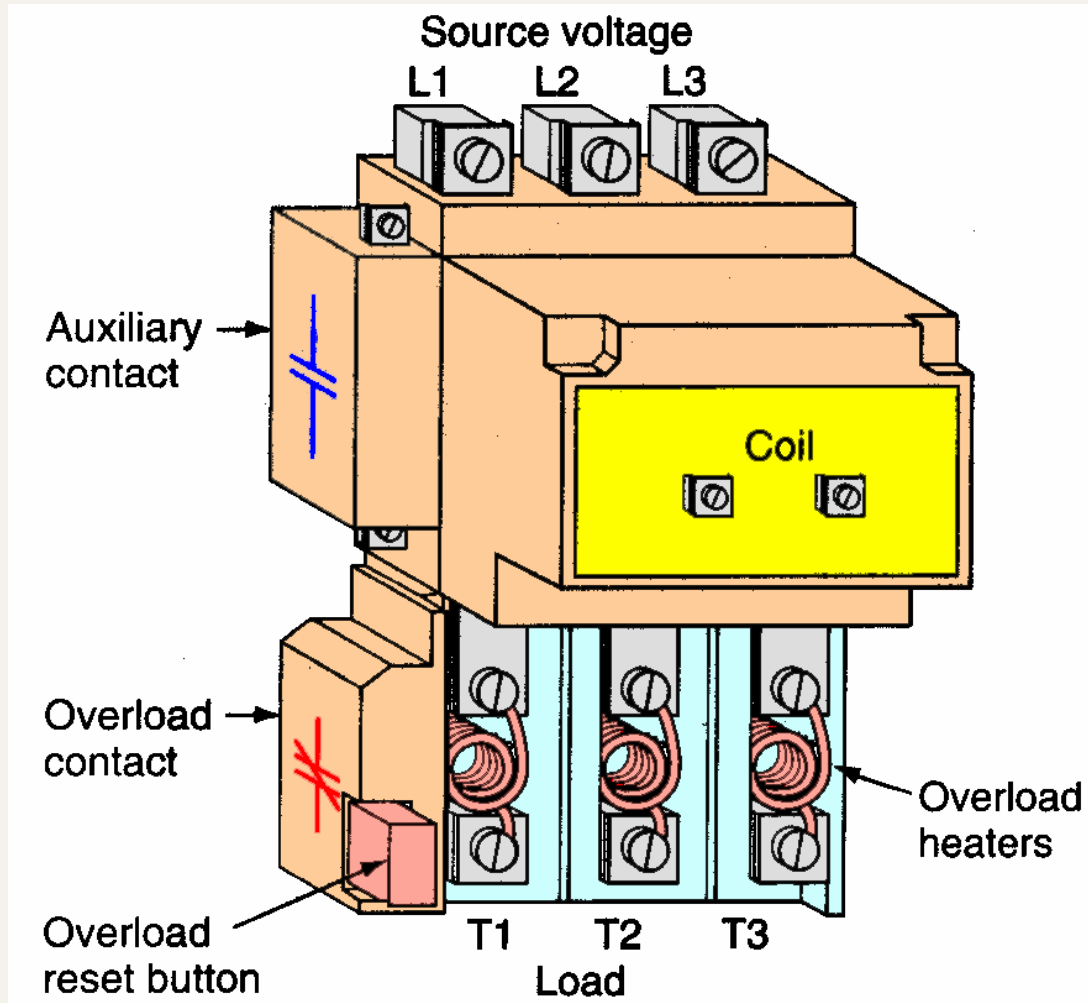
A magnetic motor starter is a contactor with an *overload relay* attached physically and electrically. They are electromagnetically operated switches that provide a safe method for starting large motor loads.



The overload relay will open the supply voltage to the starter if it detects an overload on a motor. Motor overload relay contacts are normally hardwired in series with the magnetic starter coil.



