

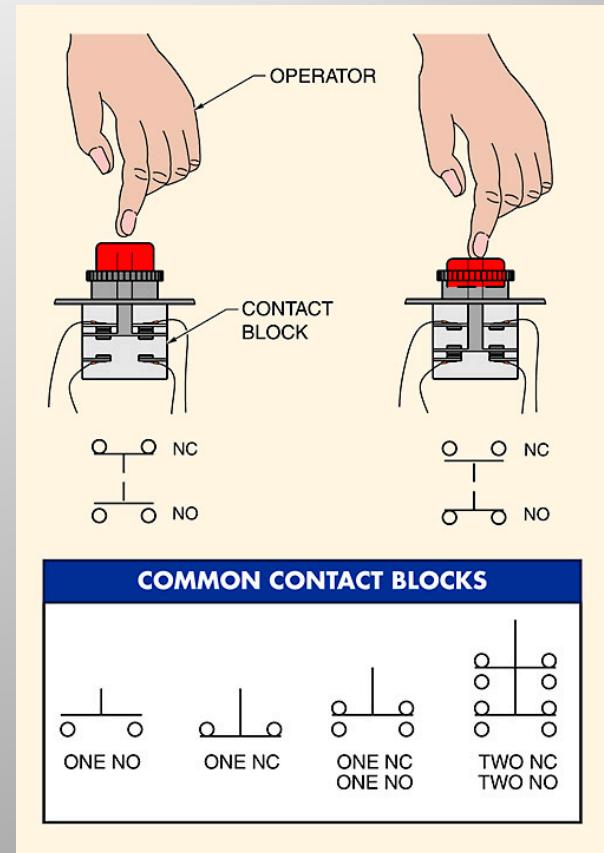
Electrical Controls



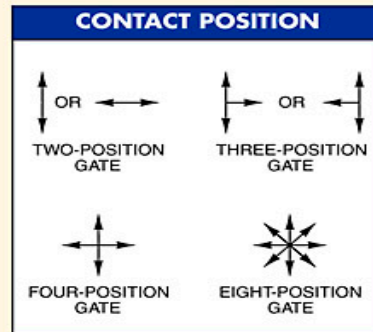
Isaac Queen –iqueen@atn.org

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- Contact blocks include normally open (NO), normally closed (NC), or both NO and NC contacts.



- A joystick is used to control many different circuit operations from one location.



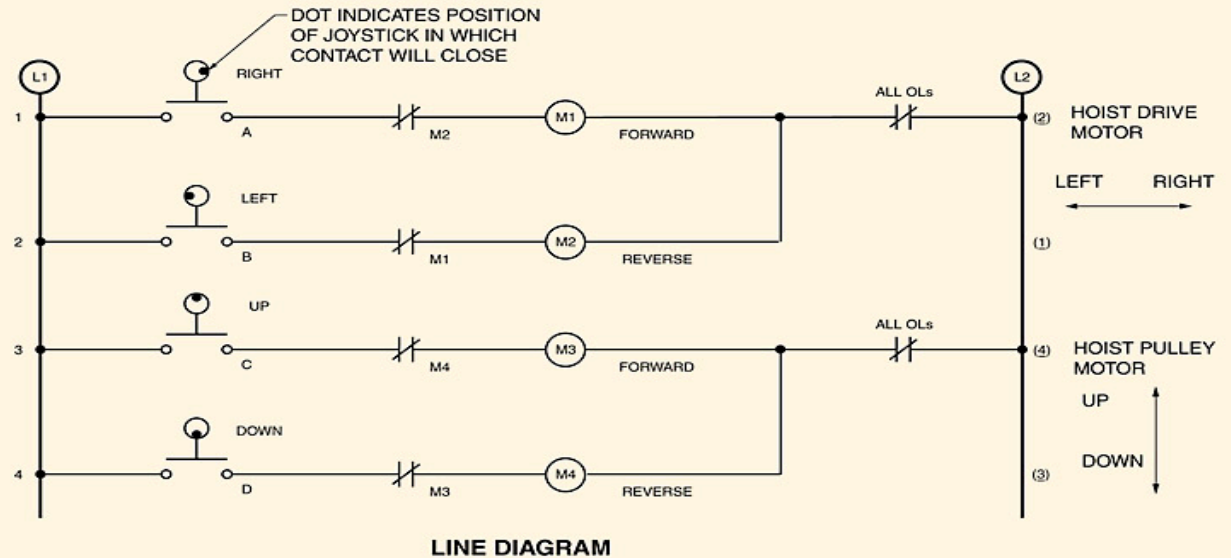
Square D Company

O INDICATES CONTACTS ARE OPEN
X INDICATES CONTACTS ARE CLOSED

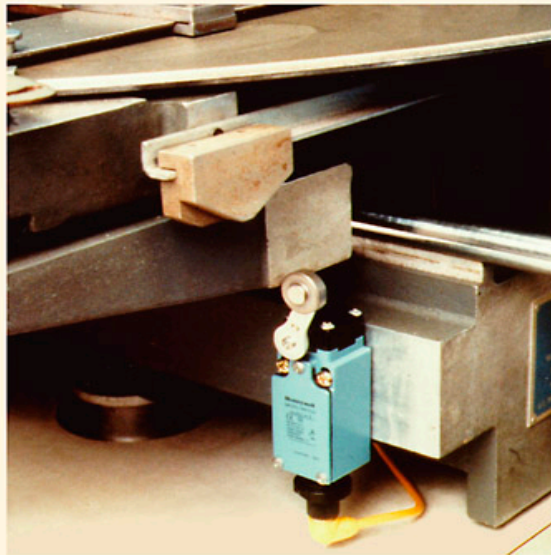
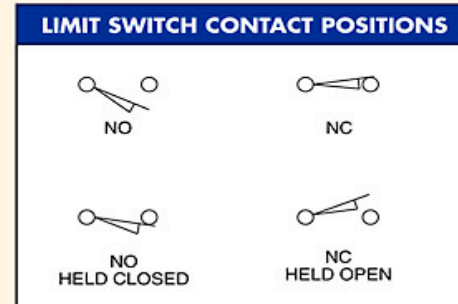
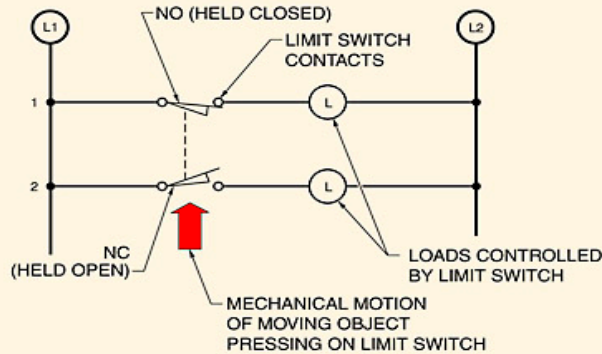
POSITION	CONTACTS			
	A	B	C	D
RIGHT	X	O	O	O
LEFT	O	X	O	O
UP	O	O	X	O
DOWN	O	O	O	X

TRUTH TABLE

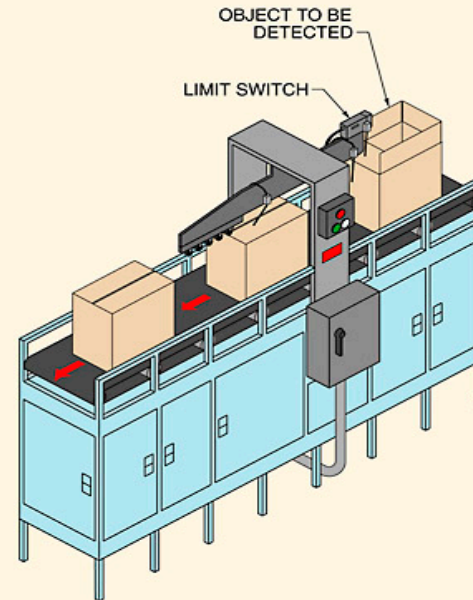
X INDICATES CONTACTS ARE CLOSED



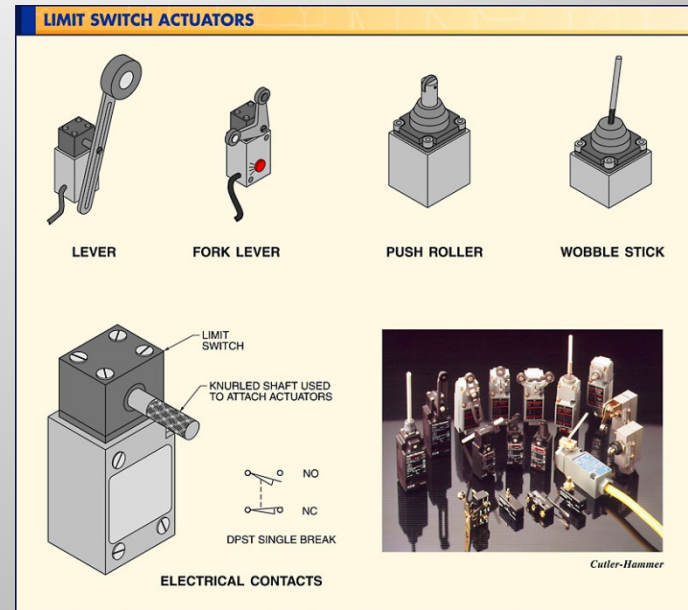
- Limit switches are used to convert a mechanical motion into an electrical signal.



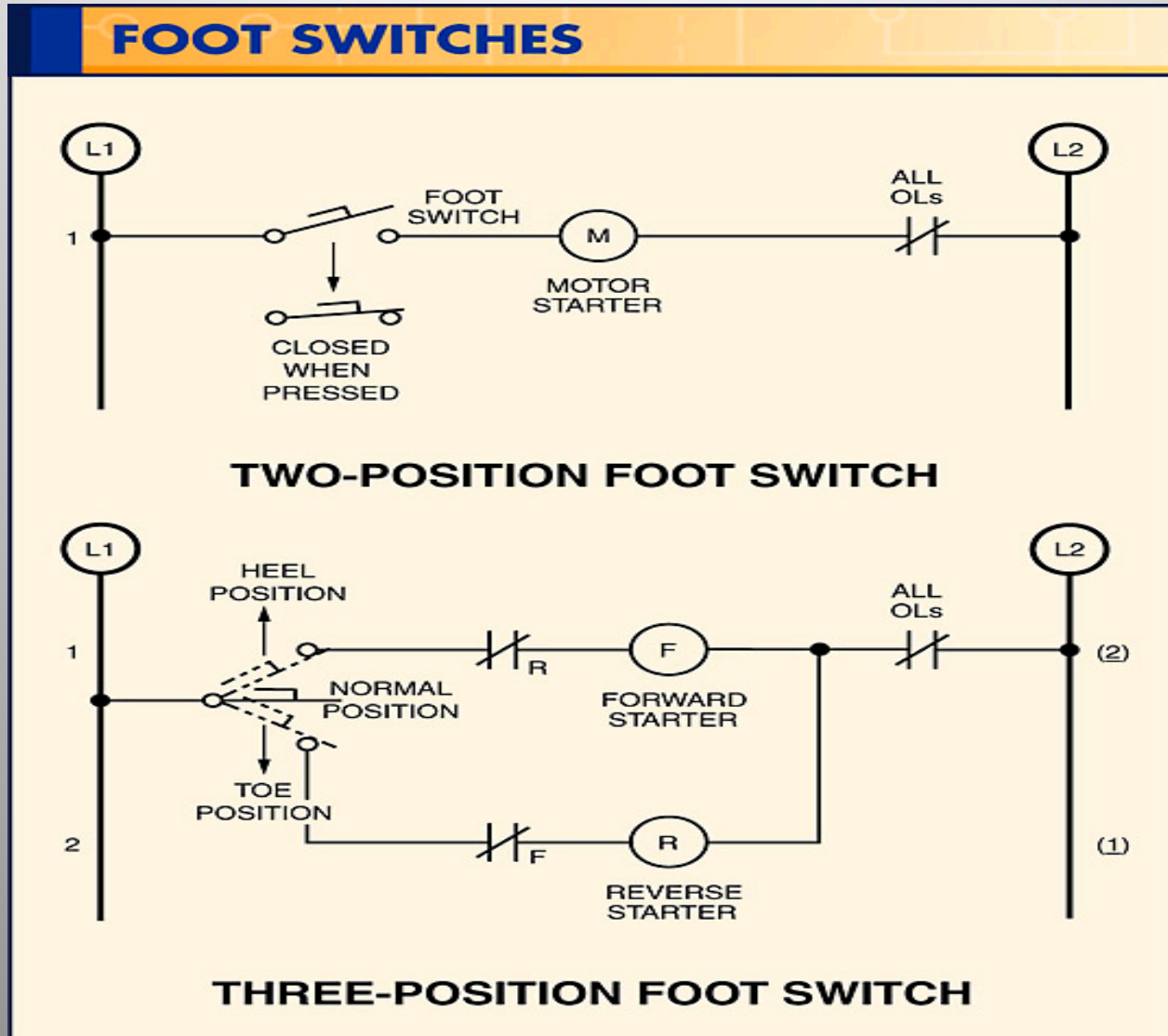
Honeywell



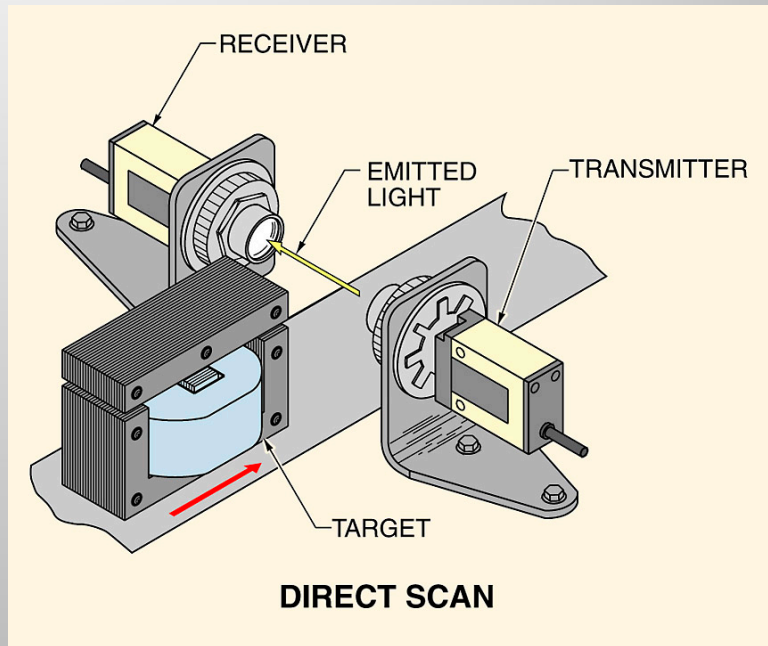
- An actuator is the part of a limit switch that transfers the mechanical force of the moving part to the electrical contacts.



