

Chapter 4

Motor Control Devices

PART 2 Mechanically Operated Switches

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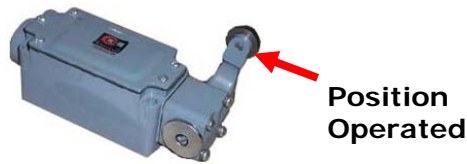
LIMIT SWITCHES

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



Temperature Operated

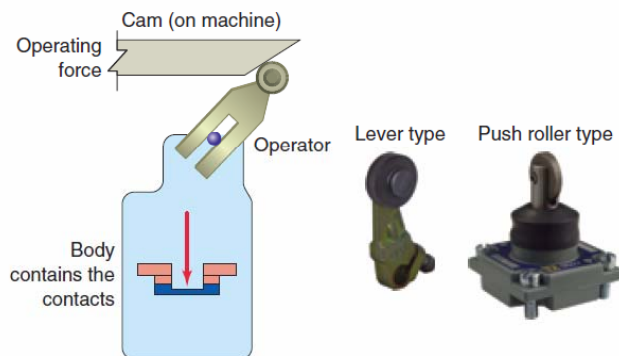


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The **limit switch** is a very common type of mechanically operated motor control device.



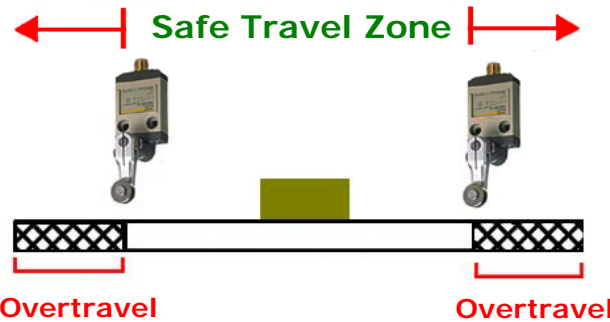
Limit switches are designed to operate only when a predetermined limit is reached, and they are usually actuated by contact with an object such as a cam.



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Limit switches take the place of human operators and are often used in the control circuits of machine processes to govern the *starting, stopping, or reversal* of motors.

Limit switches are often used to indicate an end of travel, or to prevent a motor from traveling too far in one direction.

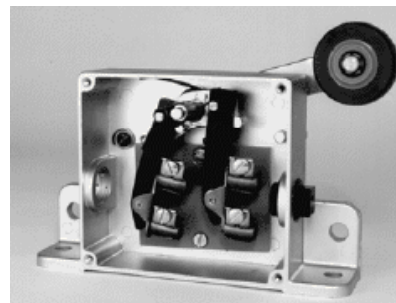


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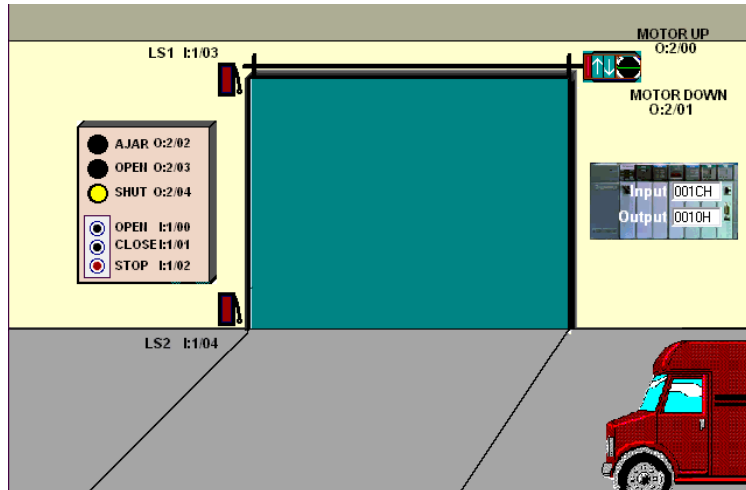
Limit switches are constructed of two main parts: the *body* and the *actuator*.

The body houses the contacts that are opened or closed in response to the movement of the actuator.