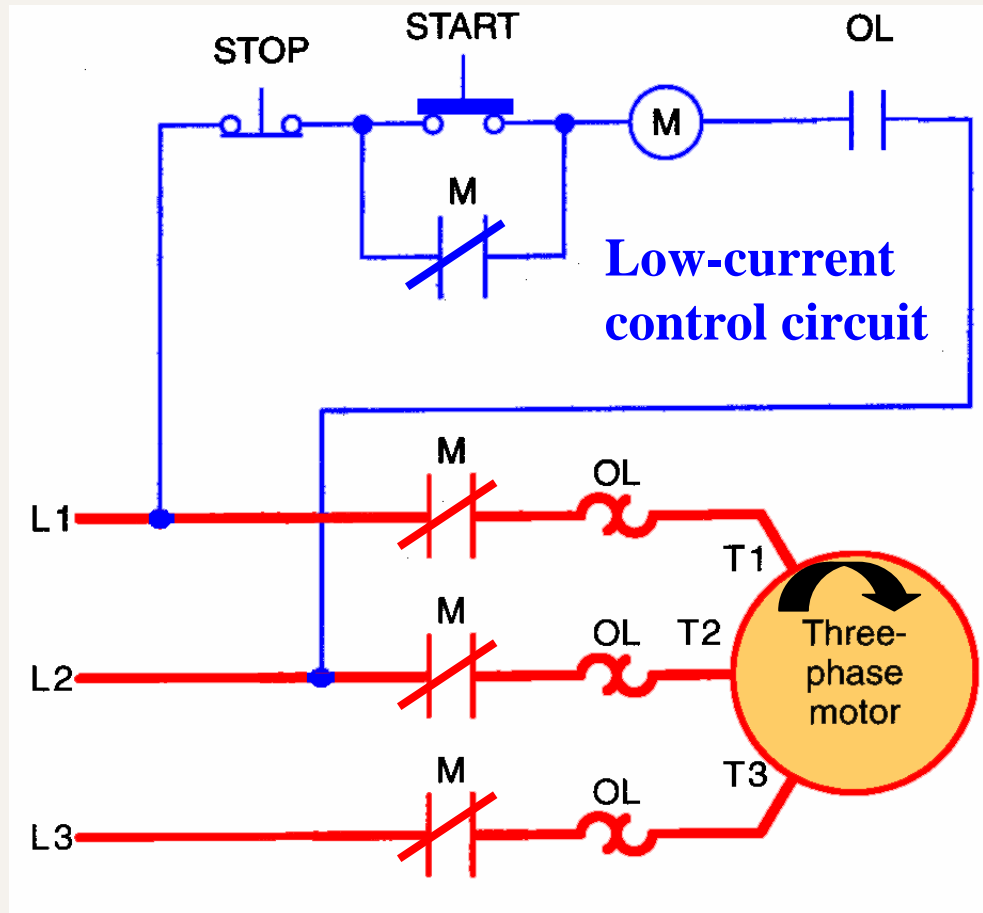
Magnetic Motor Starter



Overload heaters are connected in series with the contactor. If the motor becomes overloaded they cause a mechanical latch to trip. Tripping this latch opens a set of contacts that are wired in series with the voltage supply and motor.