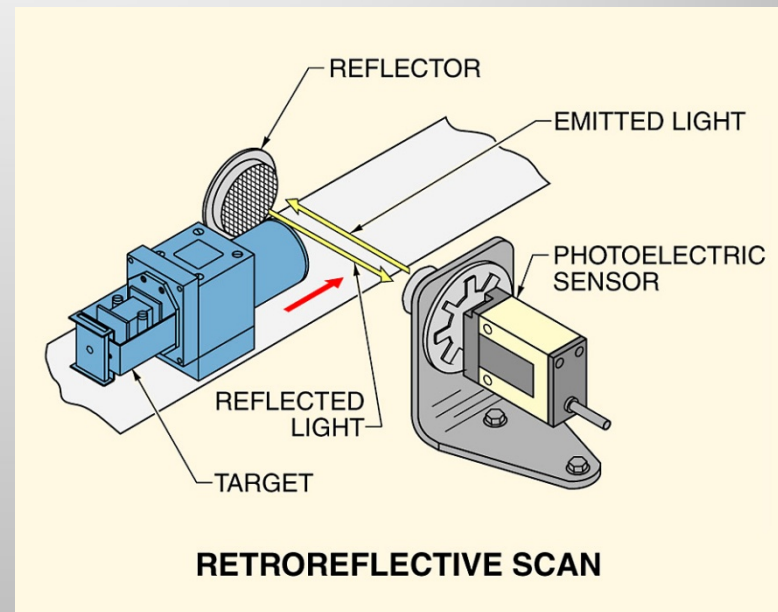
- A foot switch is used to allow hands-free control or an additional control point.



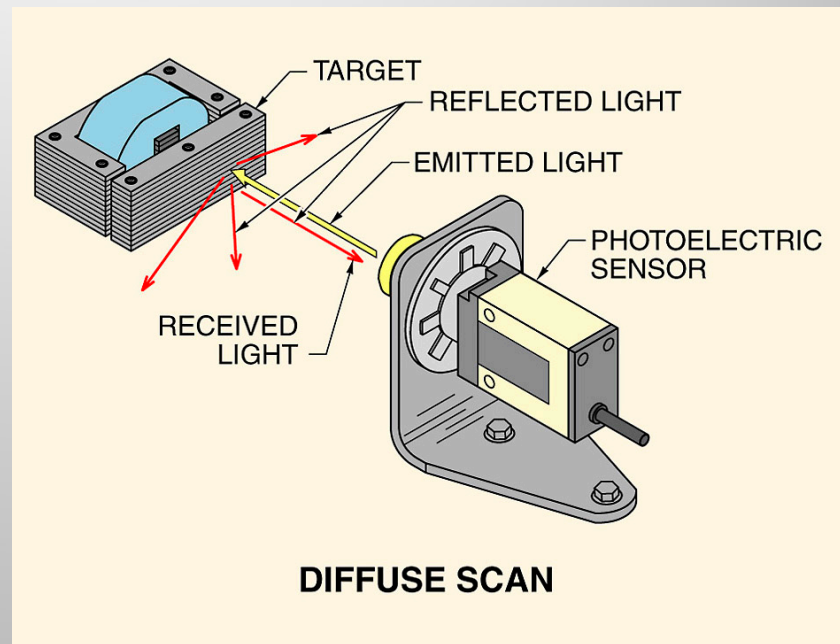
- Direct scan is a method of scanning in which the target is detected as it passes between the transmitter and receiver.



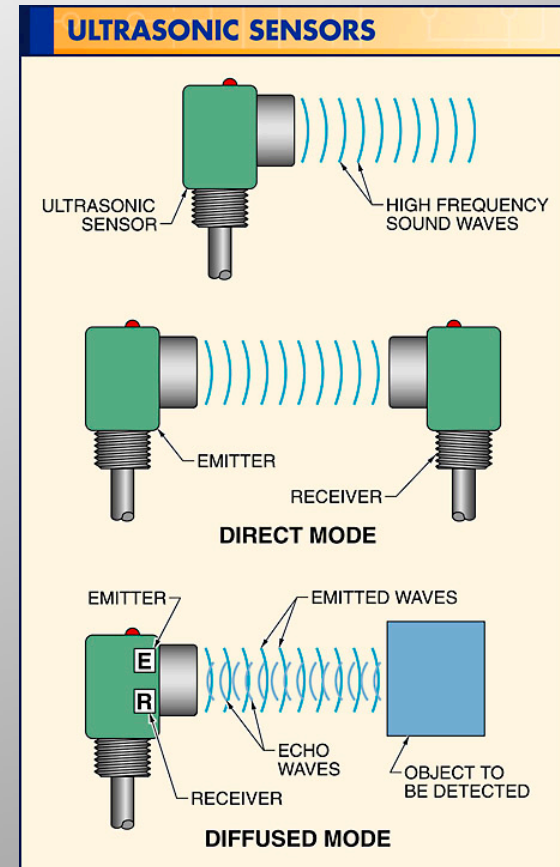
- Retroreflective scan is a method of scanning in which the target is detected as it passes between the photoelectric sensor and reflector.



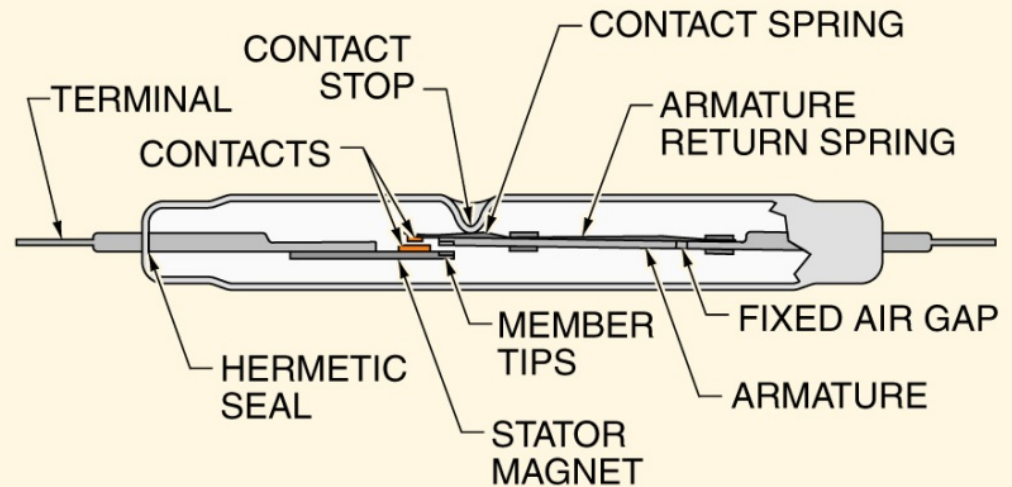
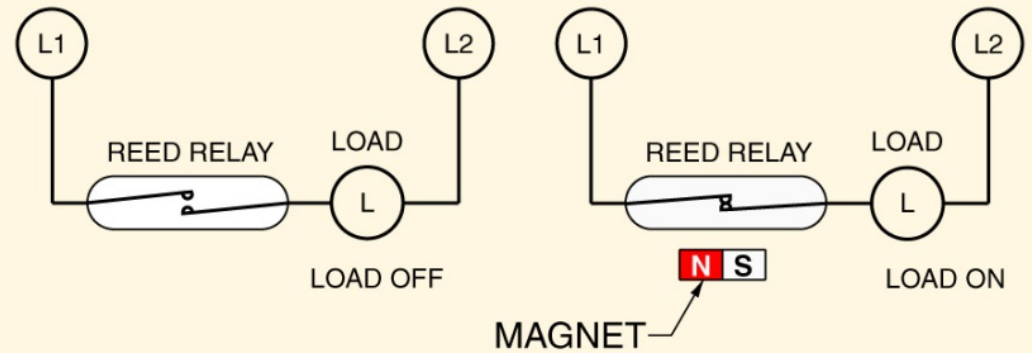
- Diffuse scan is a method of scanning in which the target is detected when some of the emitted, reflected light is received.



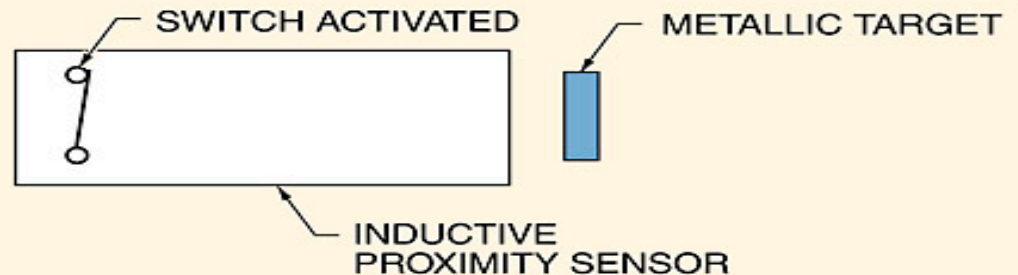
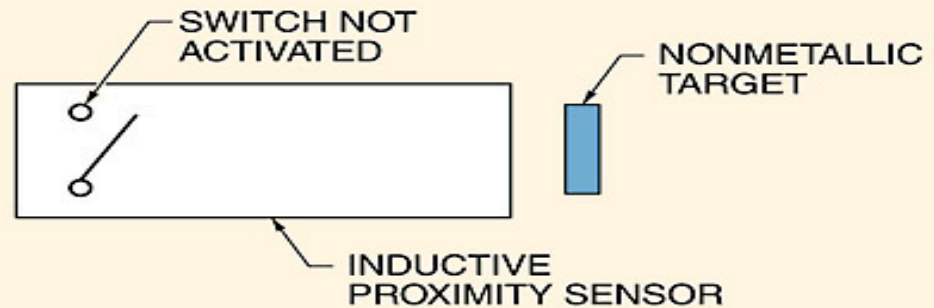
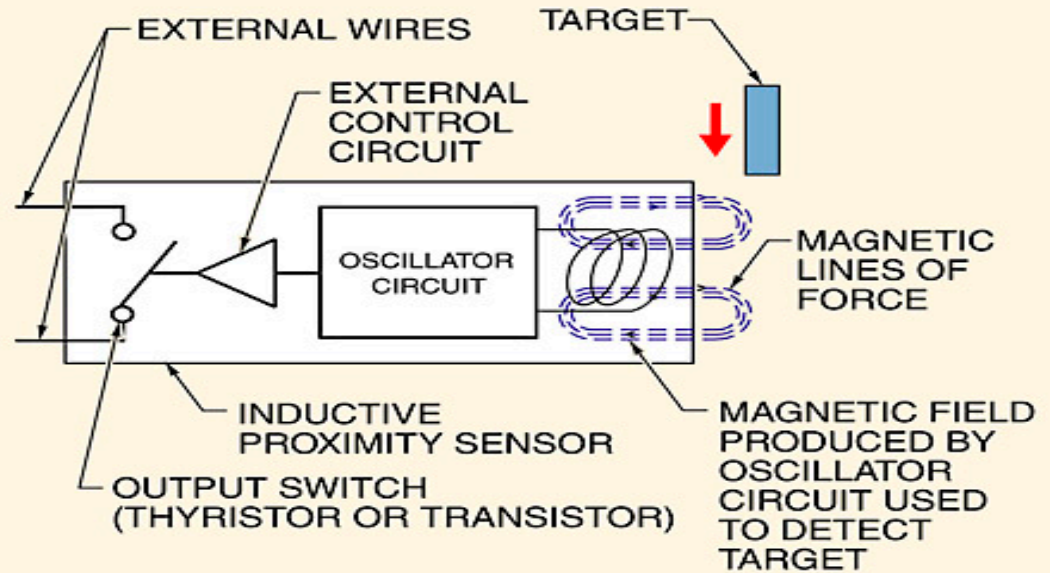
- Ultrasonic sensors detect objects by bouncing high-frequency sound waves off the object.



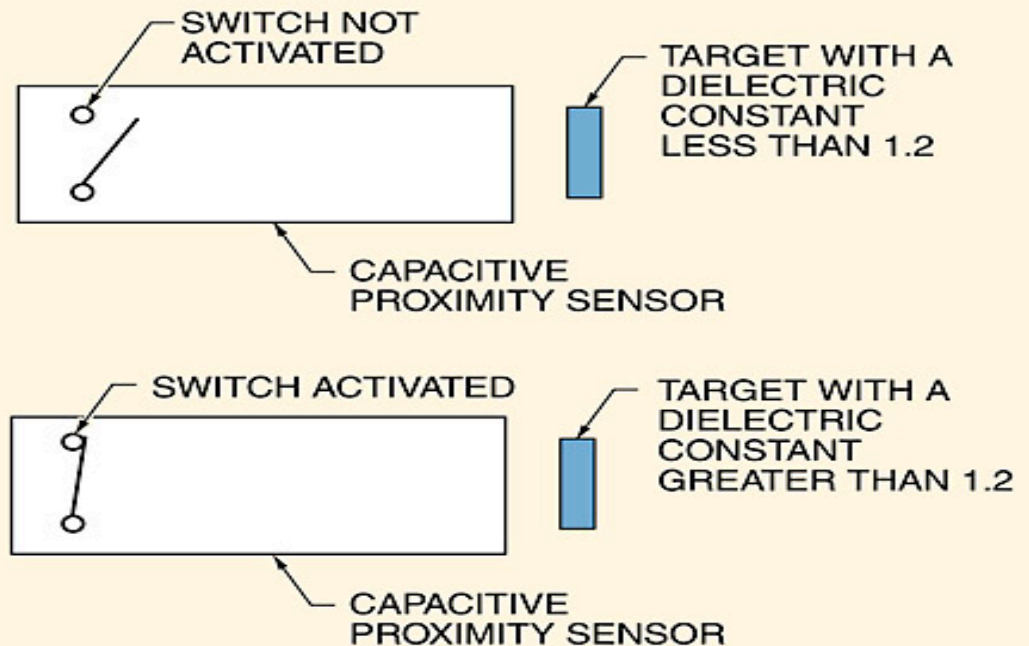
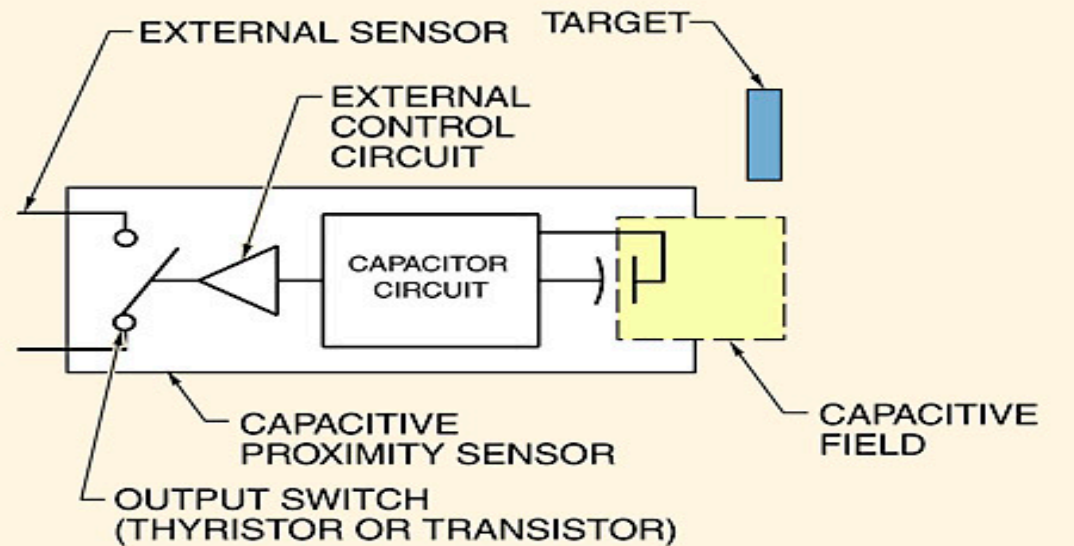
- A reed relay is a fast-operating, single-pole, single-throw switch that is activated by a magnetic field.



