

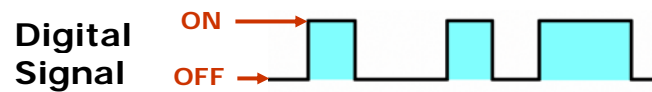
Chapter 7

Relays

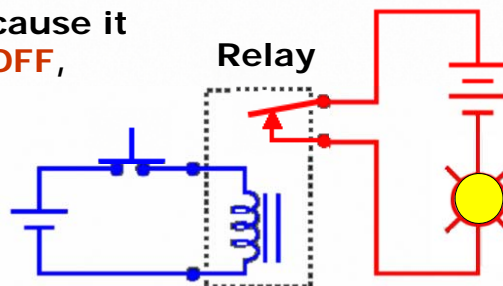
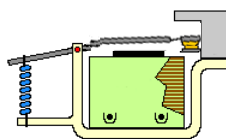
PART 5 Relay Control Logic

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Digital signals are the language of modern day computers. Digital signals comprise only two states that can be expressed as **ON** or **OFF**.



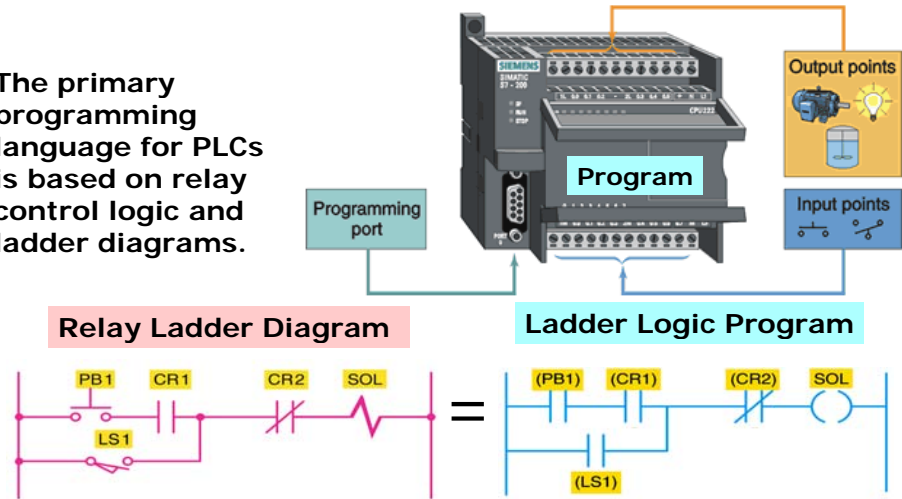
A relay can be considered digital in nature because it is basically an **ON/OFF**, two-state device.



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It is common practice to use relays to make logical decisions in motor control circuits.

The primary programming language for PLCs is based on relay control logic and ladder diagrams.


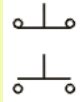








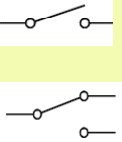




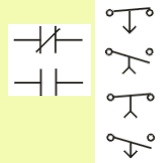


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CONTROL CIRCUIT INPUTS AND OUTPUTS

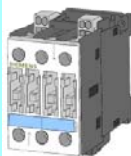
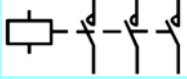

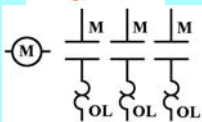








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Electrical circuits can be divided into *inputs* and *outputs*. **Inputs** provide the signals and in general start or stop the flow of current.