Across-The-Line AC Starter Operation

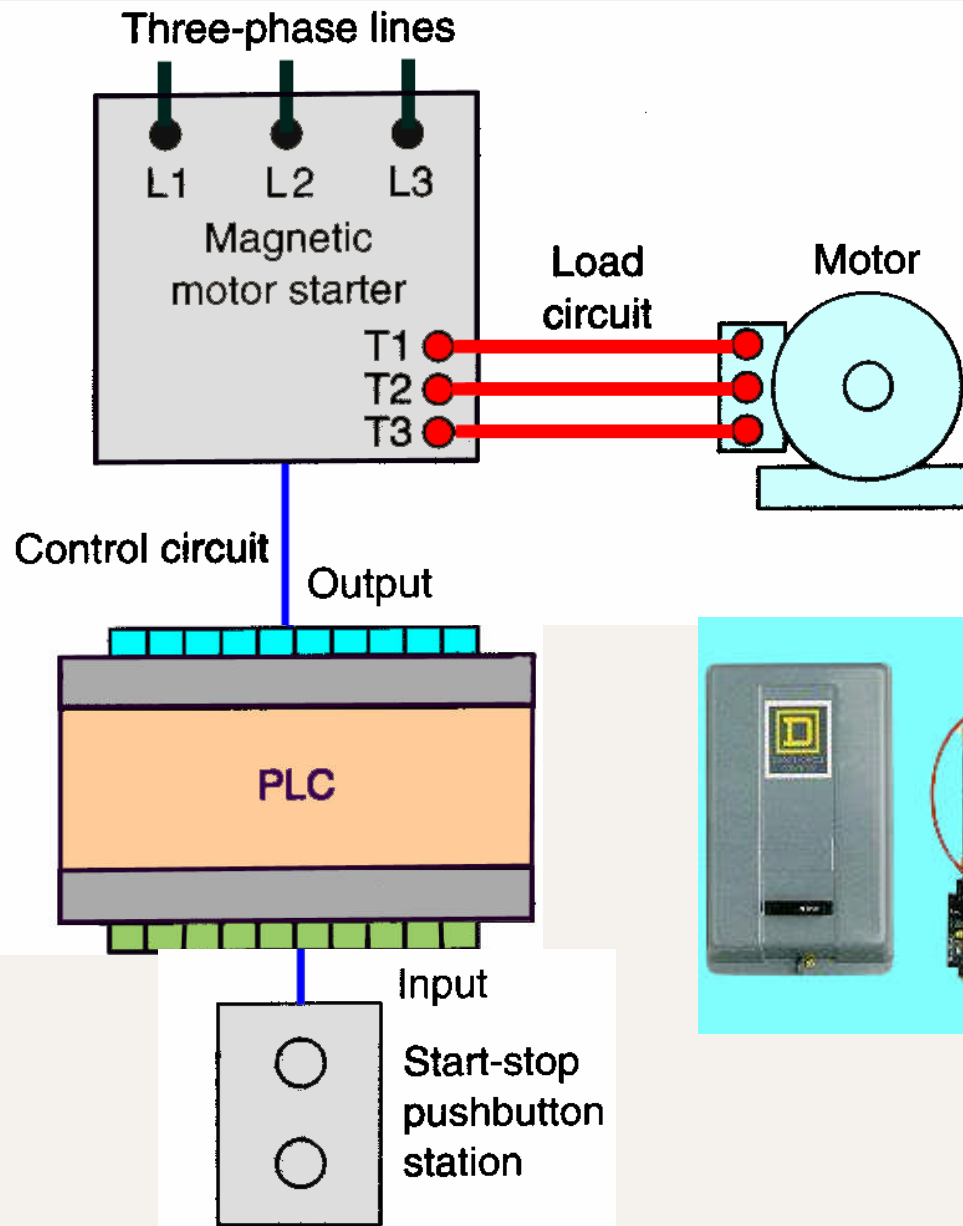


High-current
power circuit

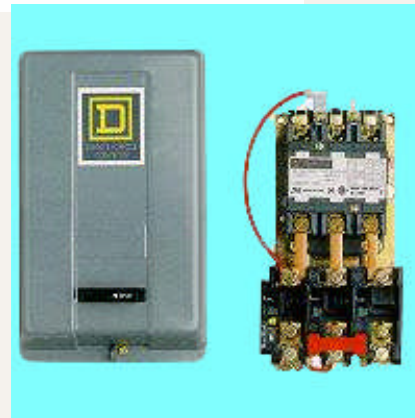
The M contacts, in series with the motor, close to complete the high-current path to the motor. When the start button is pressed, coil M energizes automatically when all M contacts are closed. If an overload is sensed, to de-energize the M coil and stop the motor. Control contact M also closes to seal-in the coil circuit when the START button is released.



PLC Control Of A Large Motor Load



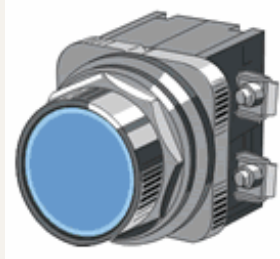
When a PLC needs to control a large motor, it must work in conjunction with a starter.



Motor starters are available in various standard National Electric Manufacturers (NEMA) sizes and ratings.



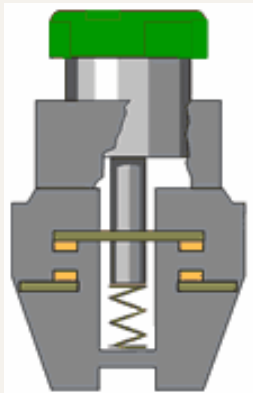
Manually Operated Switches



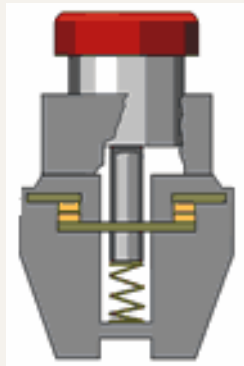
Manually operated switches are controlled by hand. Pushbutton switches are the most common form of manual control found in industry.



Normally Open (NO) pushbutton makes a circuit when it is pressed and returns to its open position when the button is released.