- Inductive proximity sensors use a magnetic field to detect the presence of a target.



- Capacitive proximity sensors use a capacitive field to detect the presence of a target.

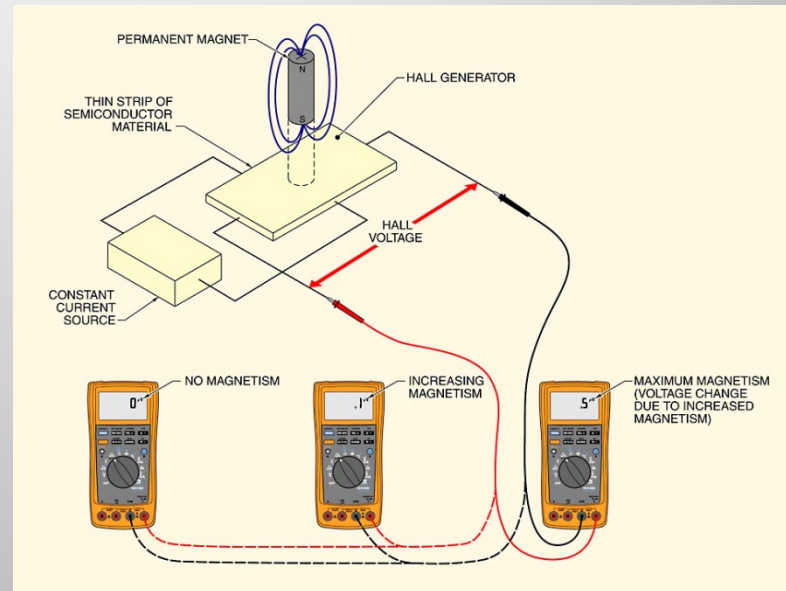


- Capacitive sensors work based on the dielectric of the material to be sensed.

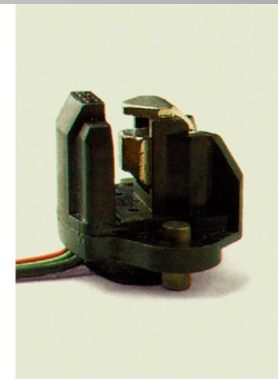
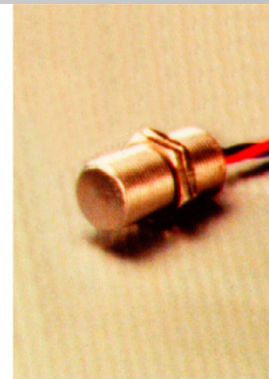
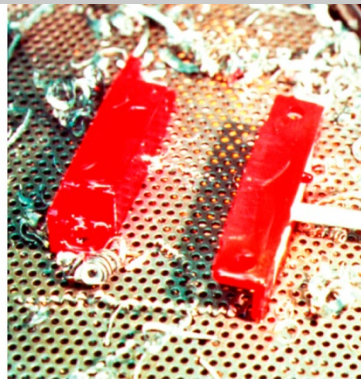
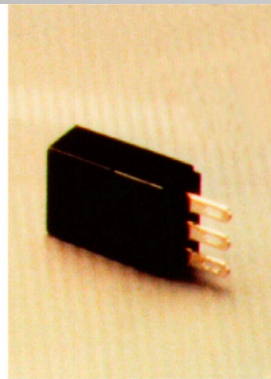
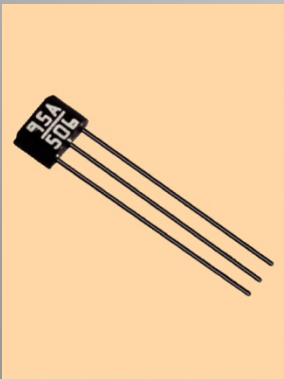
DIELECTRIC CONSTANT	
Material	Number
Acetone	20.7
Acrylic Resin	2.7 – 4.5
Air	1.000590
Ammonia (Liquid)	15 – 24
Aniline	5.5 – 7.8
Aqueous Solutions	50 – 80
Benzene	2.3
Carbon Dioxide	1.000985
Carbon Tetrachloride	2.2
Cement Powder	5 – 10
Cereal (Dry)	3 – 5
Chlorine Liquid	2.0
Ebonite	2.5 – 2.9
Epoxy Resin	3.3 – 3.7
Ethanol	24
Ethylene Glycol	37
Fly Ash	1.9 – 2.6
Flour	2.5 – 3.0
Freon 12	2.4
Gasoline	2.0
Glass	3.7 – 10
Glycerine	47 – 68
Lime	2.2 – 2.5
Marble	8.5
Melamine Resin	4.7 – 10.9
Mica	7.0
Nylon	3 – 4.4
Paraffin	2.0 – 2.5
Paper (Dry)	2.0
Petroleum Jelly	2.2 – 2.9
Phenol Resin	4.9
Polyacetal	3.6 – 3.7
Polyester Resin	3 – 4
Polypropylene	1.5
Polytetrafluoroethylene Resin	2.0
Polyvinyl Chloride Resin	3.3 – 4.5
Porcelain	6 – 8
Powdered Milk	1.8
Pressboard	2 – 5
Rubber	3.0
Salt	3 – 15
Sand (Dry)	5.0
Shellac	2.0 – 3.8
Silicon Varnish	2.8 – 3.3
Soybean	2.8
Styrene Resin	2.55 – 2.95
Sugar	3.0
Sulfur	1.6 – 1.7
Toulene (Liquid)	2.0 – 2.4
Turpentine	2.2
Urea Resin	6.2 – 9.5
Water	80 – 88
Wood, Dry	2 – 6
Wood, Wet	10 – 30

* Values will vary with changes in temperature

- A Hall generator is a thin strip of semiconductor material through which a constant control current is passed.

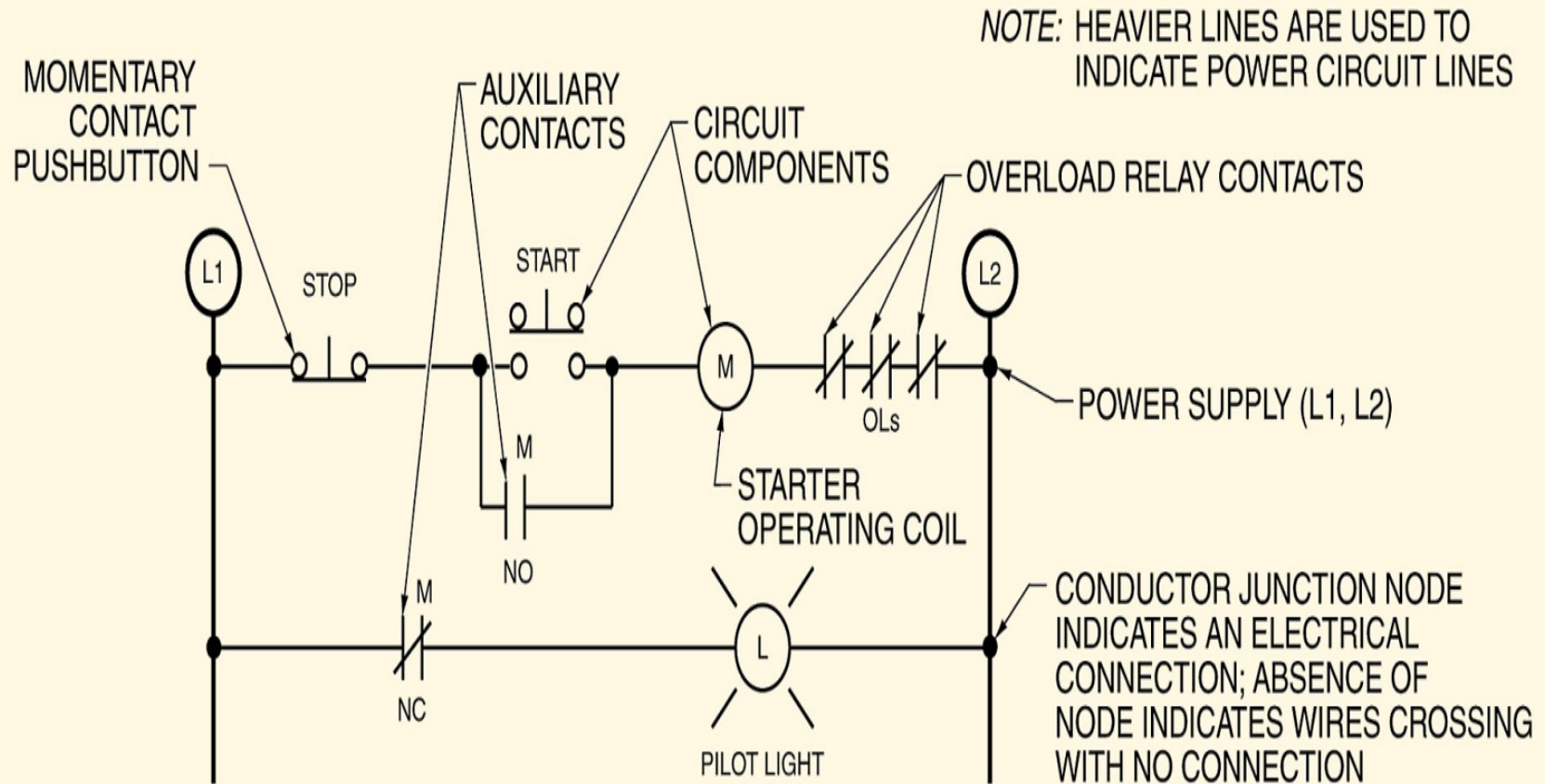


- Hall effect sensors are available in a variety of packages for different applications.



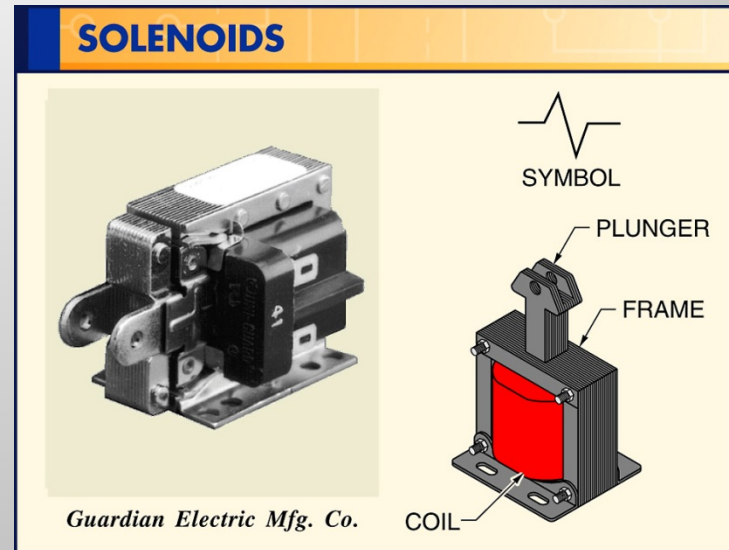
Honeywell

- A line (ladder) diagram consists of a series of symbols interconnected by lines that are laid out like rungs on a ladder to indicate the flow of current through the various components of a circuit.

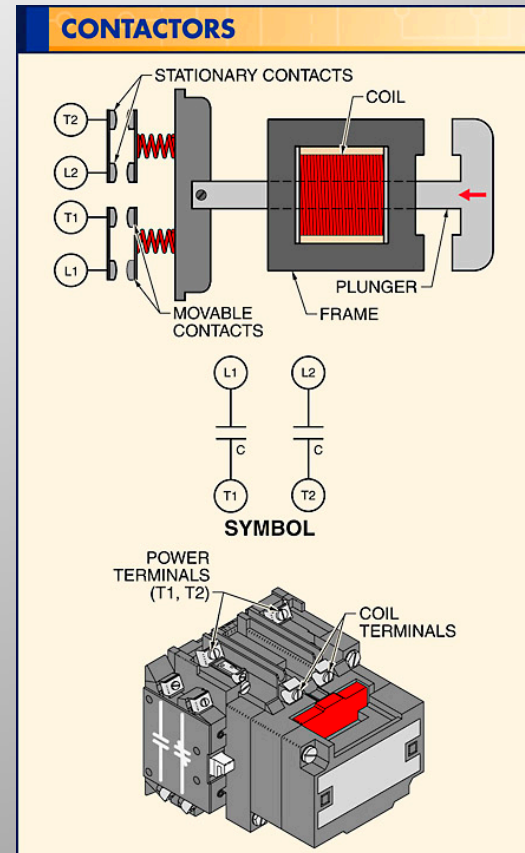


LINE DIAGRAM

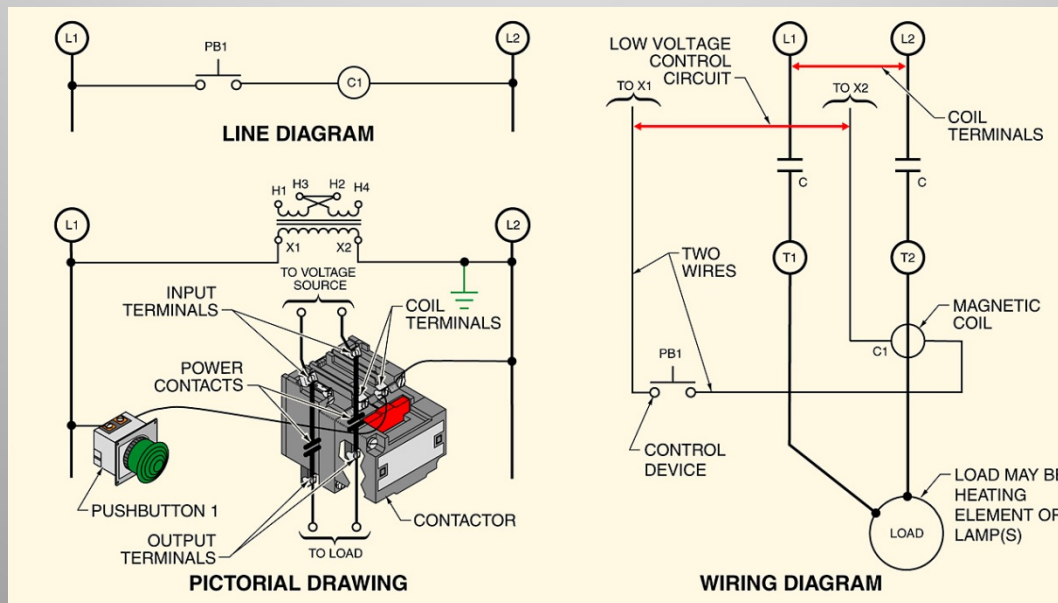
- A solenoid is an electric output device that converts electrical energy into a linear mechanical force.