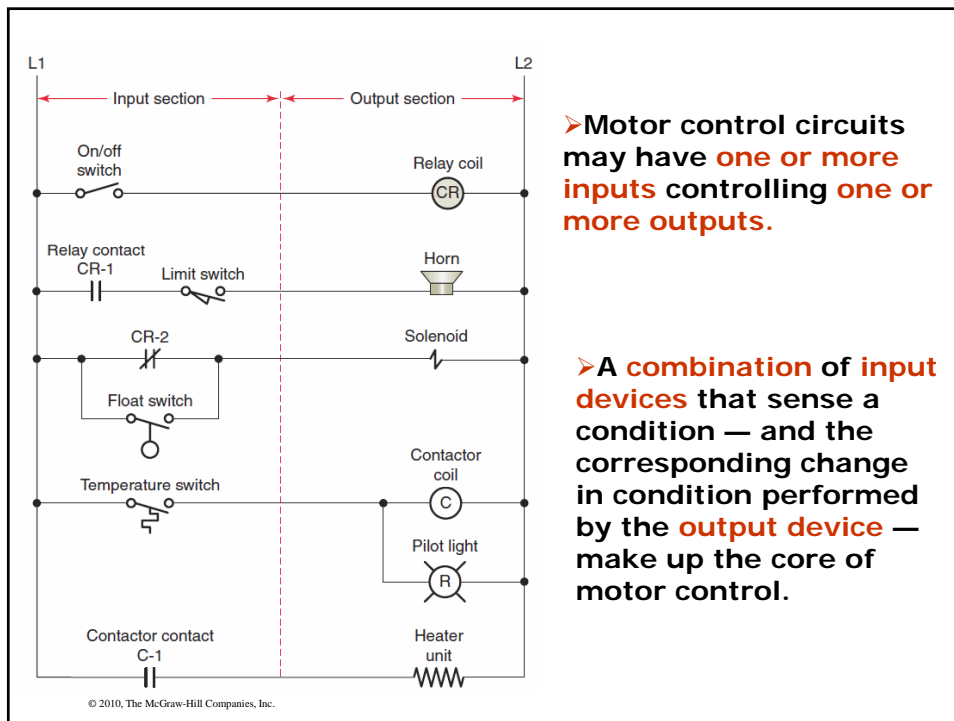
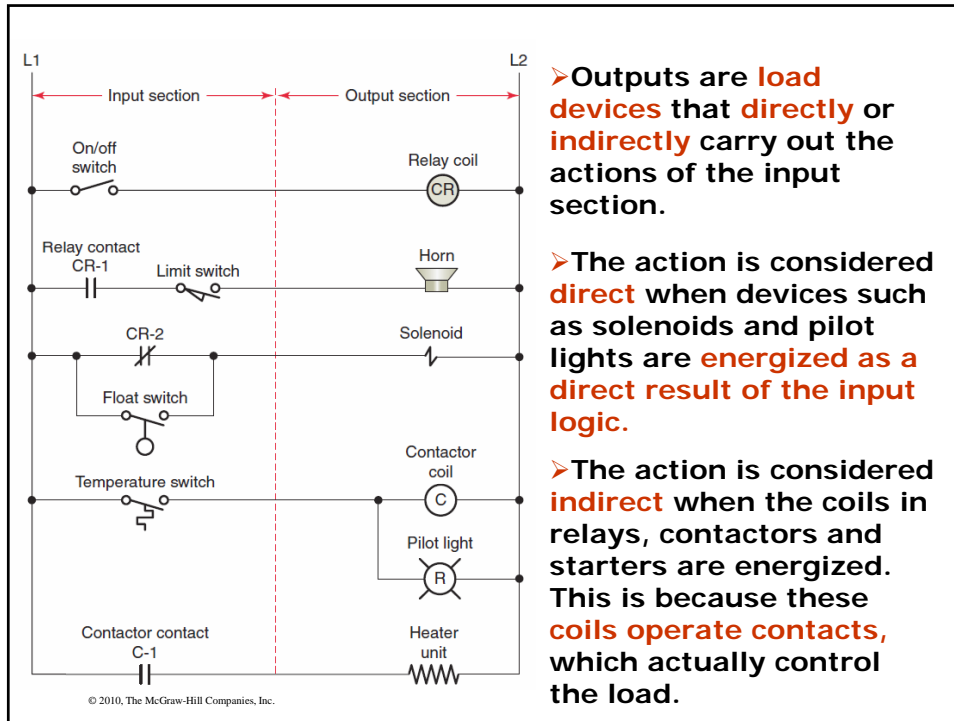
Manually Operated	Automatically Operated			Relay Contacts
 	 	 	 	