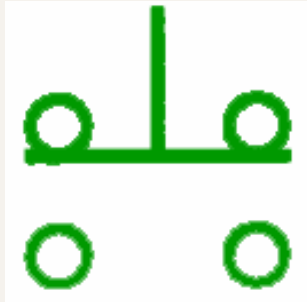
Manually Operated Switches



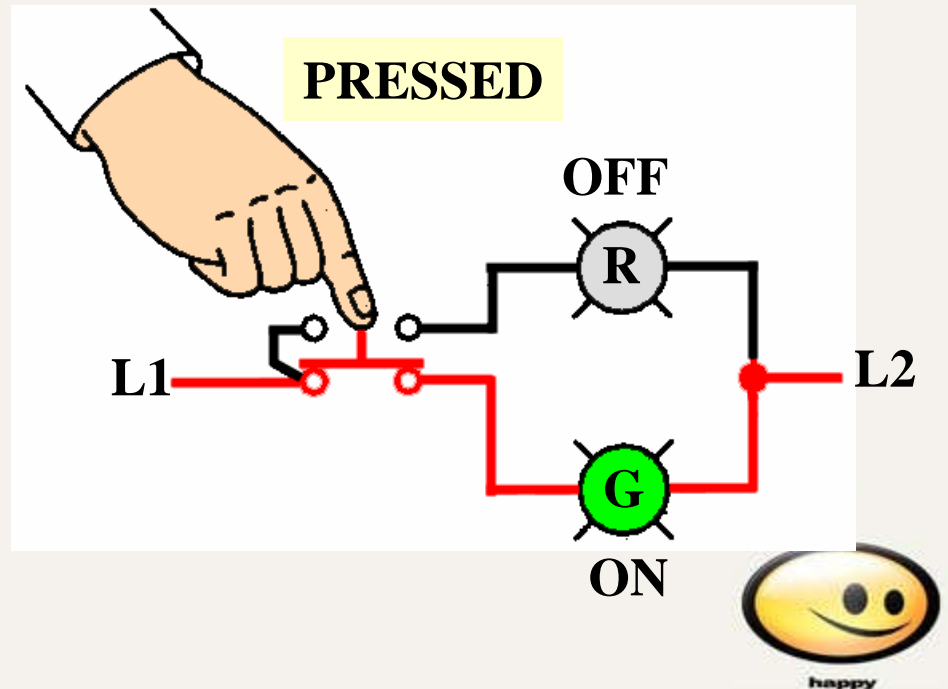
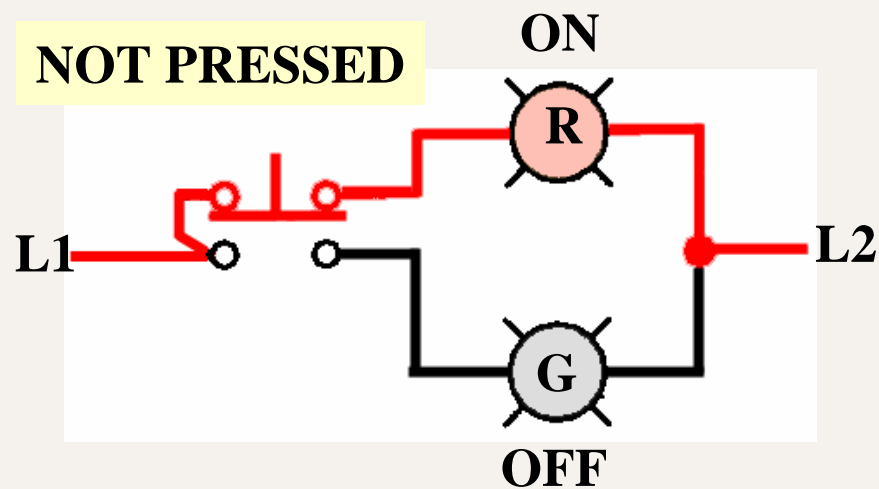
Normally Closed (NC) pushbutton opens the circuit when it is pressed and returns to the closed position when the button is released. The abbreviations NO and NC represent the state of the switch when it is *not* actuated.



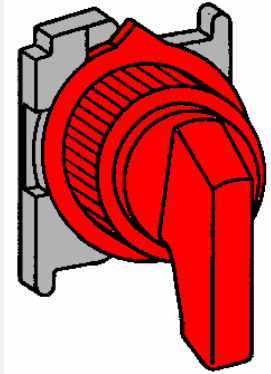
Manually Operated Switches



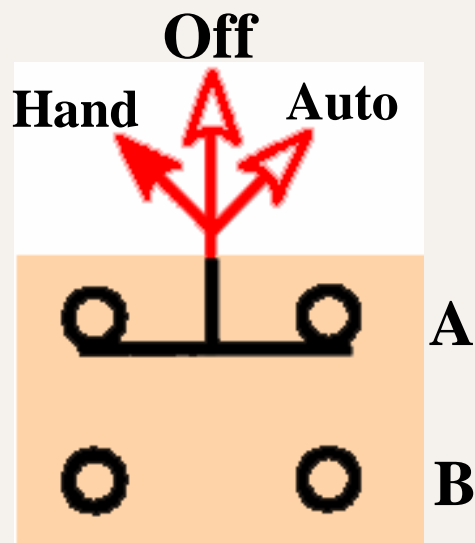
The break-make pushbutton is used for interlocking controls. In this switch the top section is NC, while the bottom section is NO. When the button is pressed, the bottom contacts are closed as the top contacts open.



Selector Switch



Selector switch positions are made by turning the operator knob – not pushing it.