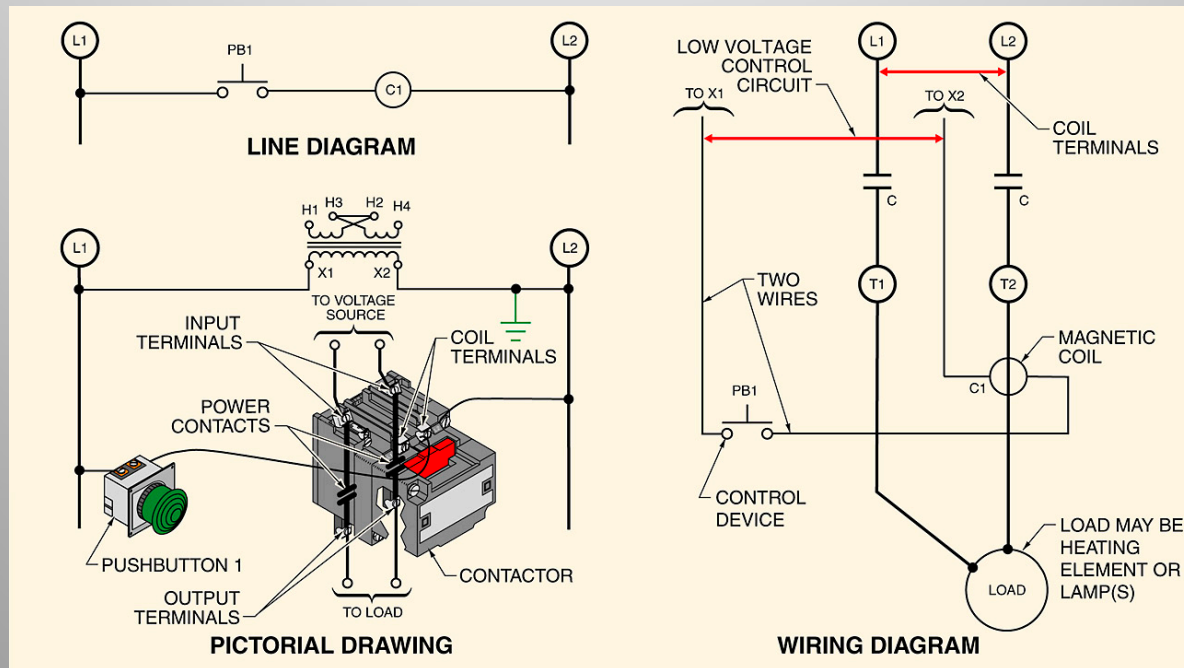
- A contactor is a control device that uses a small control current to energize or de-energize the load connected to it.



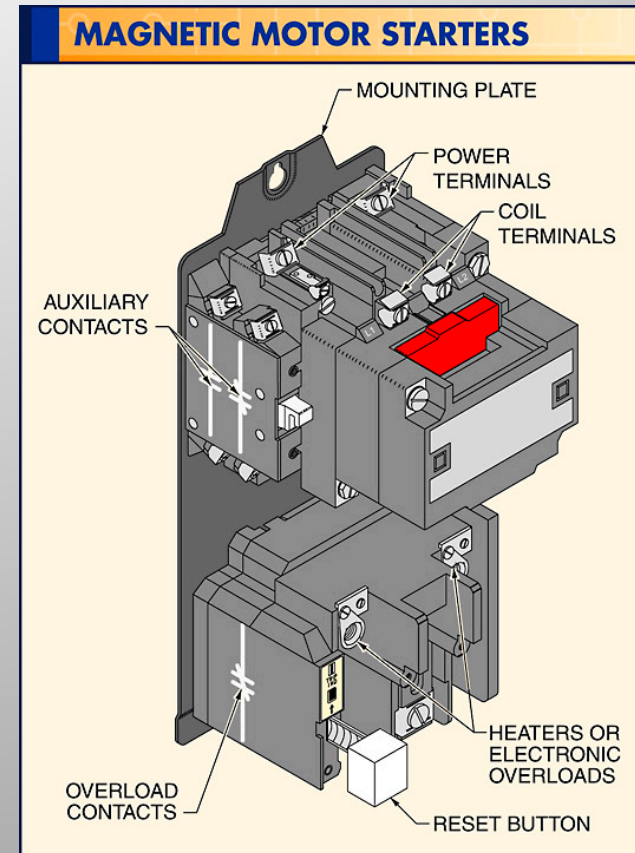
- The electrical operation of a contactor can be shown using a line diagram, a pictorial drawing, and/or a wiring diagram.



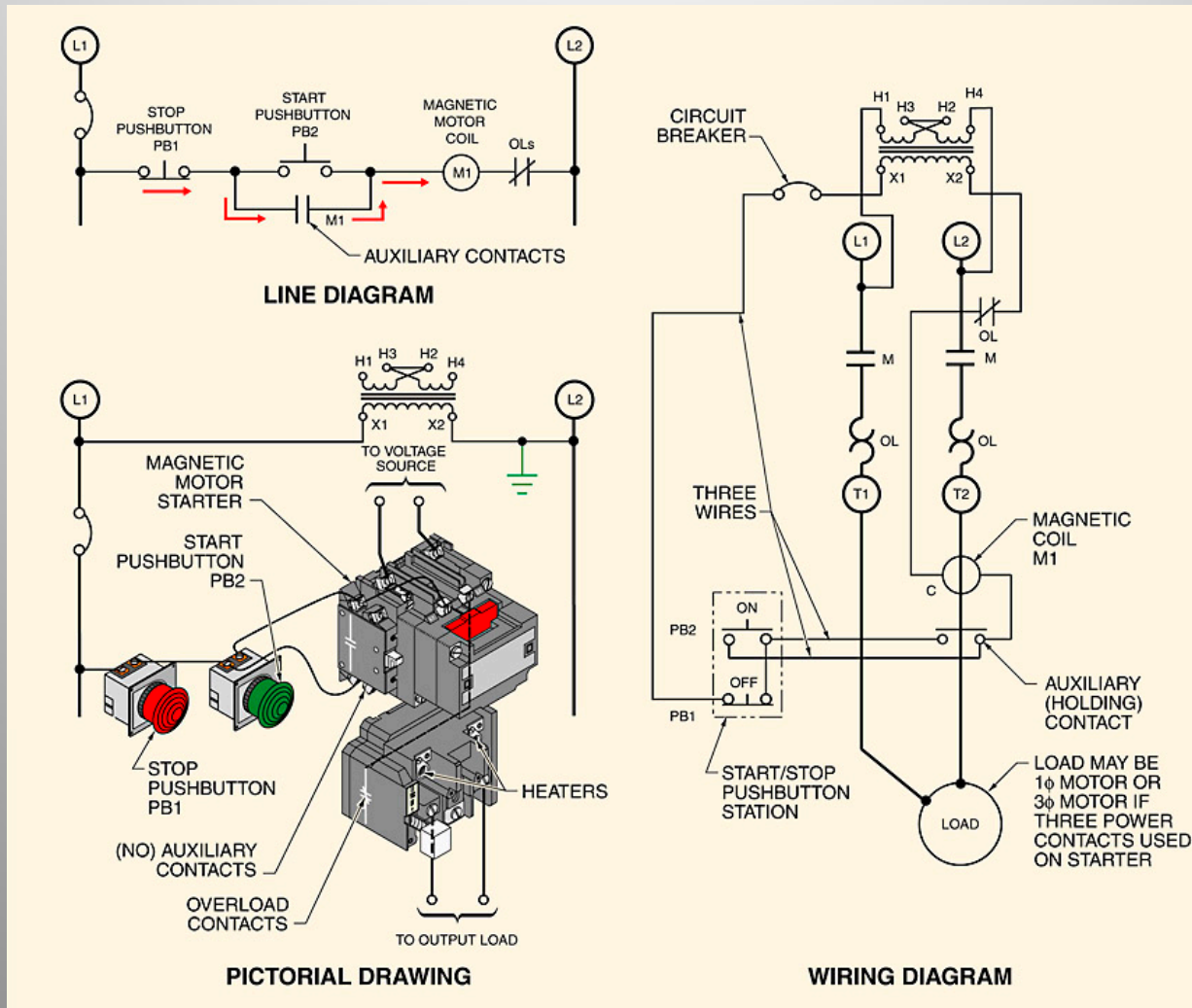
- Auxiliary contacts may be added to a contactor to form an electrical holding circuit.



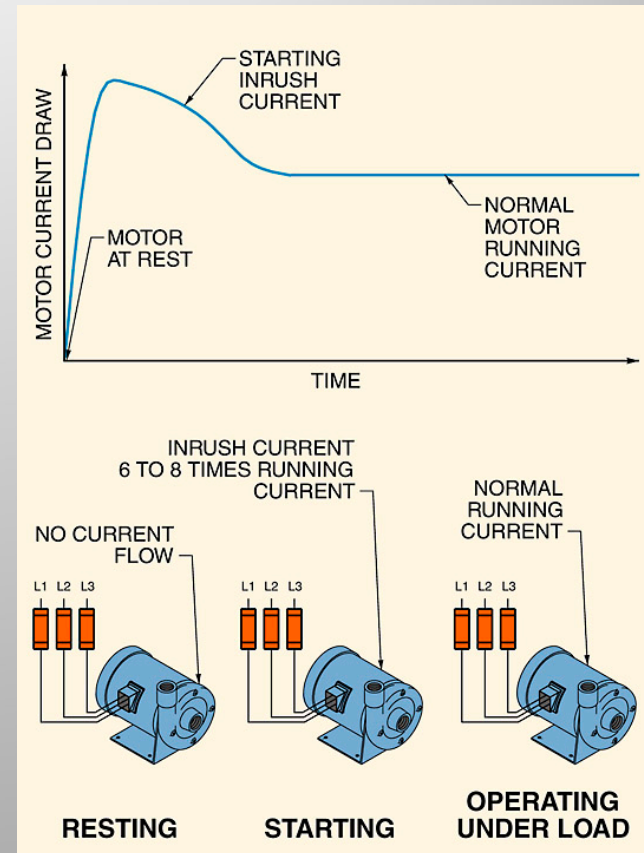
- A magnetic motor starter is an electrically operated switch (contactor) that includes motor overload protection.



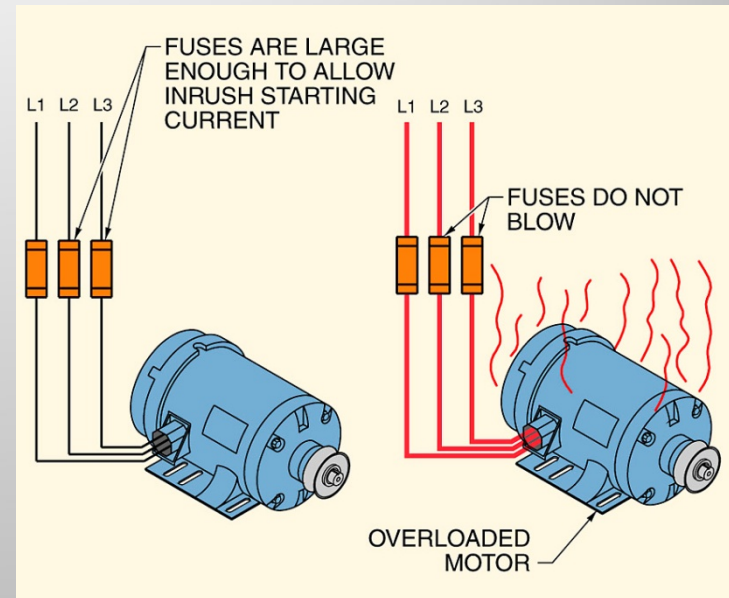
- The electrical operation of a motor starter can be shown using a line diagram, a pictorial drawing, and/or a wiring diagram.



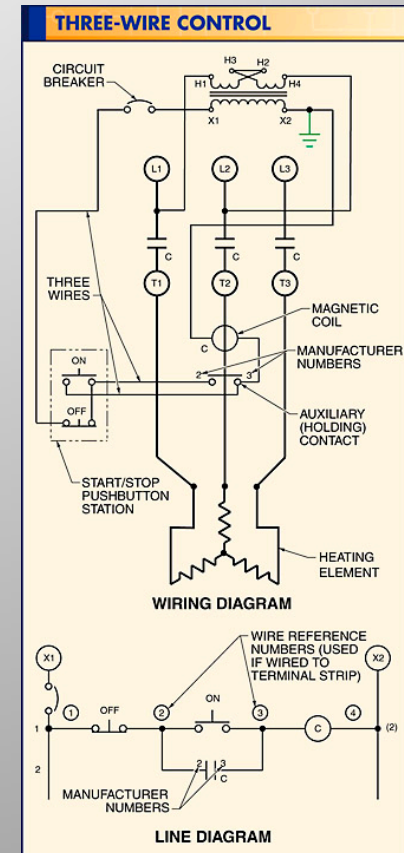
- The three stages a motor goes through during normal operation include resting, starting, and operating under load.



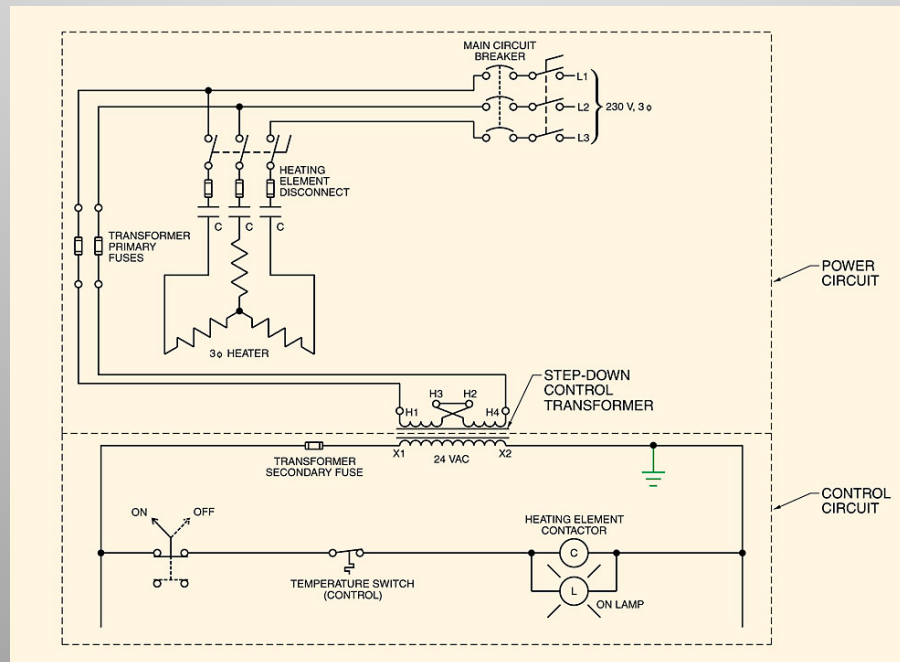
- An overload relay does not open a circuit while a motor is starting, but opens the circuit if the motor gets overloaded and the fuses do not blow.



- In three-wire control, three wires lead from the control device to the starter or contactor.