 	 	 		

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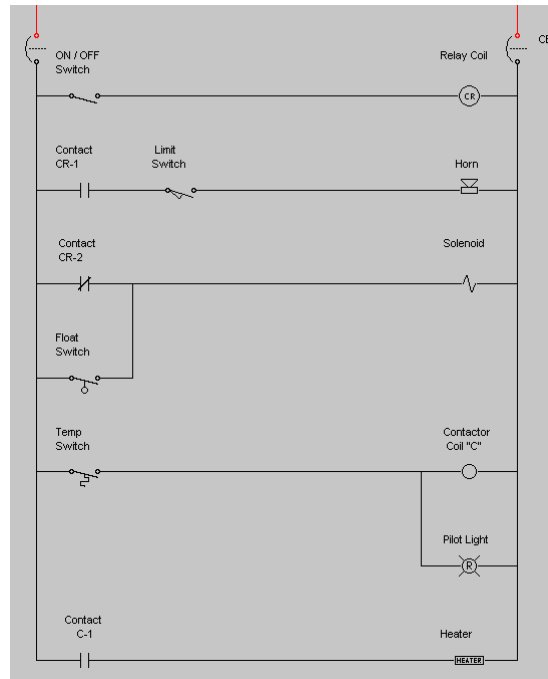
Outputs provide the action by using the electric energy to do work.

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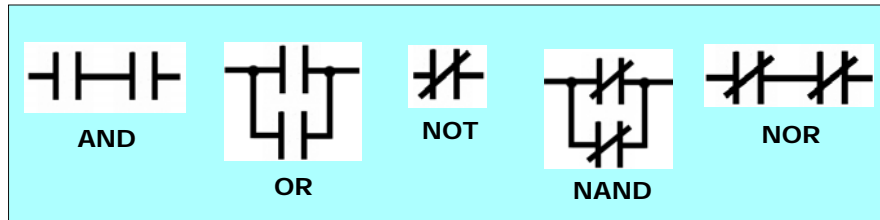


Simulated Inputs And Outputs Of A Relay Ladder Control Diagram



AND Logic Function

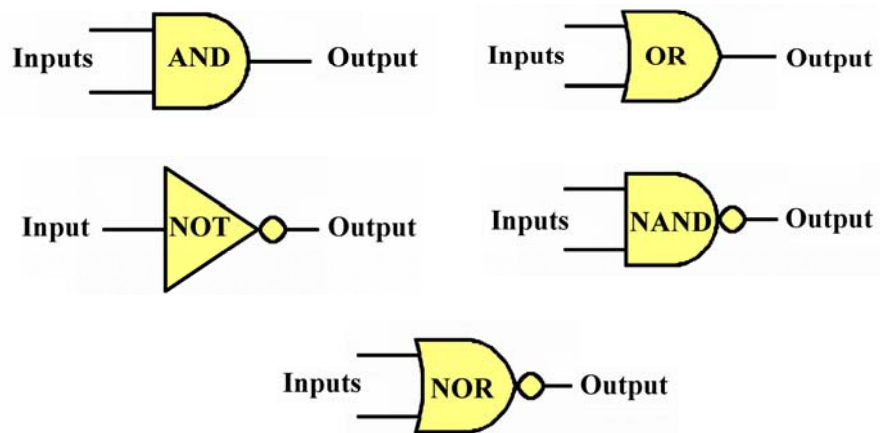
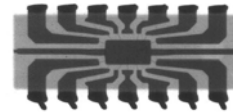
Logic is the ability to make **decisions** when one or more different factors must be taken into consideration.



Control logic functions describe how inputs interact with each other to control the outputs and include **AND**, **OR**, **NOT**, **NAND**, and **NOR** functions.

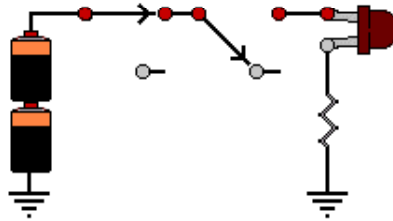
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In electronic circuits logic functions are implemented using digital circuits known as **gates**.