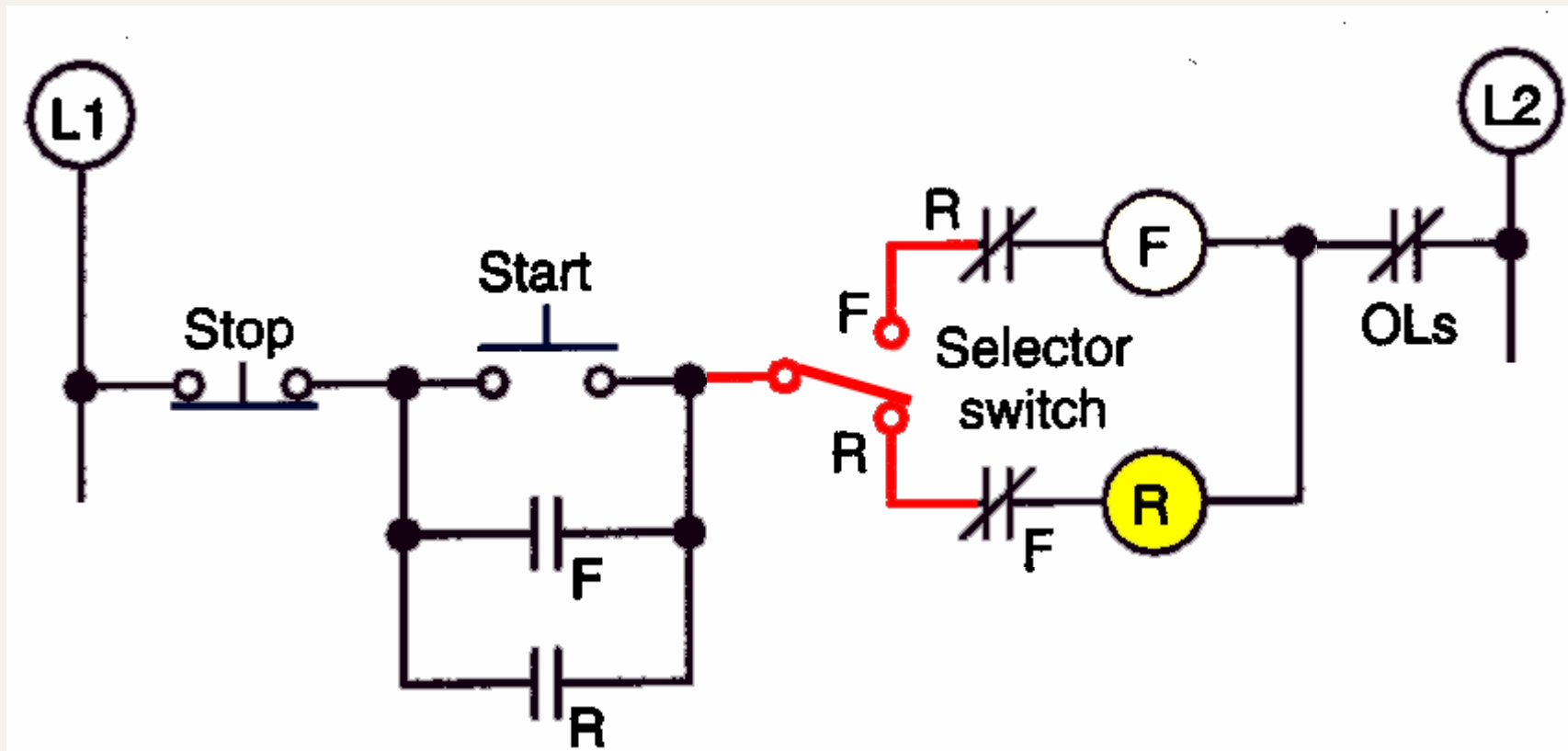


	Contacts	
Position	A	B
Hand	X	
Off		
Auto		X

Selector switch positions may have two or more selector positions with either maintained contact position or spring return to give momentary contact operation.



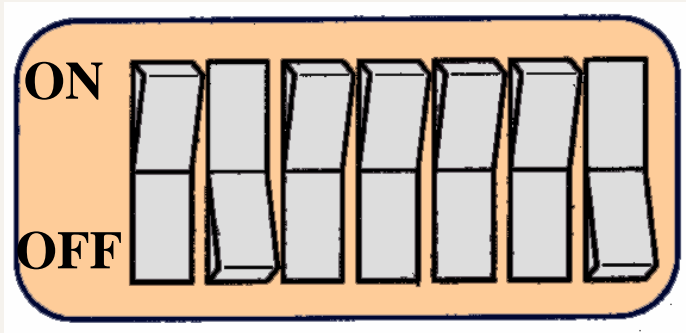
Selector Switch Motor Reversing



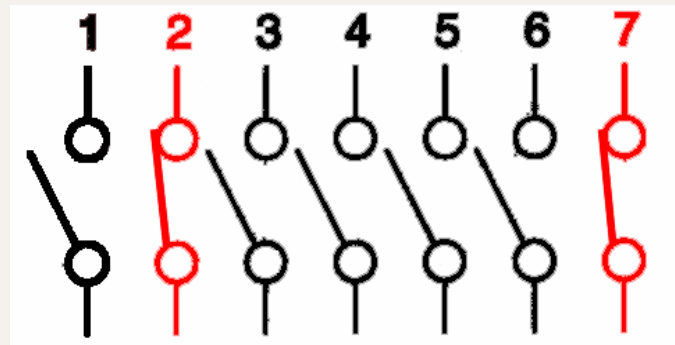
Selector switch used in conjunction with a reversing motor starter to select forward or reverse operation of the motor.



Dual In-Line Package (DIP) Switches



Are small switch assemblies designed for mounting on printed circuit board modules.



Switch settings are seldom changed, and the changes occur mainly during installation or configuration of the system.



Mechanically Operated Switches

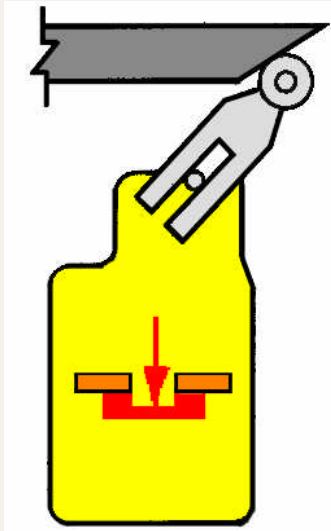
A mechanically operated switch is controlled automatically by factors such as pressure, position, and temperature.