- A step-down control transformer is used to step down the voltage to the level required in the control circuit.

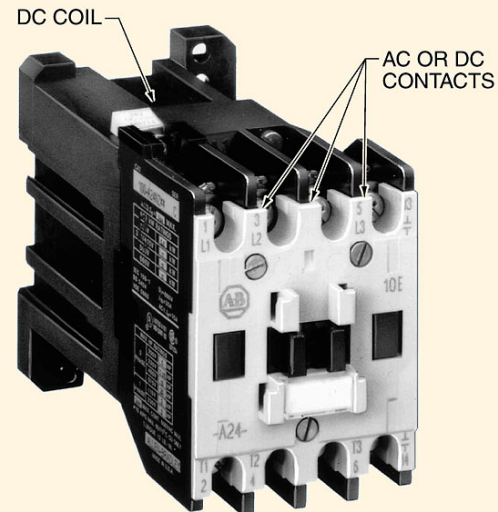


- Contactors have either an AC coil or a DC coil, but may have either AC or DC contacts.



General Electric Company

AC CONTACTOR



Rockwell Automation, Allen-Bradley Company, Inc.

DC CONTACTOR

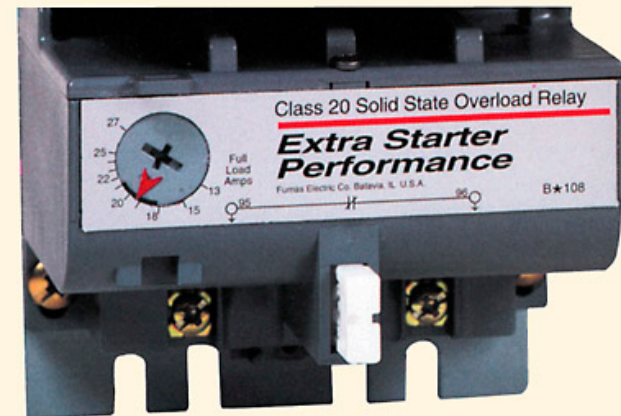
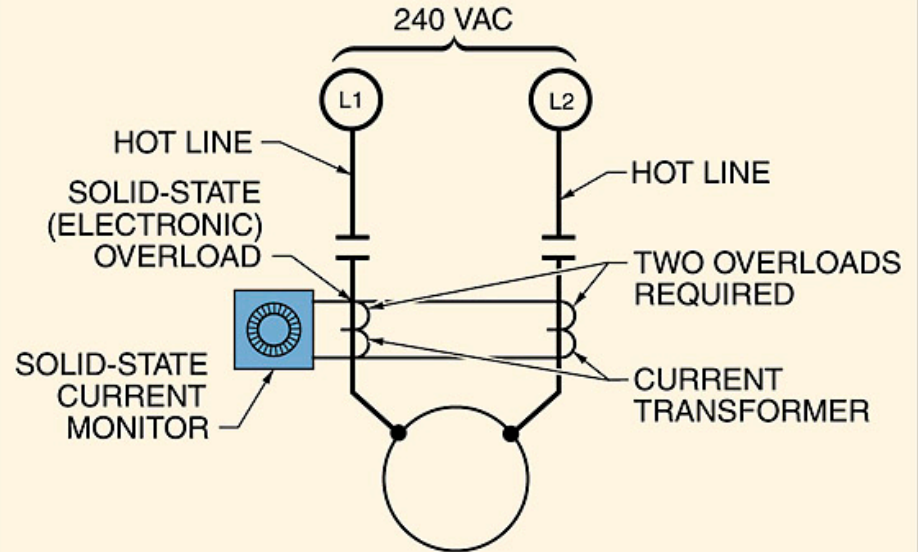
- A magnetic motor starter is a contactor with overload protection added.



Furnas Electric Co.

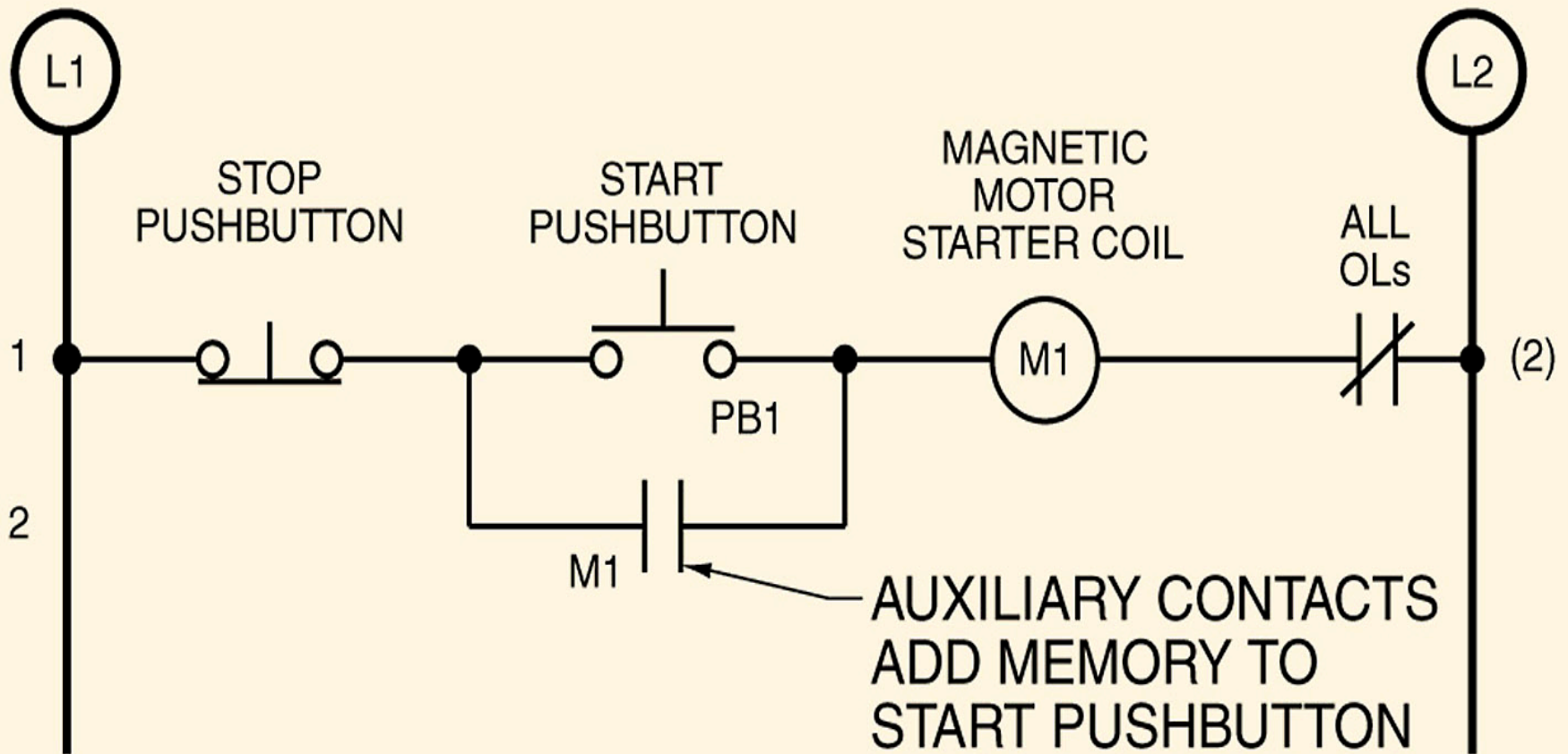
- An electronic overload has built-in circuitry that senses changes in current and temperature.

ELECTRONIC OVERLOADS

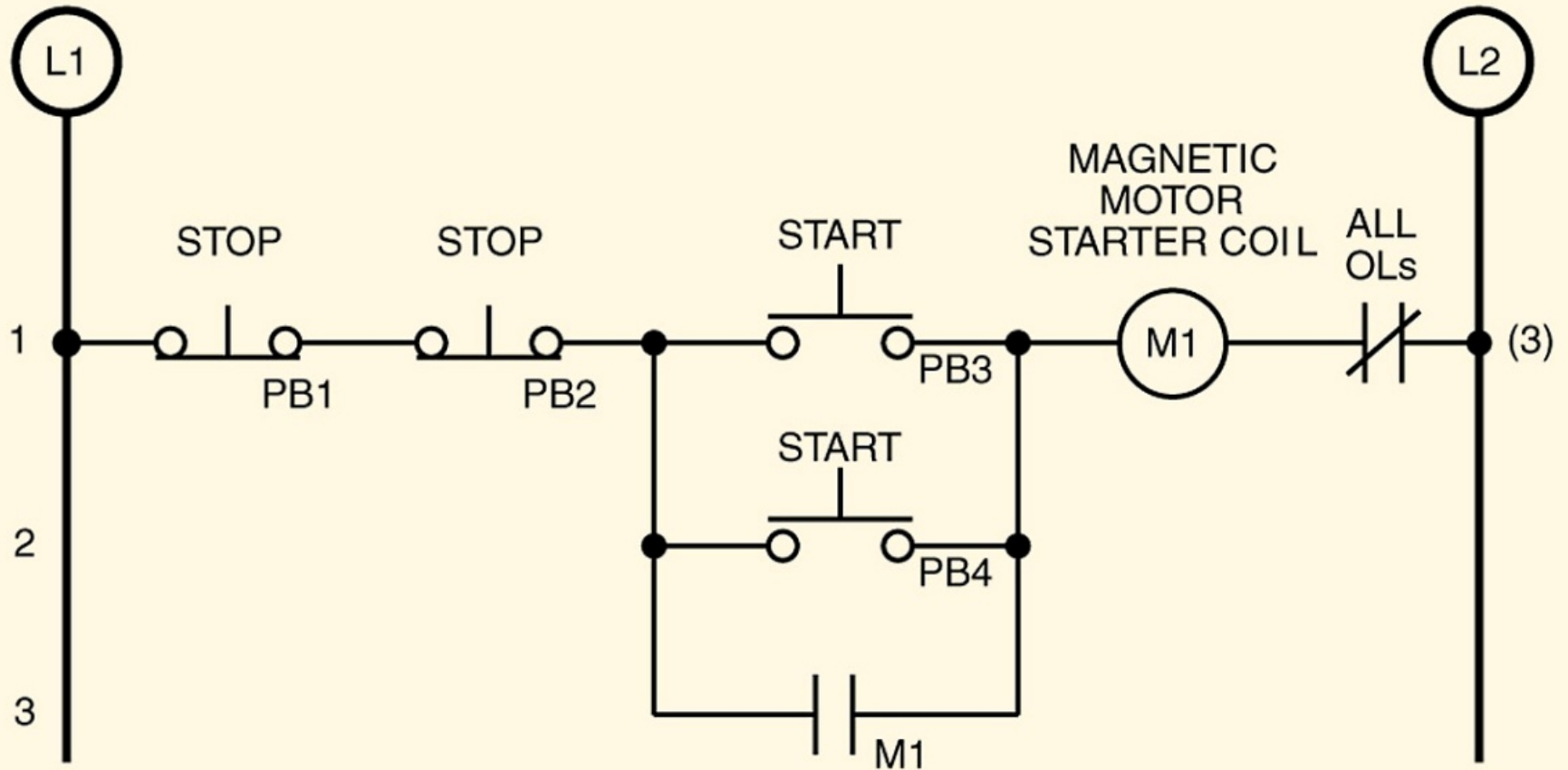


Furnas Electric Co.

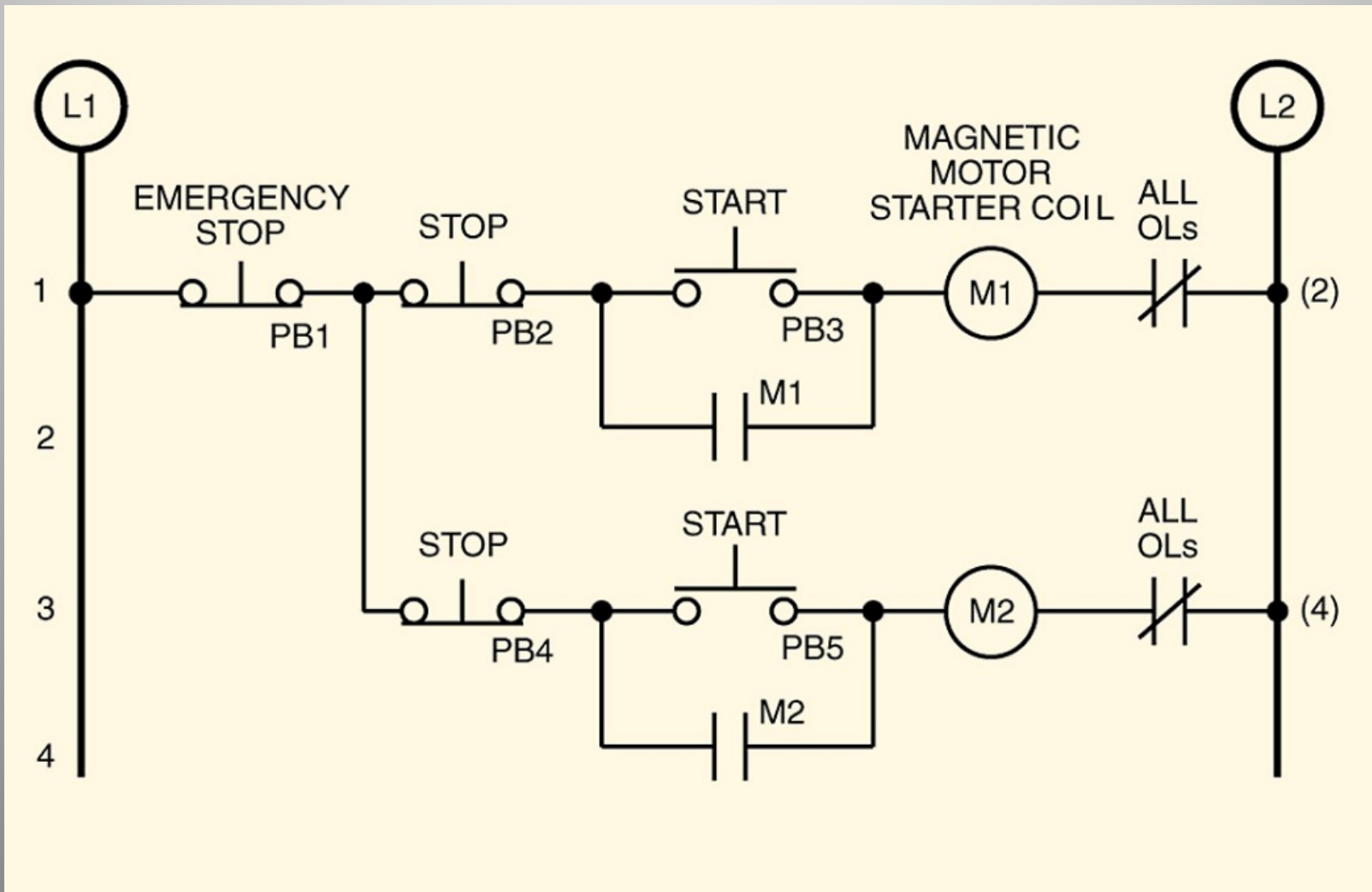
- Auxiliary contacts are added to give circuits with pushbuttons memory.