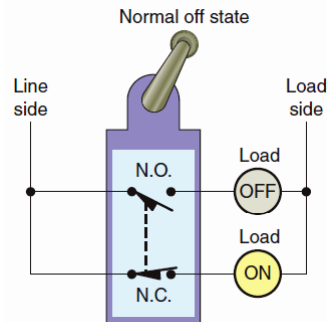
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Simulated Door Limit Switch Operation

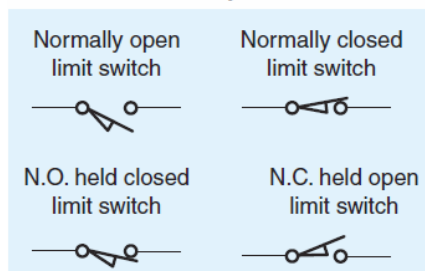


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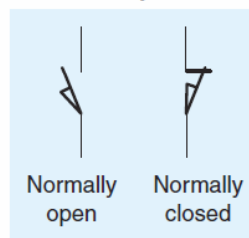
Limit switch contacts may be of the normally open, normally closed, momentary (spring returned), or maintained contact types.



NEMA symbols

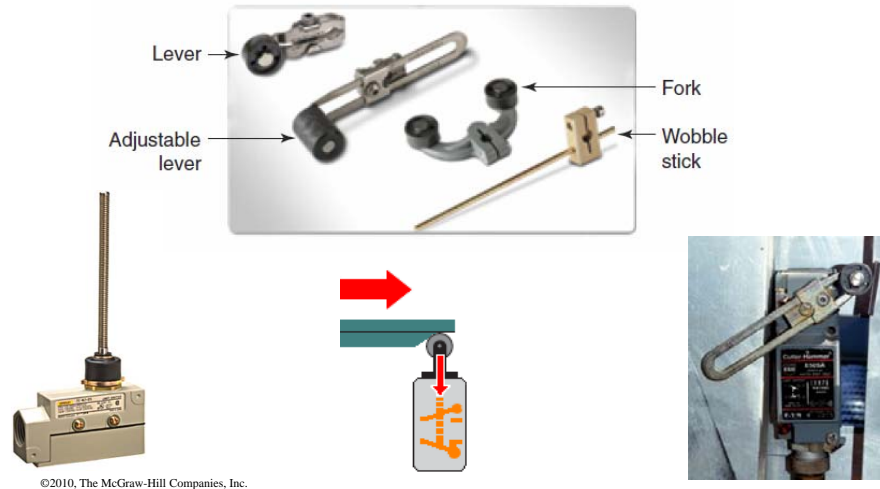


IEC symbols

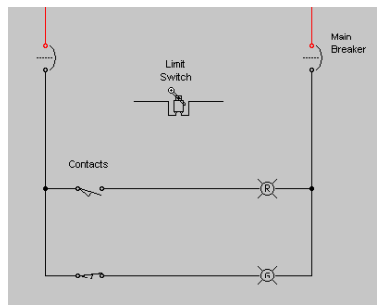


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Limit switches come with a wide variety of *actuators or operators* designed for a broad range of applications.