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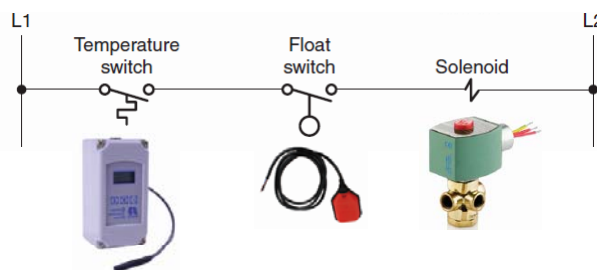
The **AND** logic function operates like a **series circuit**.



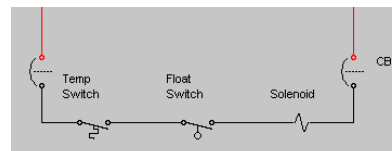
AND logic is used when two or more inputs are connected in series and they **all must be closed** in order to energize the output load.

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Most **AND** logic circuits use **normally open** input devices connected in **series**. In this application **both** the temperature switch and the float switch inputs must be closed to energize the solenoid output.



Temp Switch	Float Switch	Solenoid
Open	Open	De-energized
Open	Closed	De-energized
Closed	Open	De-energized
Closed	Closed	Energized

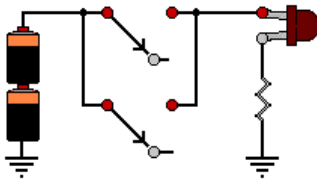


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OR Logic Function

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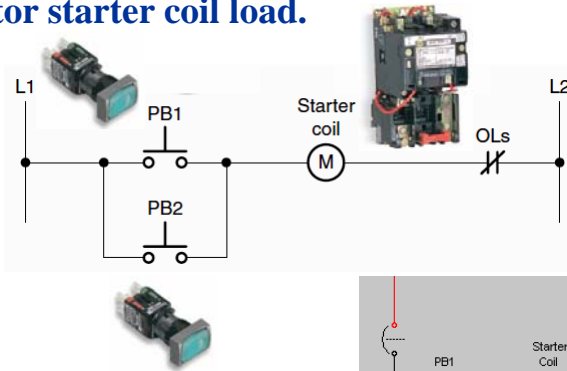
The *OR* logic function operates like a parallel circuit.



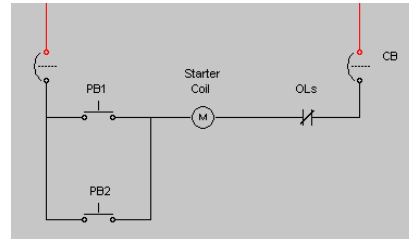
OR logic is used when two or more inputs are connected in parallel and so that **any one of the inputs** can close to energize the output load.

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Most **OR** logic circuits use **normally open** input devices connected in **parallel**. In this circuit **any one** of the two pushbutton inputs can close to energize the motor starter coil load.



PB1	PB2	Starter Coil
Open	Open	De-energized
Open	Closed	Energized
Closed	Open	Energized
Closed	Closed	Energized