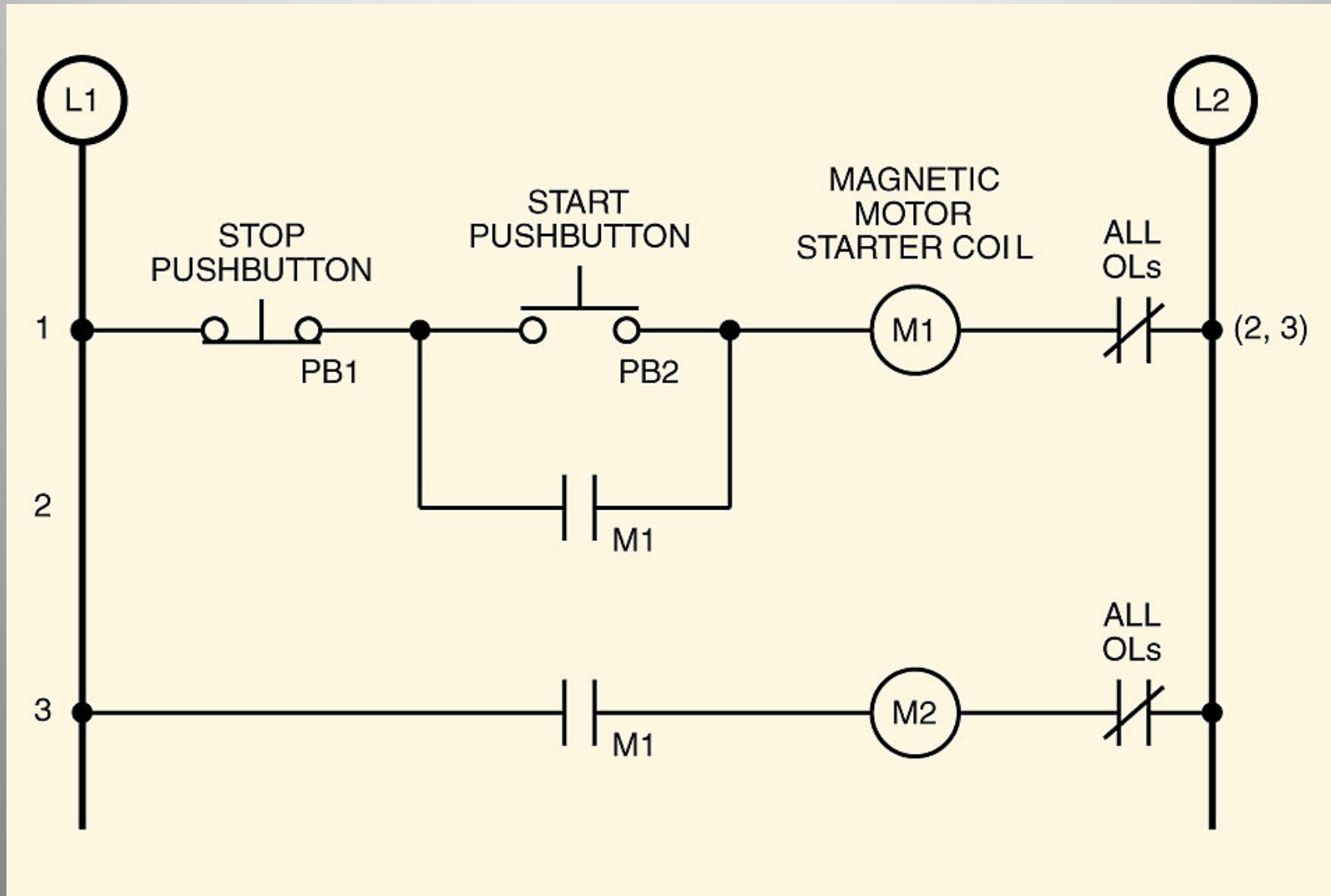
- Two stop pushbuttons connected in series and two start pushbuttons connected in parallel are used to control a motor from two locations.



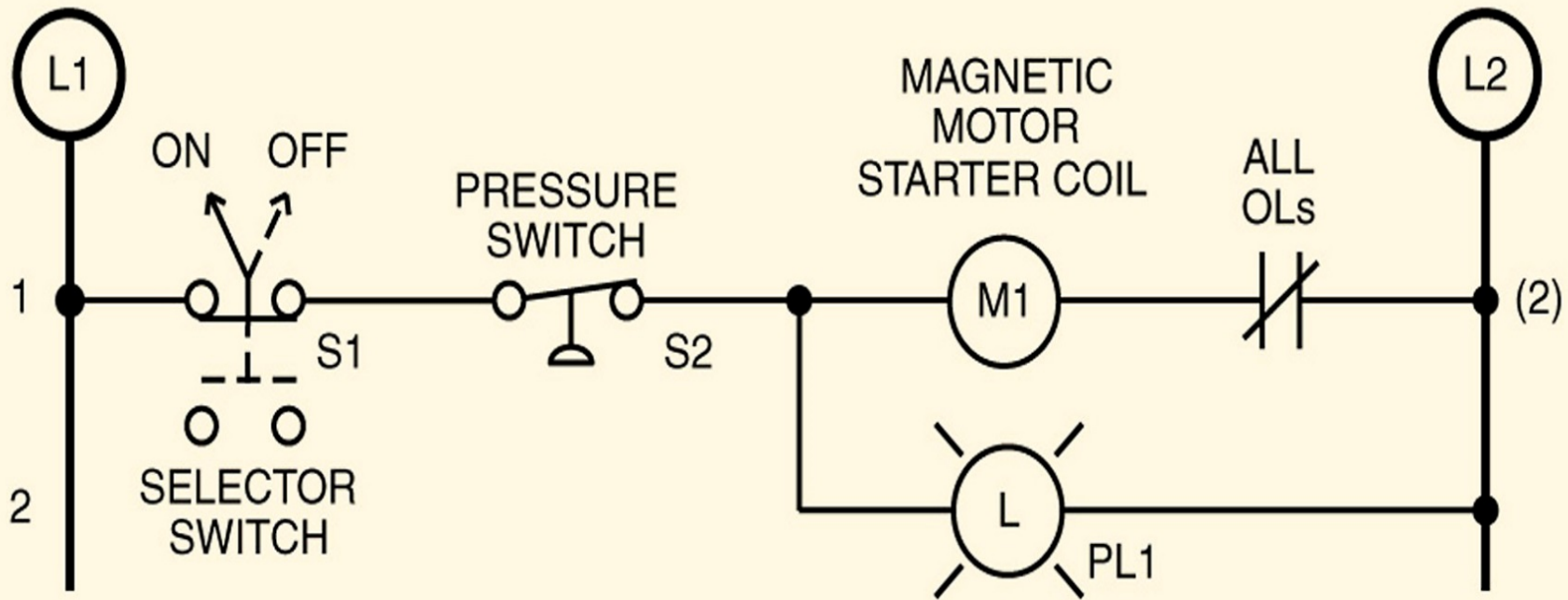
- Two start/stop stations are used to control two separate magnetic motor starter coils with a common emergency stop protecting the entire system.



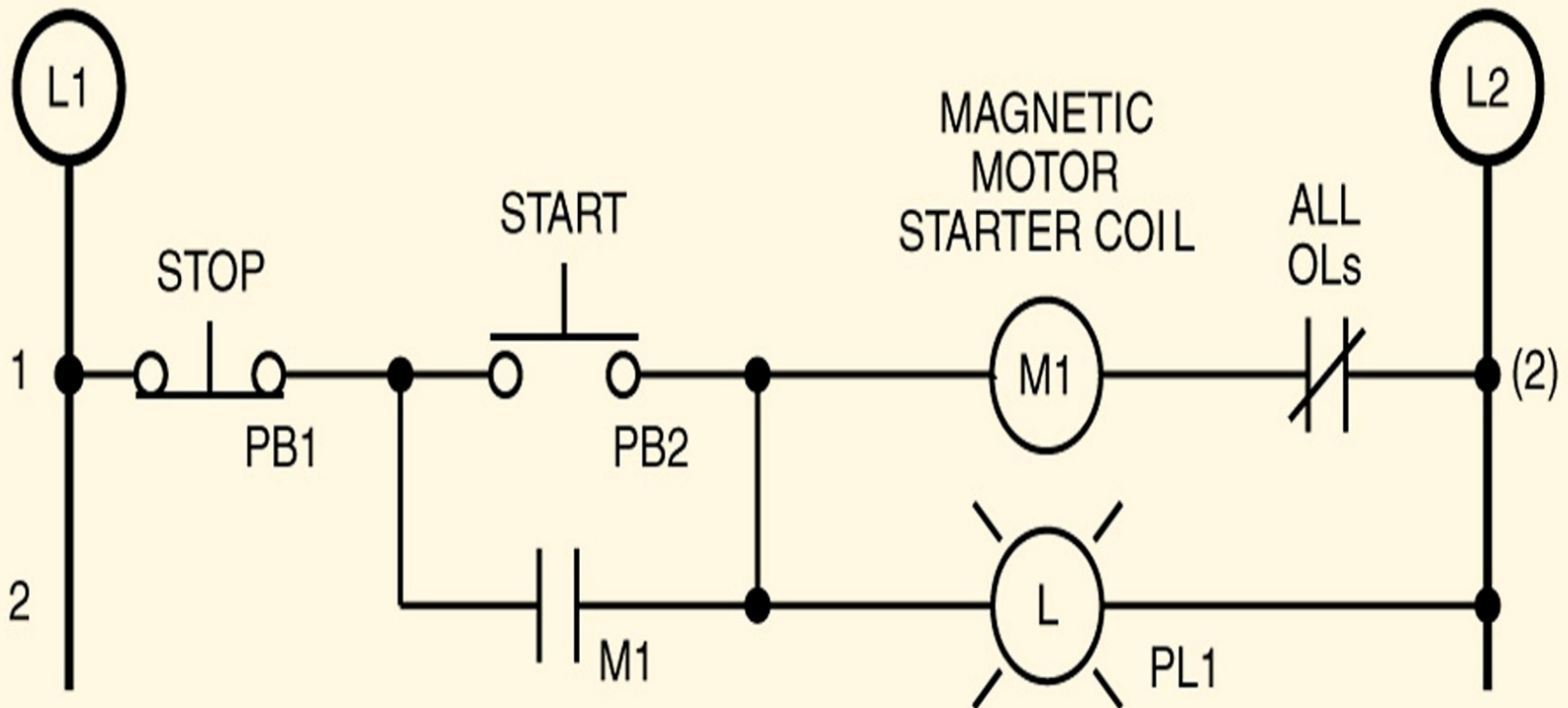
- Two motors can be started almost simultaneously from one location to prevent product separation or stretching.



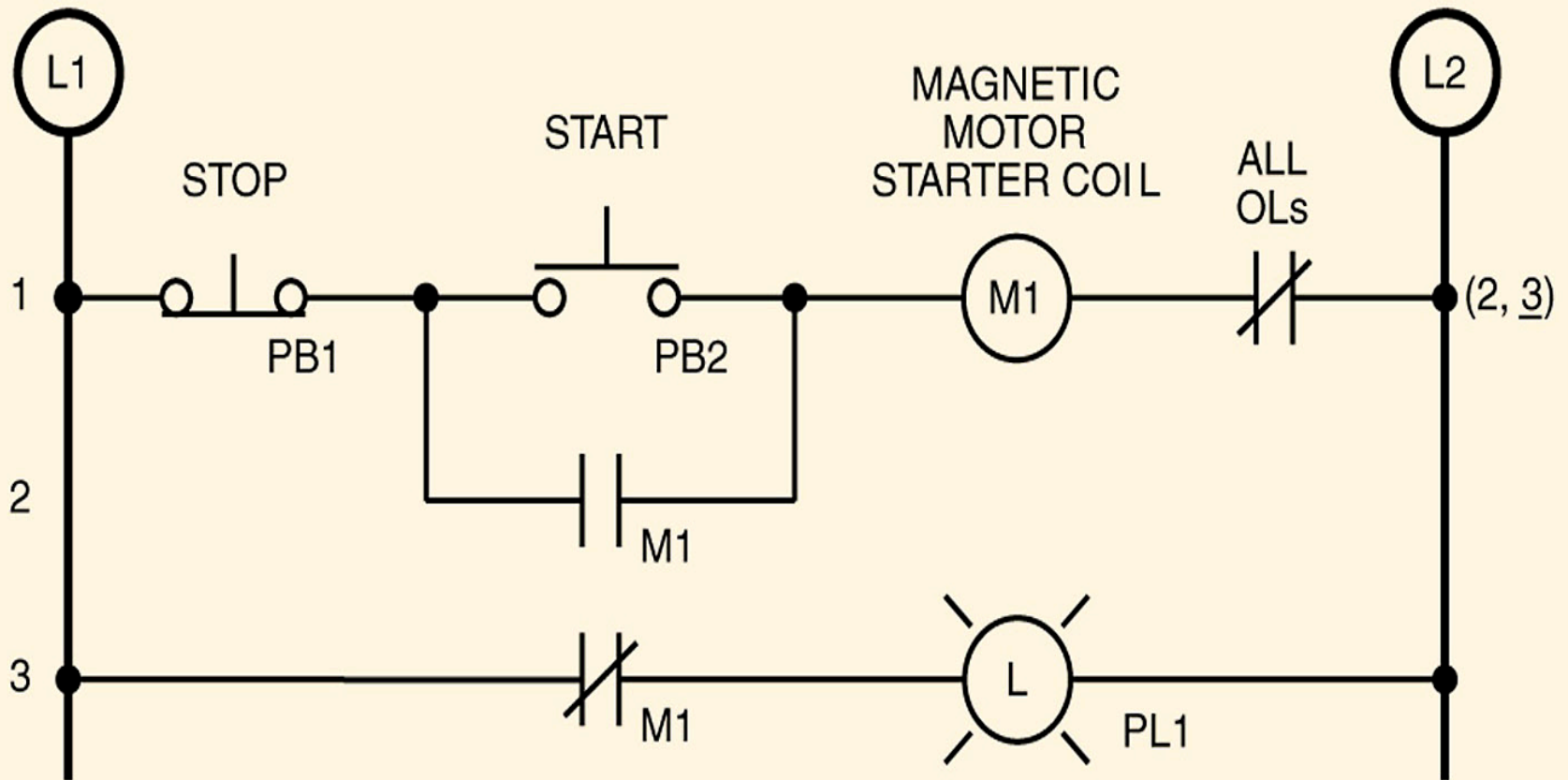
- A pilot light is used with a pressure switch to indicate when a device is activated.