The limit switch is a type of mechanically operated switch designed to operate only when a predetermined limit is reached, and is usually actuated by contact with an object such as a cam.



Limit Switch Operation



Limit switches take the place of a human operator.

Symbols



NO Contact

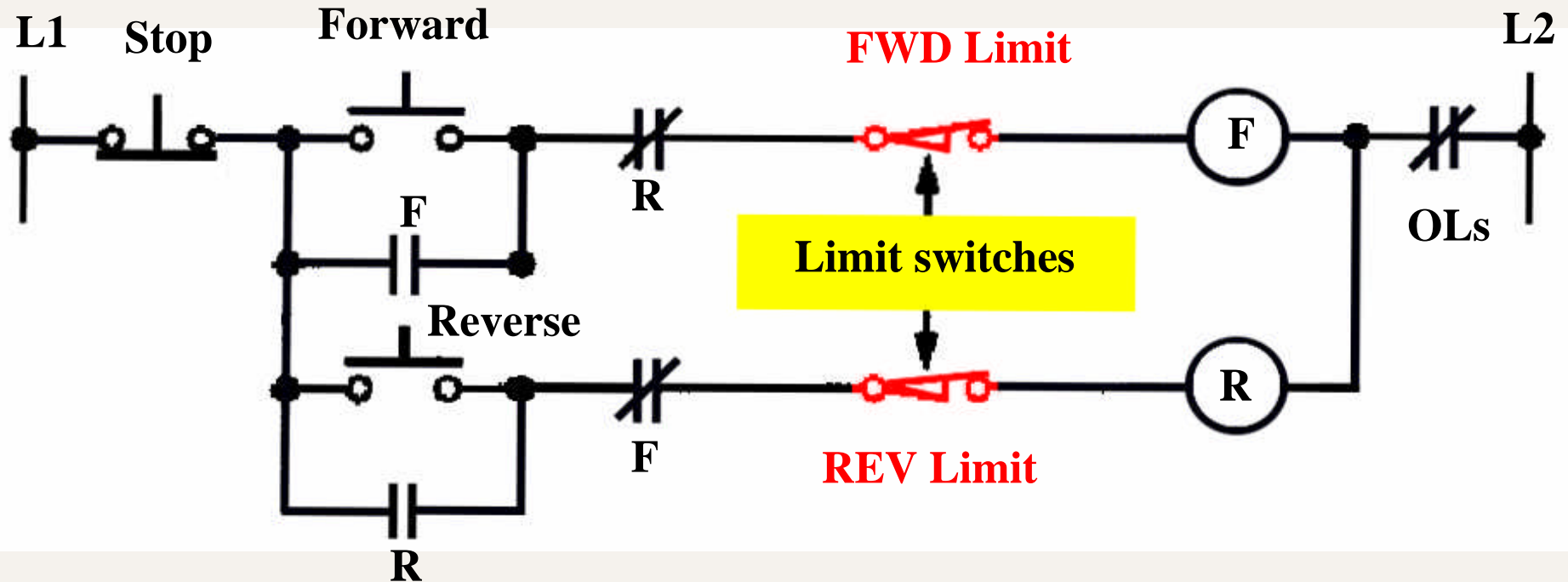


NC Contact

They are often used in the control of machine processes to govern the starting, stopping, or reversal of motors.



Typical Limit Switch Circuit



Control circuit for starting and stopping a motor in forward and reverse with limit switches providing over travel protection.



Temperature Switch

The temperature switch or thermostat is used to sense temperature changes and is actuated by some specific environmental temperature change.

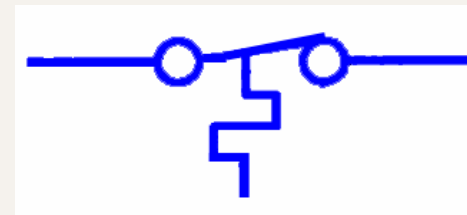


Responds to changes in temperature by opening or closing an electric circuit.