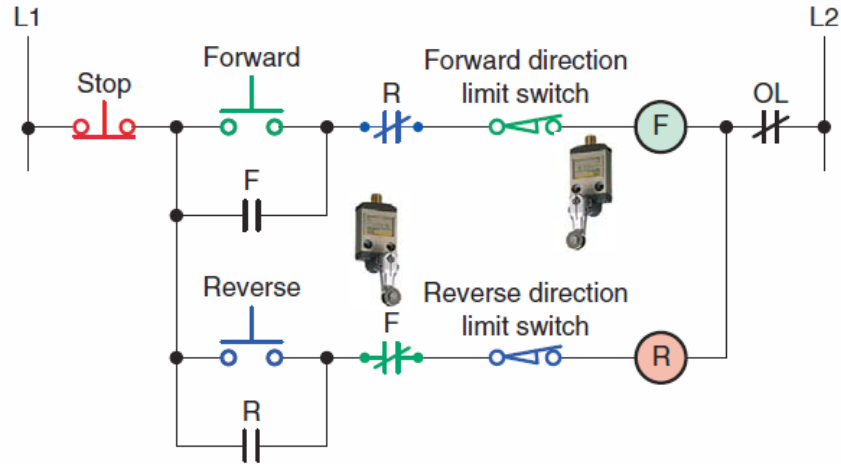


Simulated Limit Switch Operation



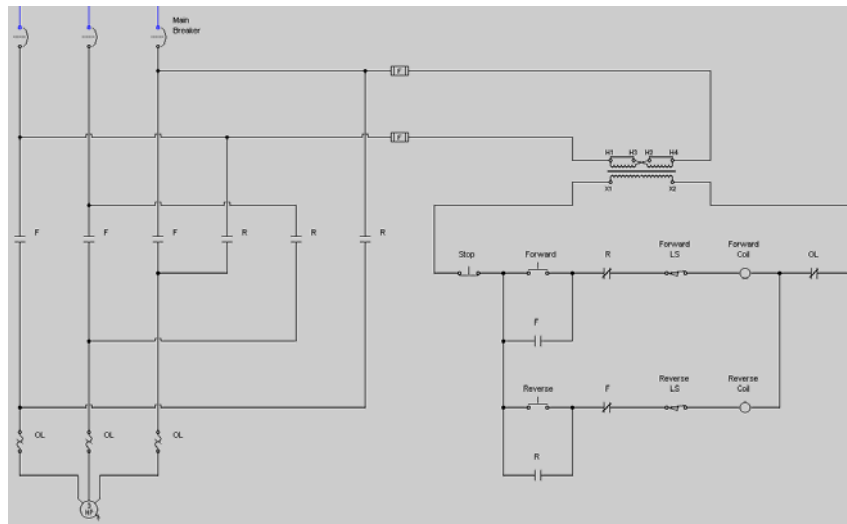
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Control circuit for starting and stopping a motor in the forward and reverse directions with two limit switches providing *overtravel protection*.



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Simulated Overtravel Protection Circuit



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The ***micro limit switch*** is a snap-acting switch housed in a small enclosure. Snap action micro switches produce a very rapid transfer of contacts from one position to another.



In a **snap-acting switch**, the actual switching of the circuit takes place at a fixed speed no matter how quickly or slowly the activating mechanism moves.

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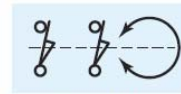
A ***rotating cam limit switch*** is a control device that senses angular shaft rotation within 360° and then activate contacts.



Switch assembly

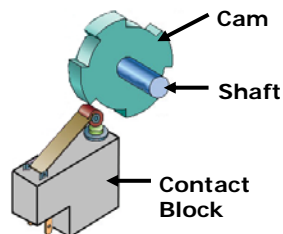


Enclosure



Symbol

They are typically used with machinery having a repetitive cycle of operation, where motion is correlated to shaft rotation.



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TEMPERATURE CONTROL DEVICES

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Temperature switches are used to monitor the temperature or changes in temperature.



Electric Baseboard Heater Control



Furnace Control



Remote Sensing

Although there are many types available, they are all actuated by some specific environmental temperature change.

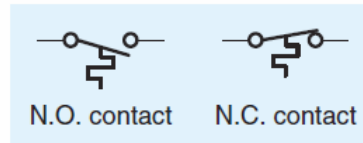
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Temperature switch contacts open or close when a designated temperature is reached.

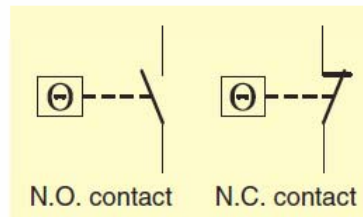
Programmable thermostat



NEMA symbols

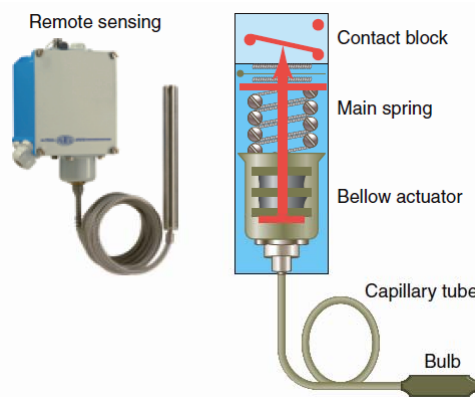


IEC symbols



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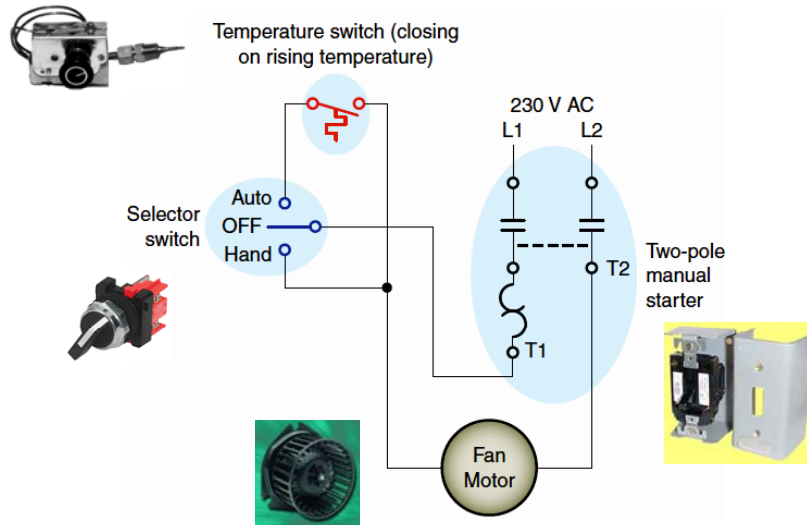
The fluid *capillary tube* type temperature switch operates on the principle that a temperature sensitive liquid will expand and contract with a change in temperature.