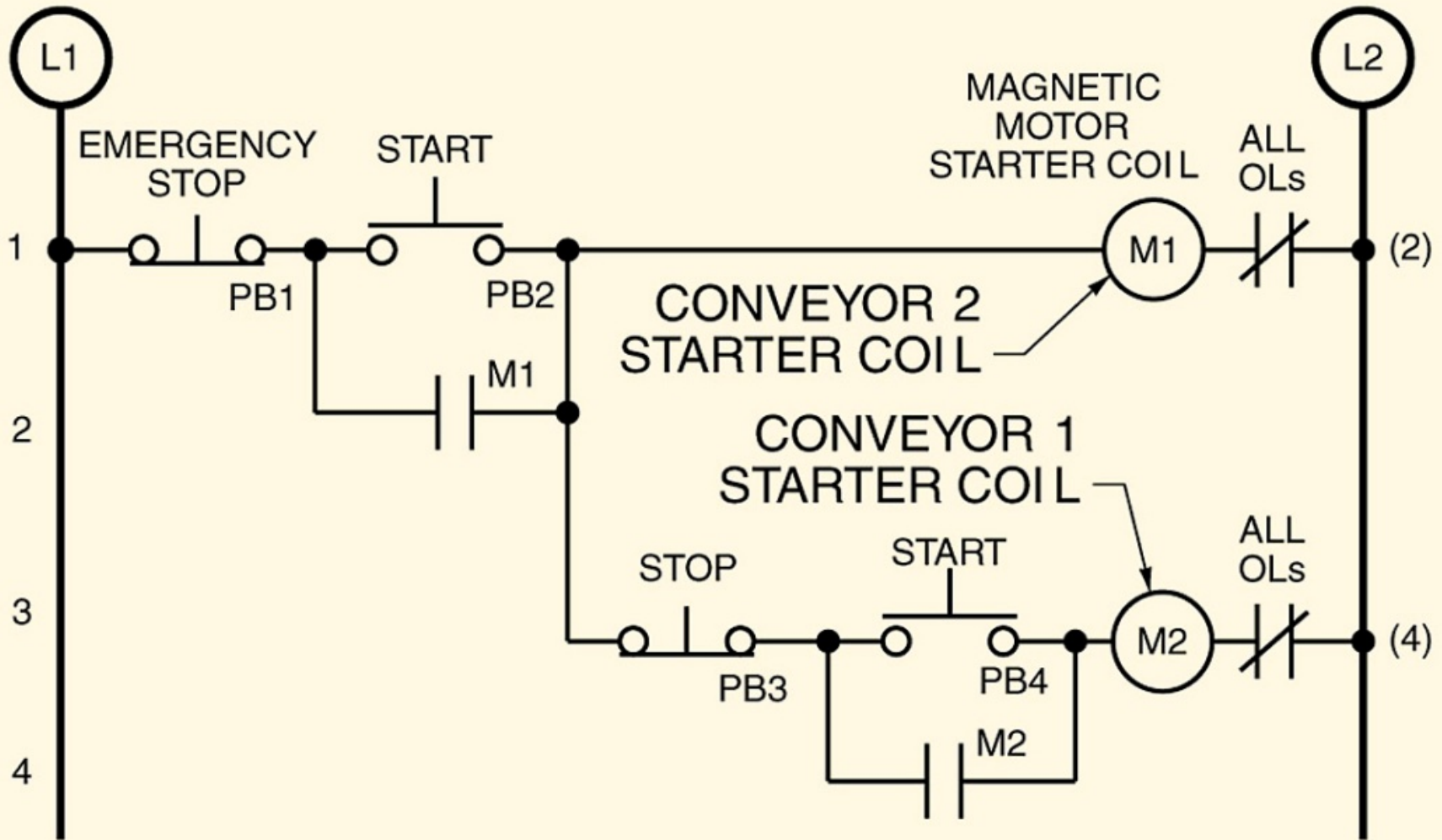
- A pilot light is used with a start/stop station to indicate when a device is activated.



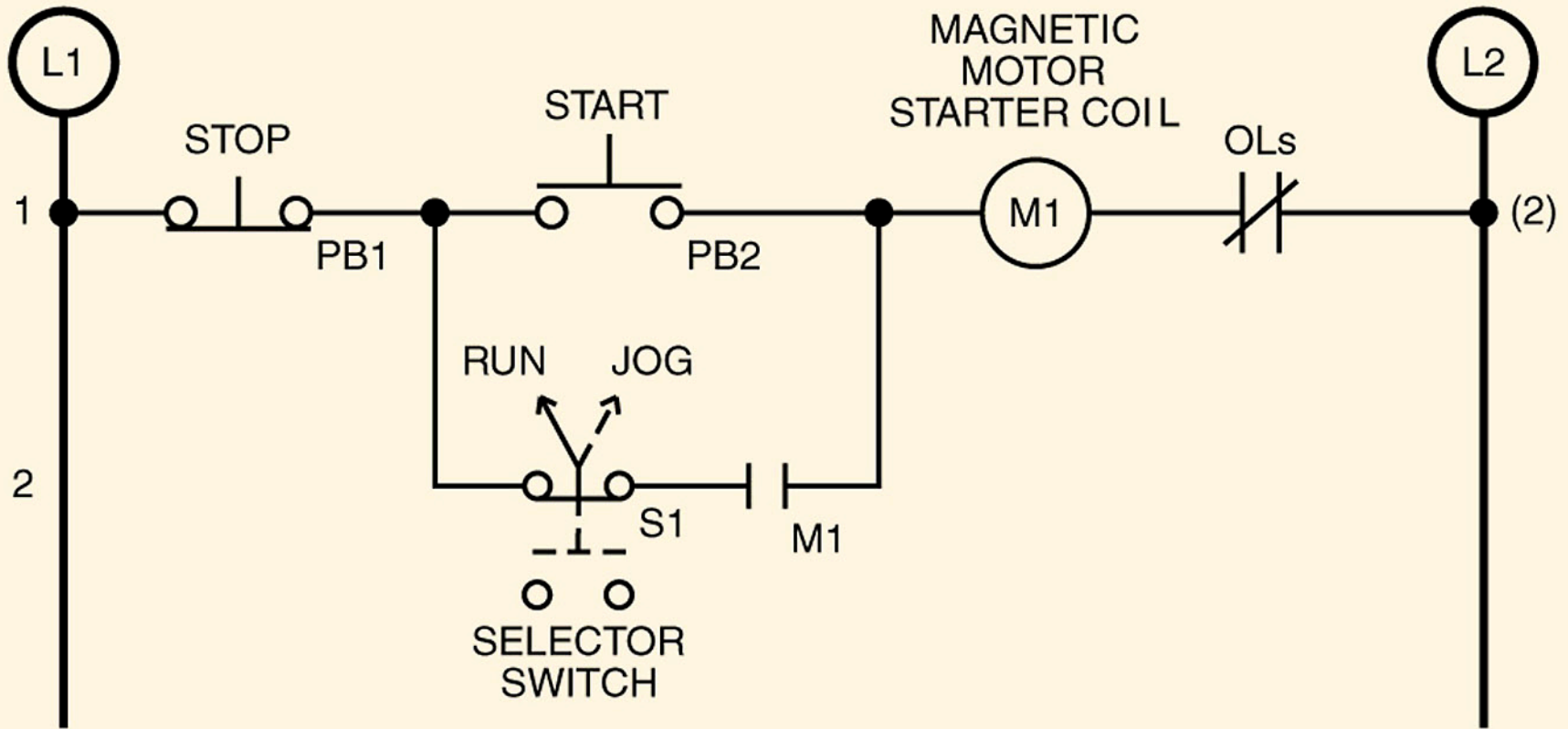
- NOT logic is used to indicate when a device is not operating.

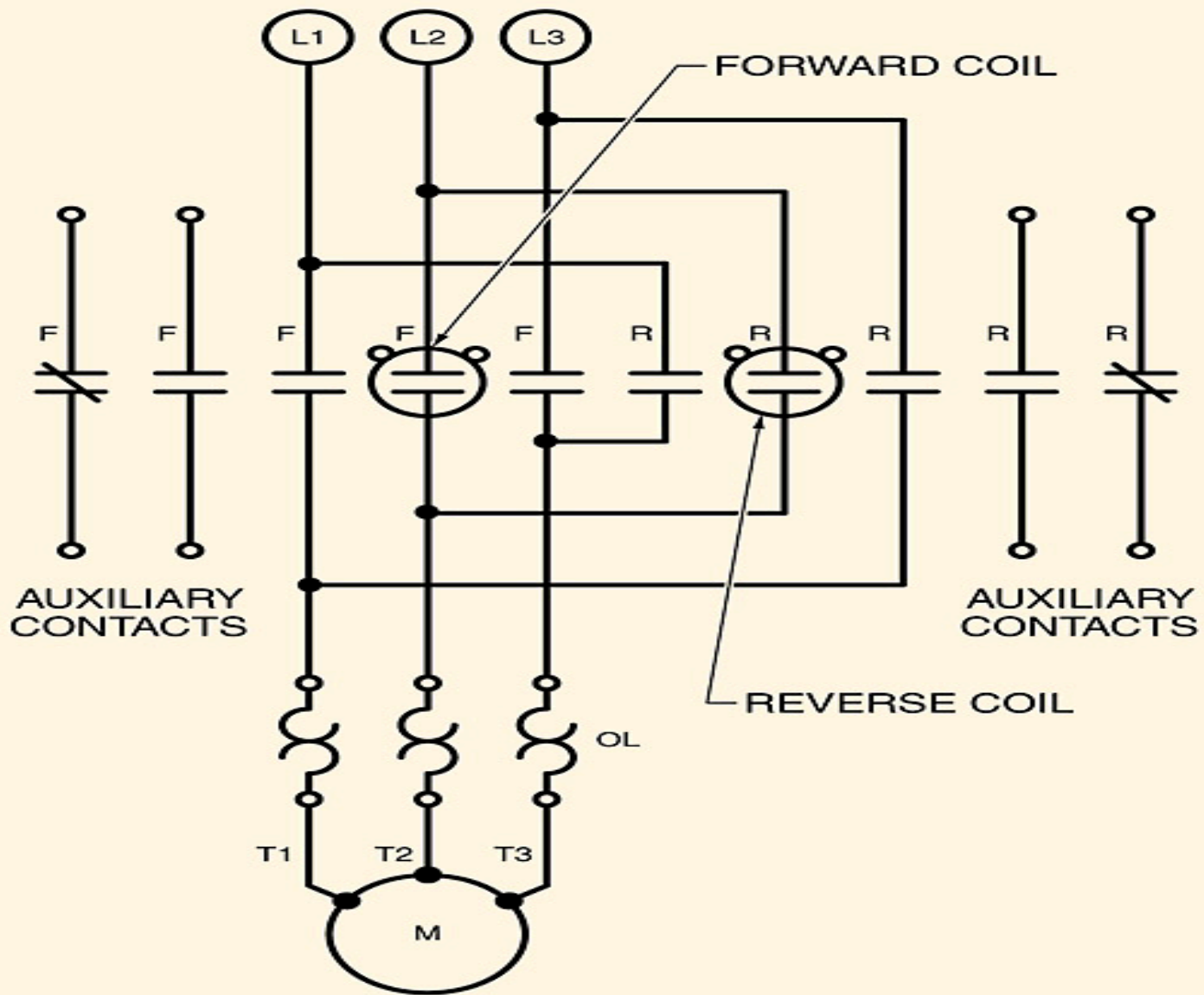


- A sequence control circuit does not let the first conveyor operate unless the second conveyor has started and is running.