Symbols



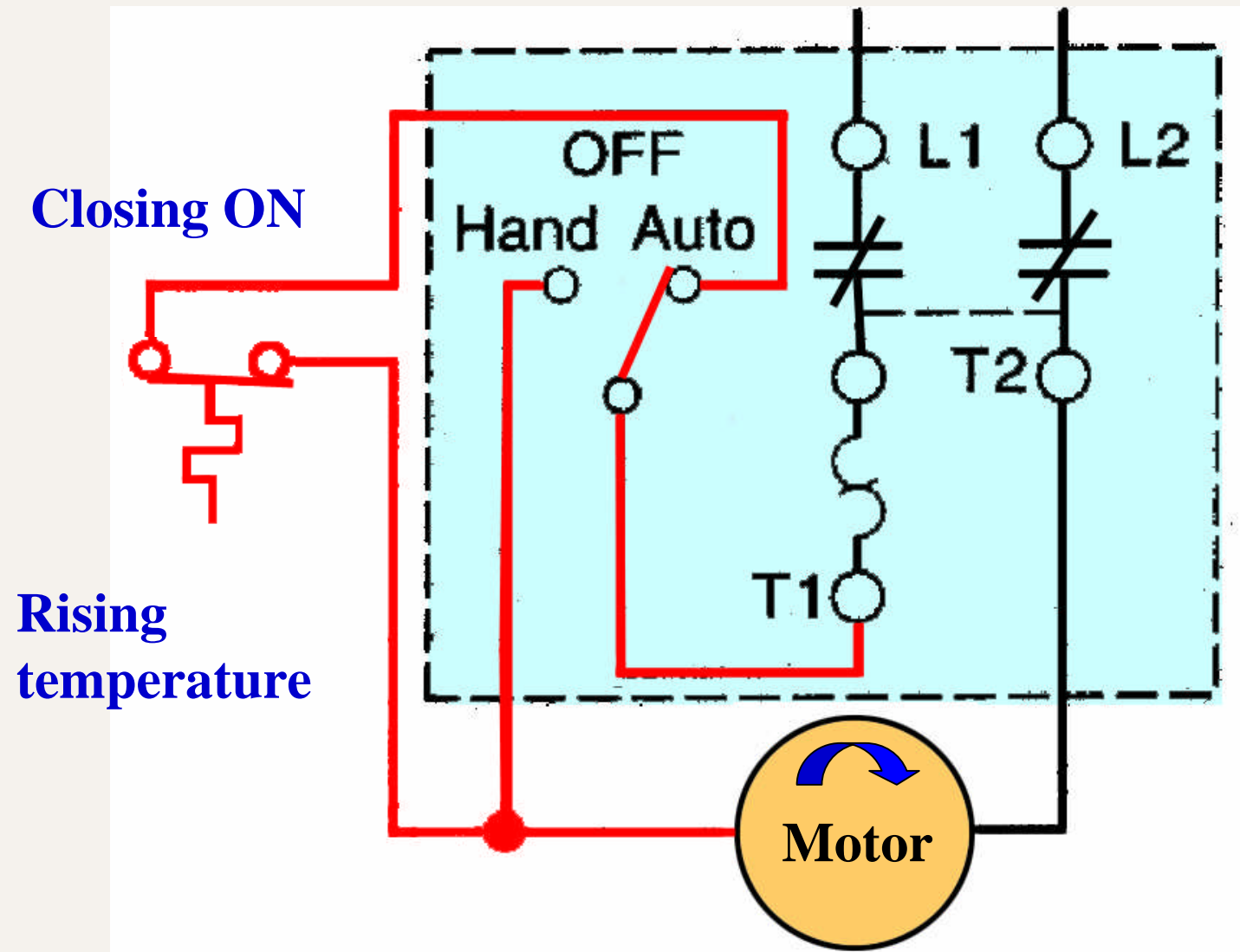
NO Contact



NC Contact



Temperature Switch Control of a Motor

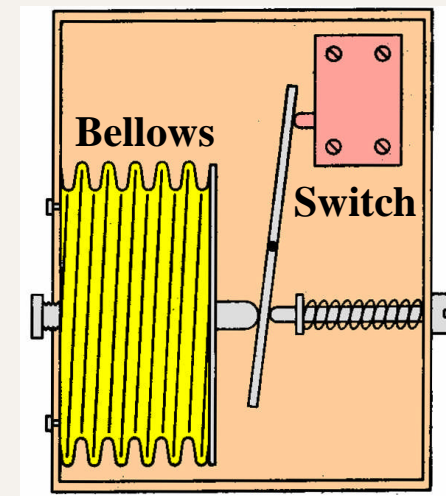


Pressure Switch

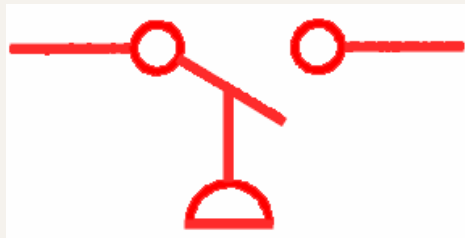
Pressure switches are used to control the pressure of liquids and gases and are activated when a specific pressure is reached.



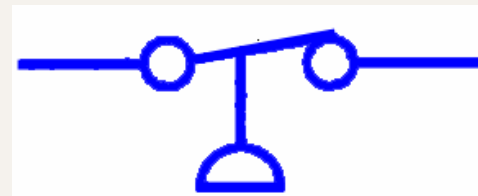
Opens or closes an electric circuit in response to a change in pressure.