Pressure in the system changes in proportion to temperature and is transmitted through bellows to activate the contact block.

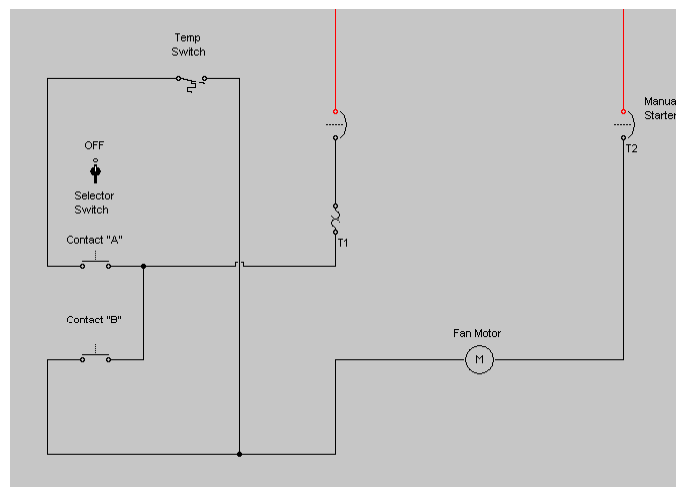
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Temperature switch utilized as part of a motor control circuit.



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Simulated temperature switch control of a motor circuit.

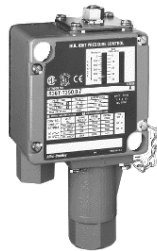


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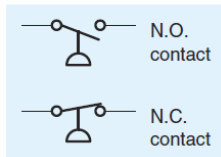
PRESSURE SWITCHES

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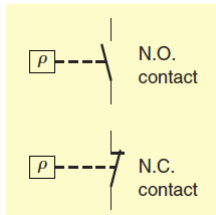
Pressure switches are used to monitor and control the pressure of liquids and gases.



NEMA symbols for pressure switch contacts

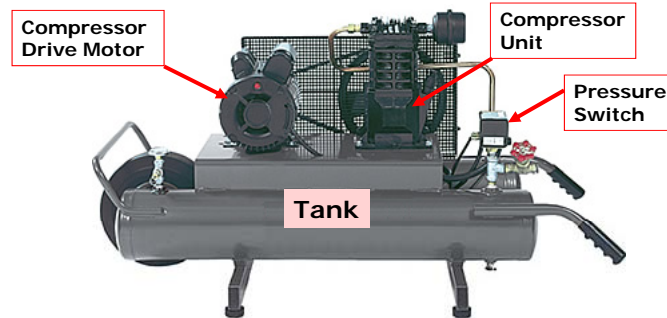


IEC symbols for pressure switch contacts



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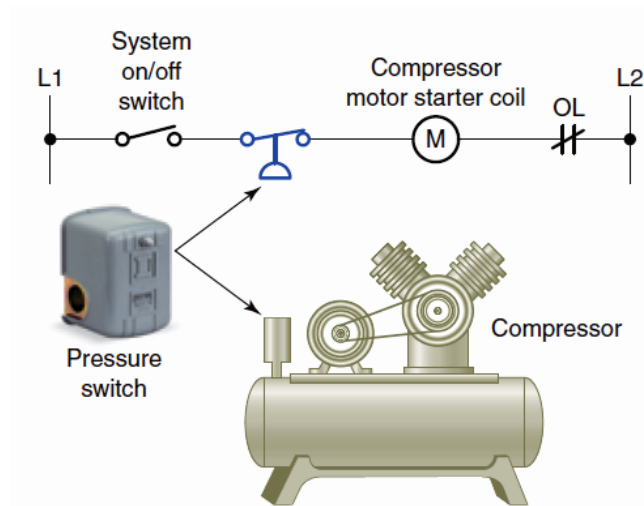
The three categories of pressure switches used to activate electrical contacts are: *positive* pressure, *vacuum* (negative pressure) and *differential* pressure.