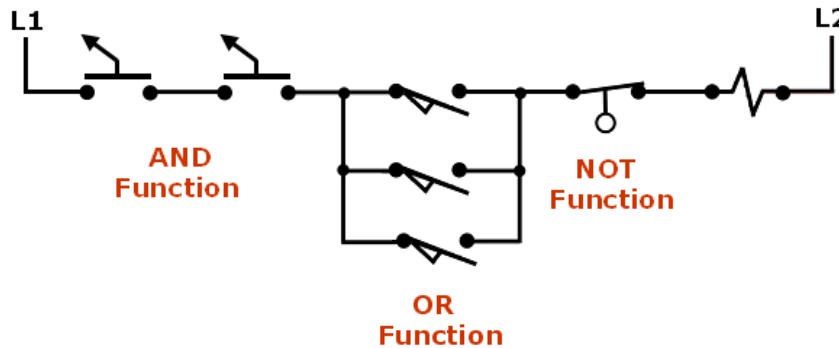


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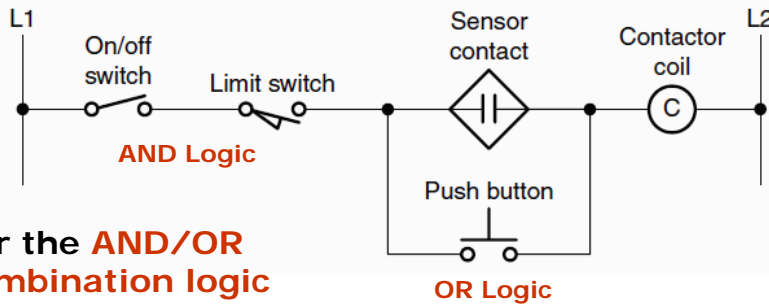
COMBINATION Logic Function

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Control INPUTS often require **more than one type** of logic function.

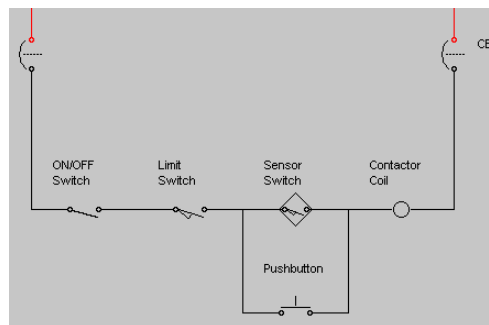


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For the **AND/OR combination logic** circuit shown, both the **ON/OFF switch AND** limit switch, in addition to the **sensor contact OR** pushbutton must be closed to energize the **contactor coil**.

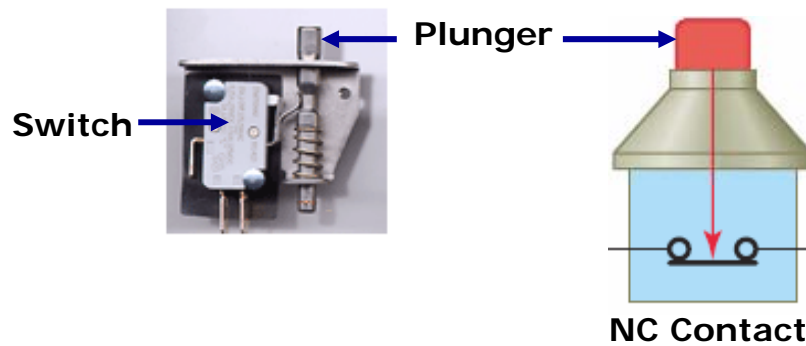
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NOT Logic Function

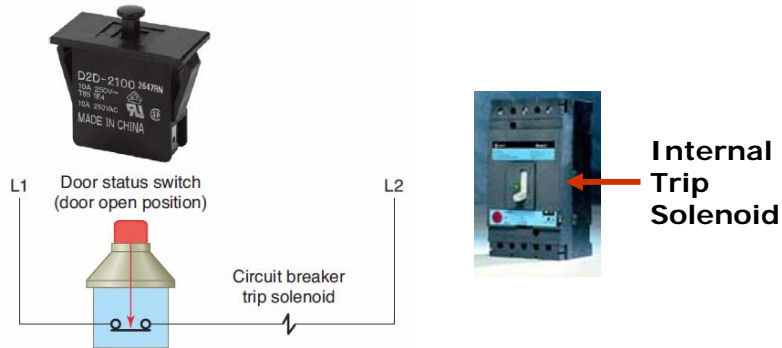
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Unlike the AND logic and OR logic, the *NOT logic* function uses a **single normally closed** rather than normally open input device.



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NOT logic energizes the load when the control signal is **off**.