Symbols



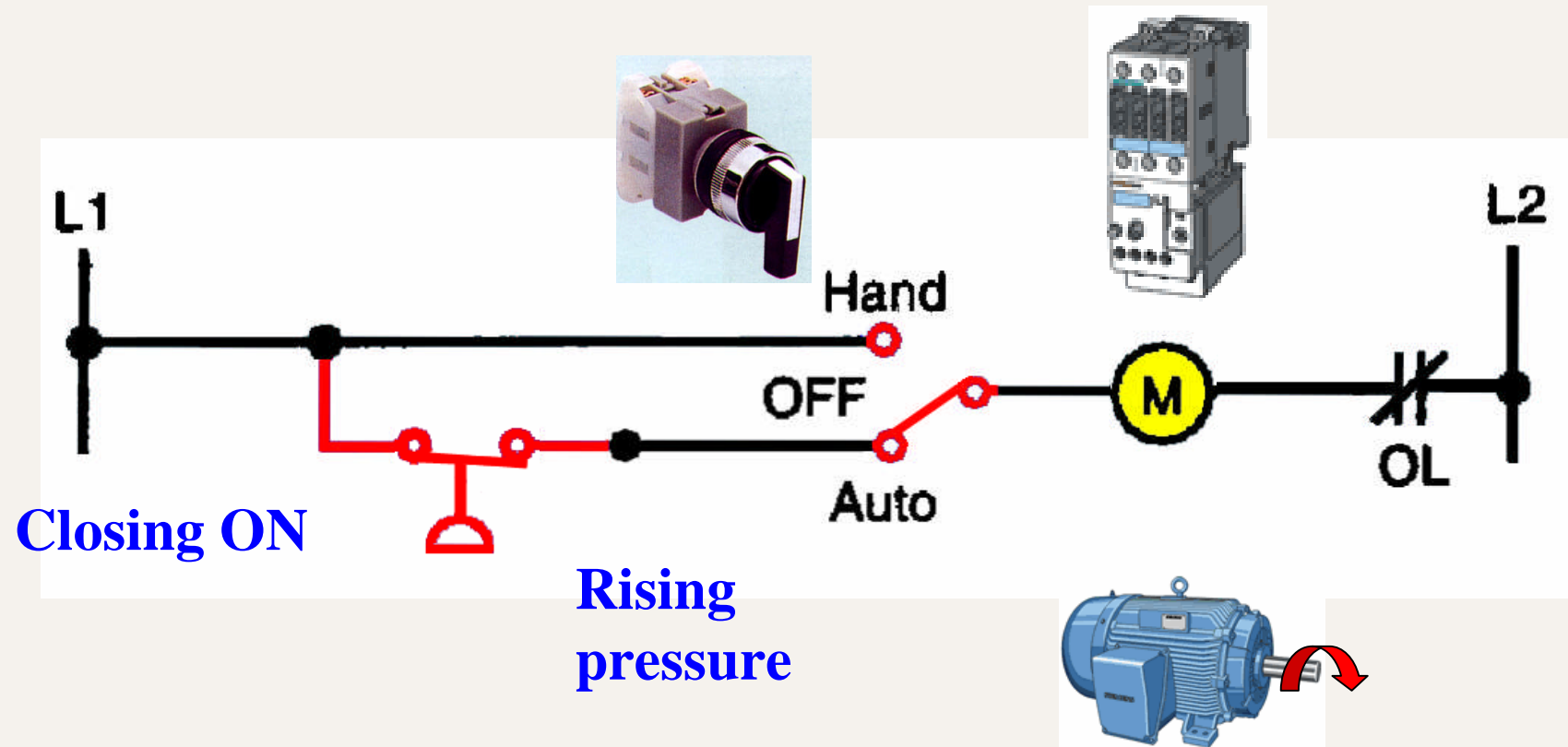
NO Contact



NC Contact



Starter Operated By A Pressure Switch



Level Switch

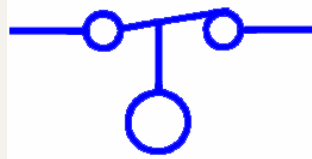
Level or float switches are used to sense the height of a liquid.

Opens or closes an electric circuit in response to a change in liquid level.

Symbols



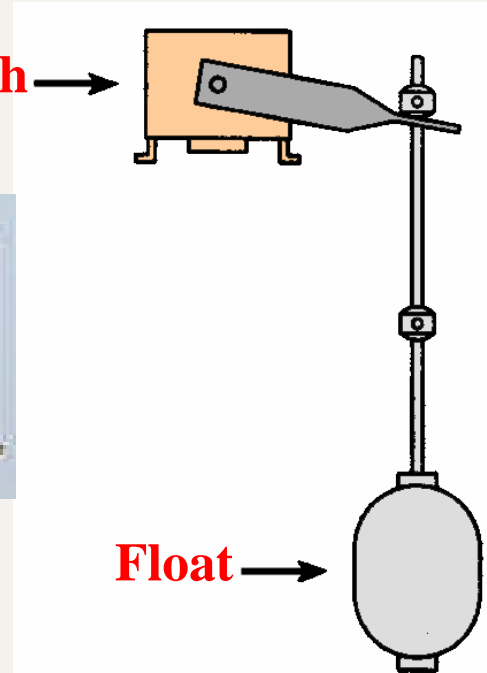
NO Contact



NC Contact



Switch



Float

Two-wire level switch control of starter.