A pressure switch is used to automatically stop and start the motor when tank pressure increases above or drops below a preset value.

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Pressure switch used as part of an air compressor control system.



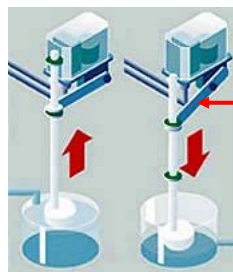
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FLOAT and FLOW SWITCHES

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A *float switch* is used to sense the height of a liquid. They provide automatic control for motors that pump liquid from a sump or into a tank.

A float operator assembly is attached to the float switch by a rod. The float switch is actuated based on the location of the float in the liquid.

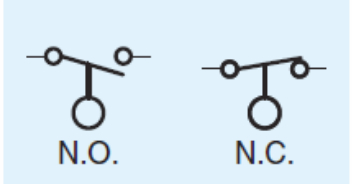



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Float switch types and symbols.

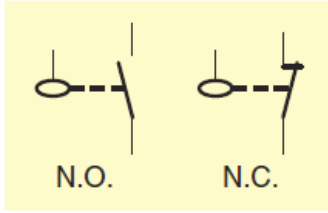


NEMA symbols



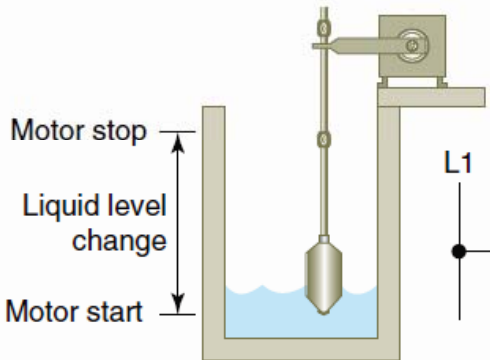


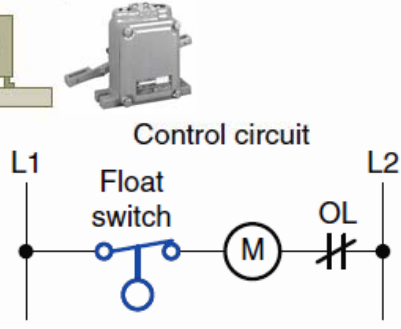
IEC symbols



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Float switch automatic *tank filling operation.*

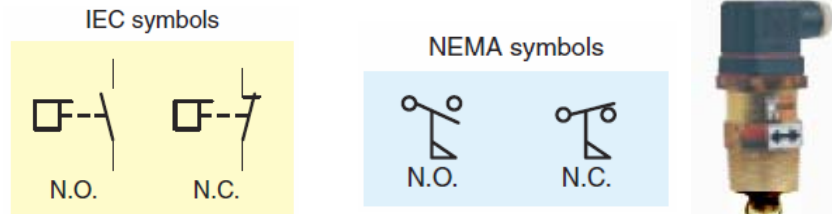




- The float switch contacts are **open** when the float forces the operating lever to the **UP** position.
- When the float reaches a preset **low level**, the float switch contacts **close**, activating the circuit and starting the pump motor.

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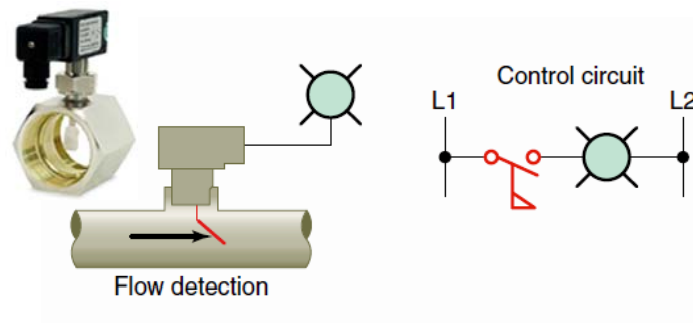
A *flow switch* is used to detect the movement of air or liquid through a duct or pipe.



A paddle extends into a pipe and moves to actuate the electrical contacts of the flow switch when the fluid flow is sufficient to overcome the spring tension on the paddle.

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Flow switch monitoring circuit.



Flow switch closes to turn on the pilot light when sufficient liquid flow is detected.

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