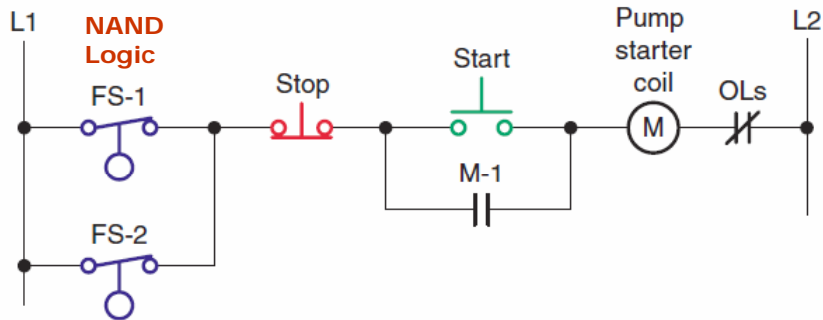
The **normally closed** safety switch operates by detecting the opening of a door. Contacts of the switch are held open by the **shut door**. When the **door is opened**, the switch returns to its normally closed state and the trip solenoid of the circuit breaker is energized to remove all power from the circuit.

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NAND Logic Function

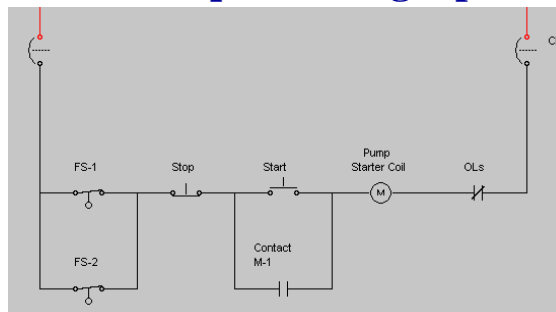
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NAND logic is a combination of AND logic and NOT logic in which two or more **normally closed contacts** are connected in **parallel** to control the load



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Dual Tank Liquid Filling Operation



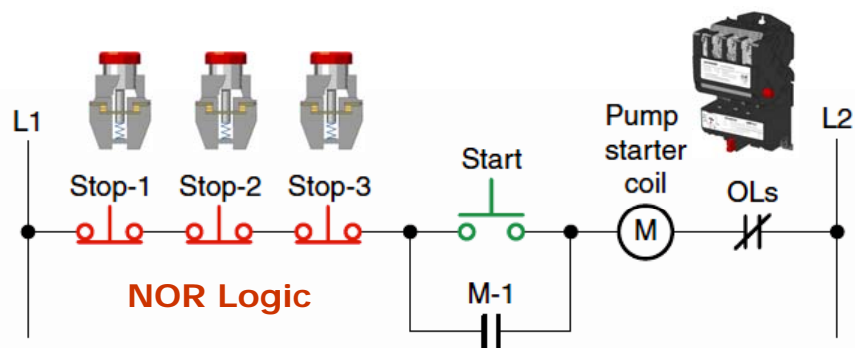
- Two tanks are interconnected and each is equipped with a float switch installed at the full level of the each tank.
- With either or both tanks below the full level, momentarily depressing the start pushbutton energizes the motor starter coil turning on the pump motor.
- Both float switches must open for the motor to shut off automatically.
- The stop pushbutton will shut down the process at any time.

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NOR Logic Function

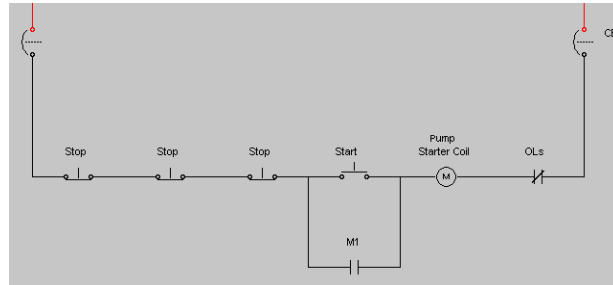
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***NOR* logic** is a combination of OR logic and NOT logic in which two or more **normally closed** contacts are connected in **series** to control the load.



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NOR Logic Function Simulation



- In this circuit the motor can be started from one location, but can be stopped from three locations.
- The three **series** connected **normally closed stop pushbuttons** provide the **NOR** function of the circuit.
- Once energized, if any one of the three stop pushbuttons is pressed the starter coil M will de-energized.

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