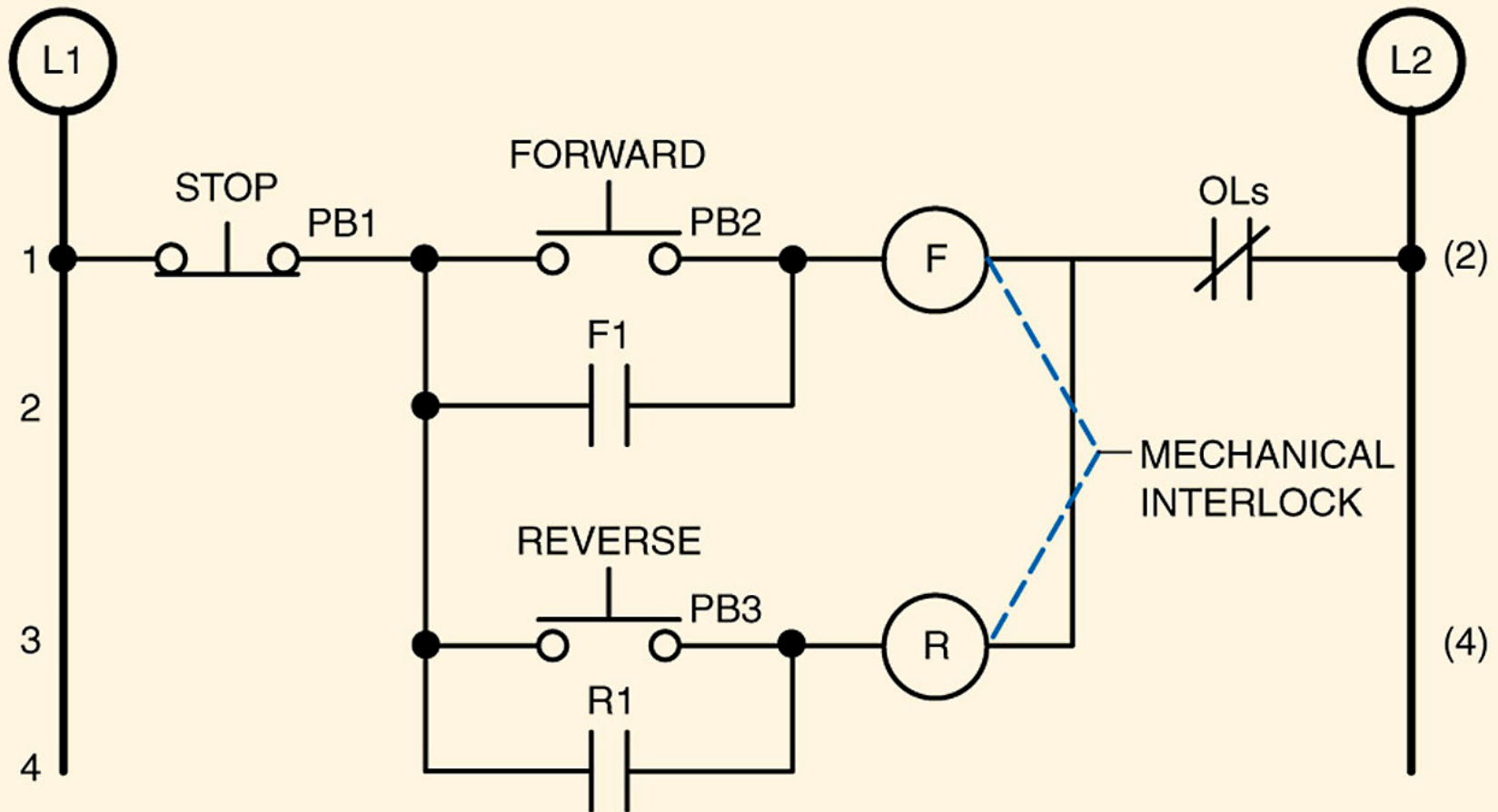


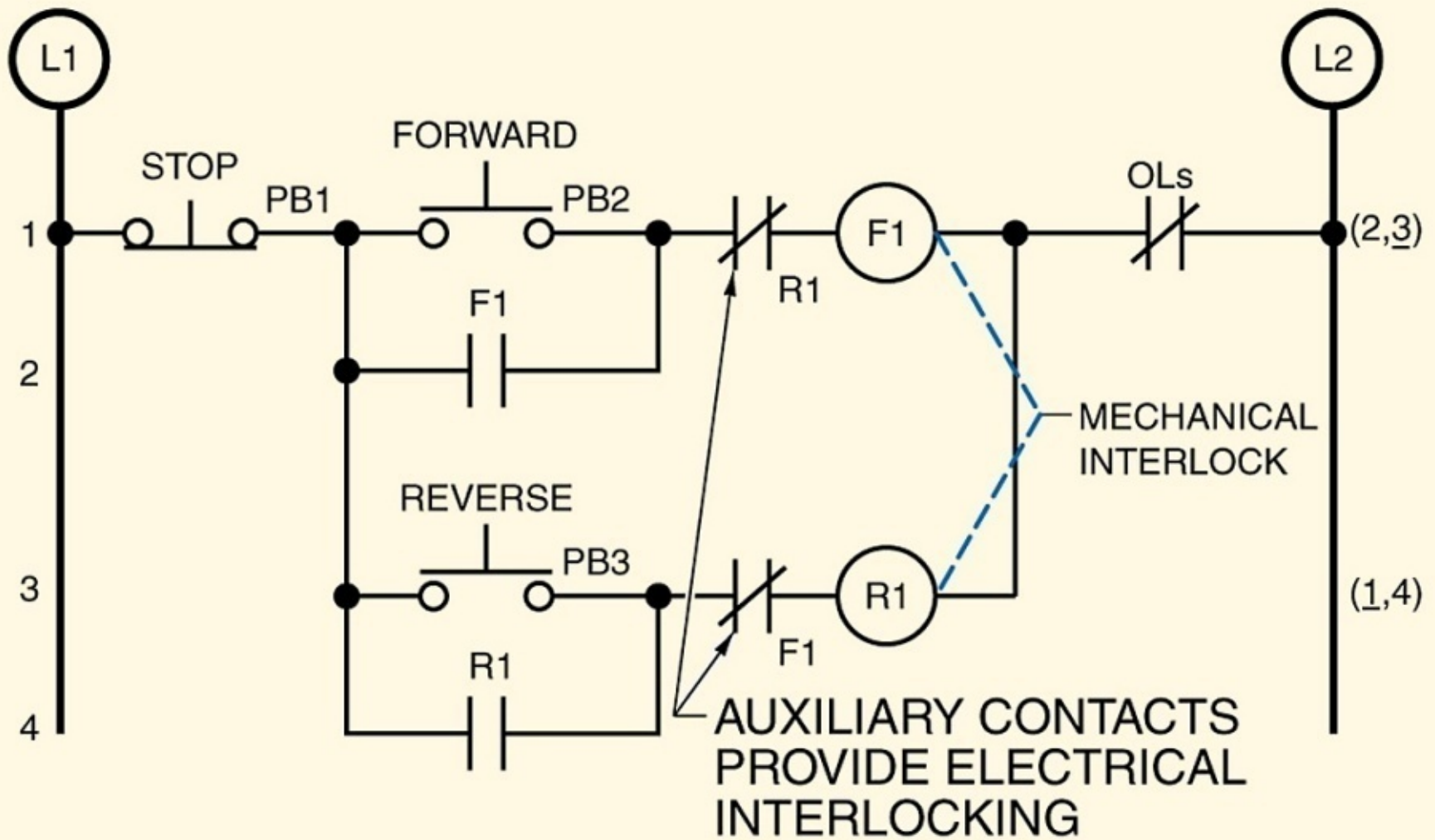
- A selector switch is used to provide a common industrial jog/run circuit.

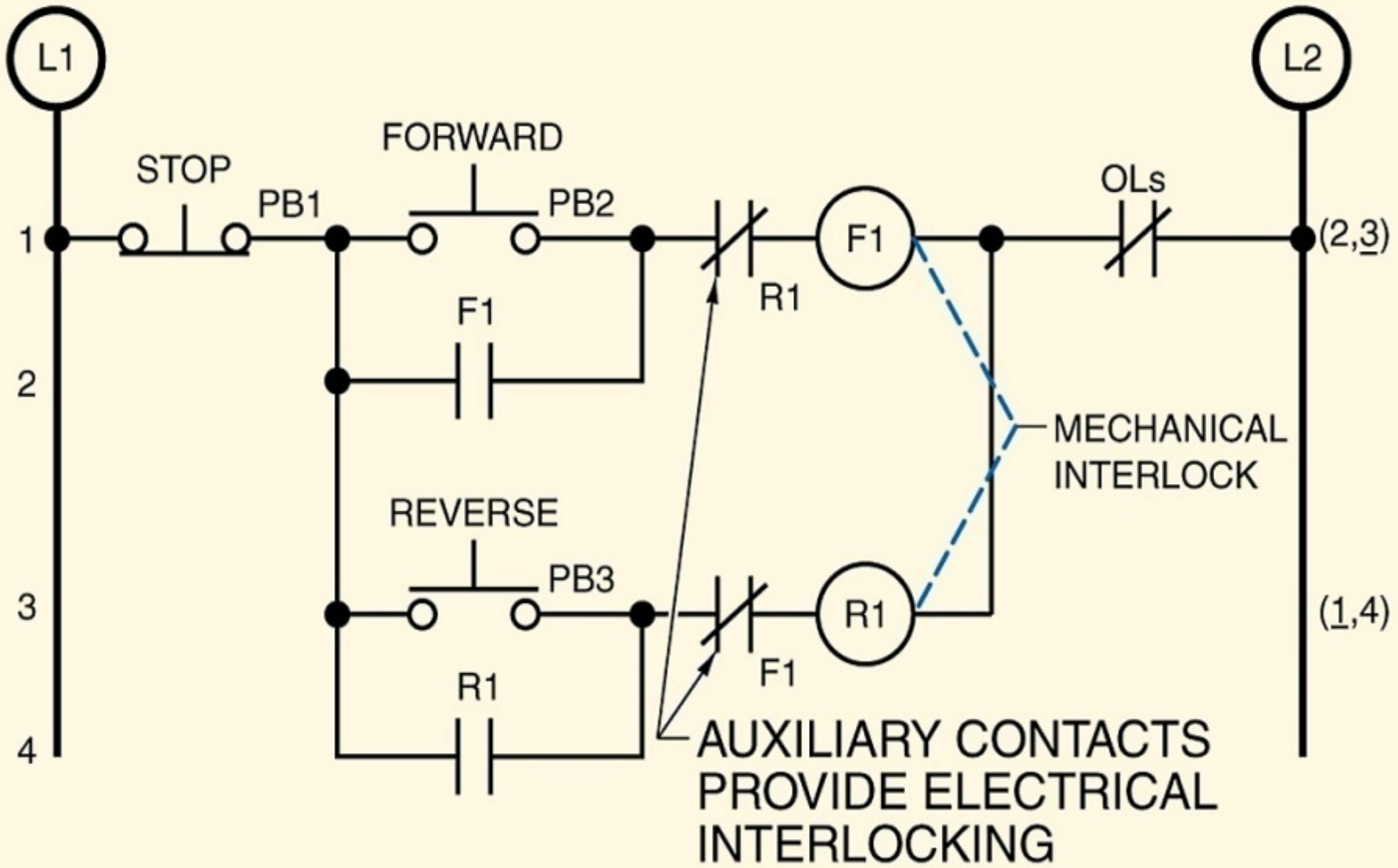


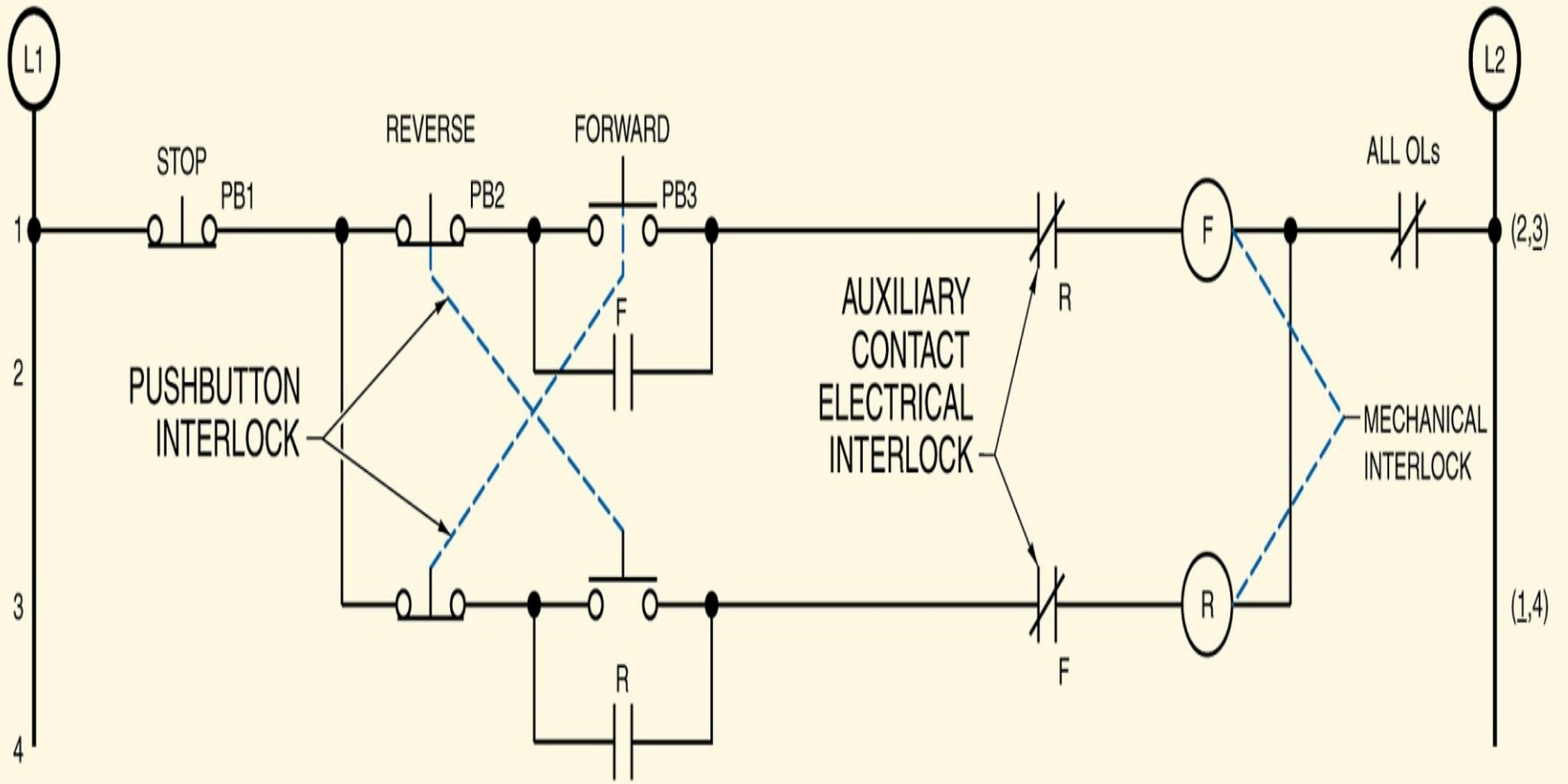


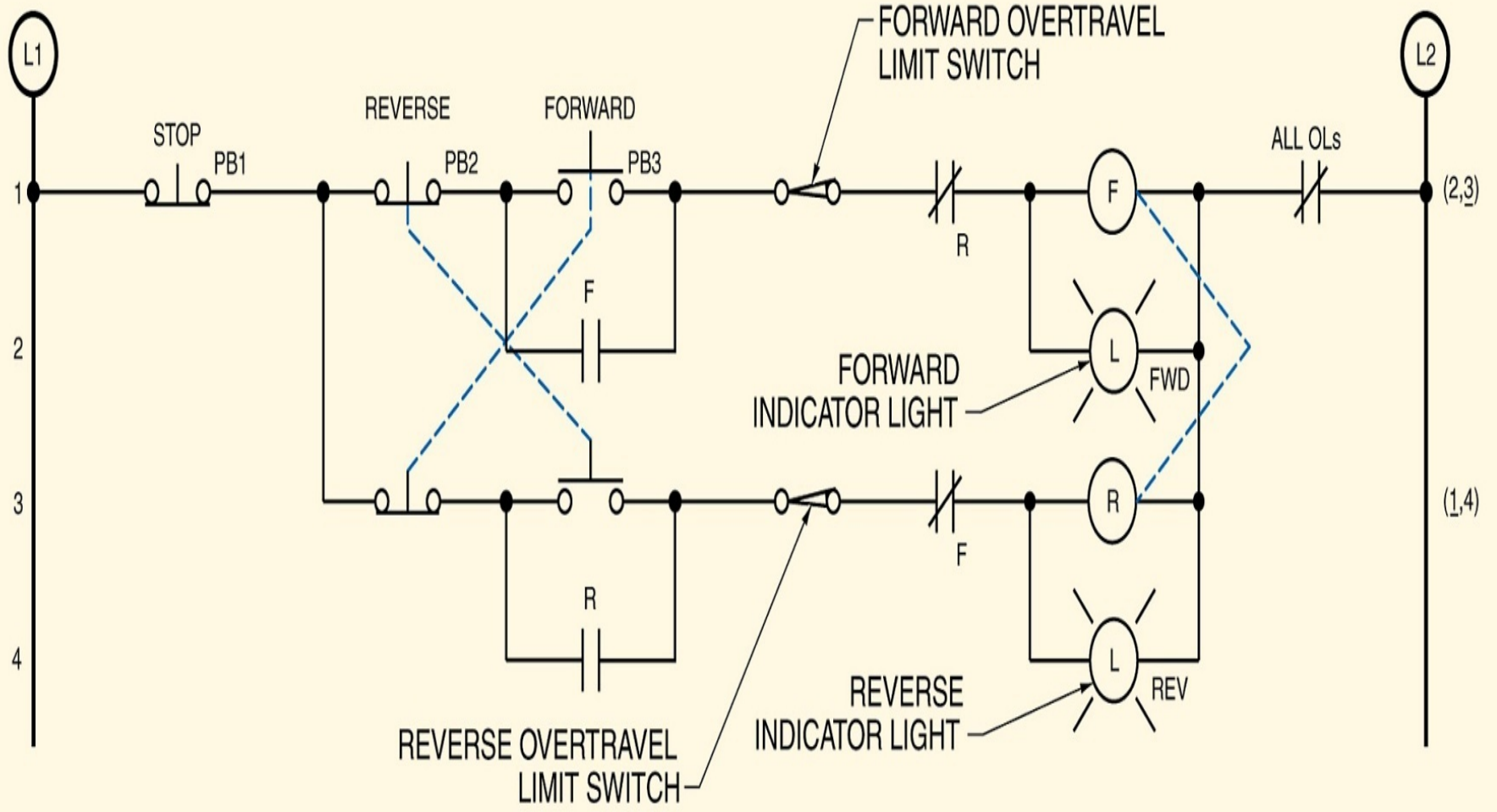
- A magnetic reversing starter may be controlled by forward and reverse pushbuttons.





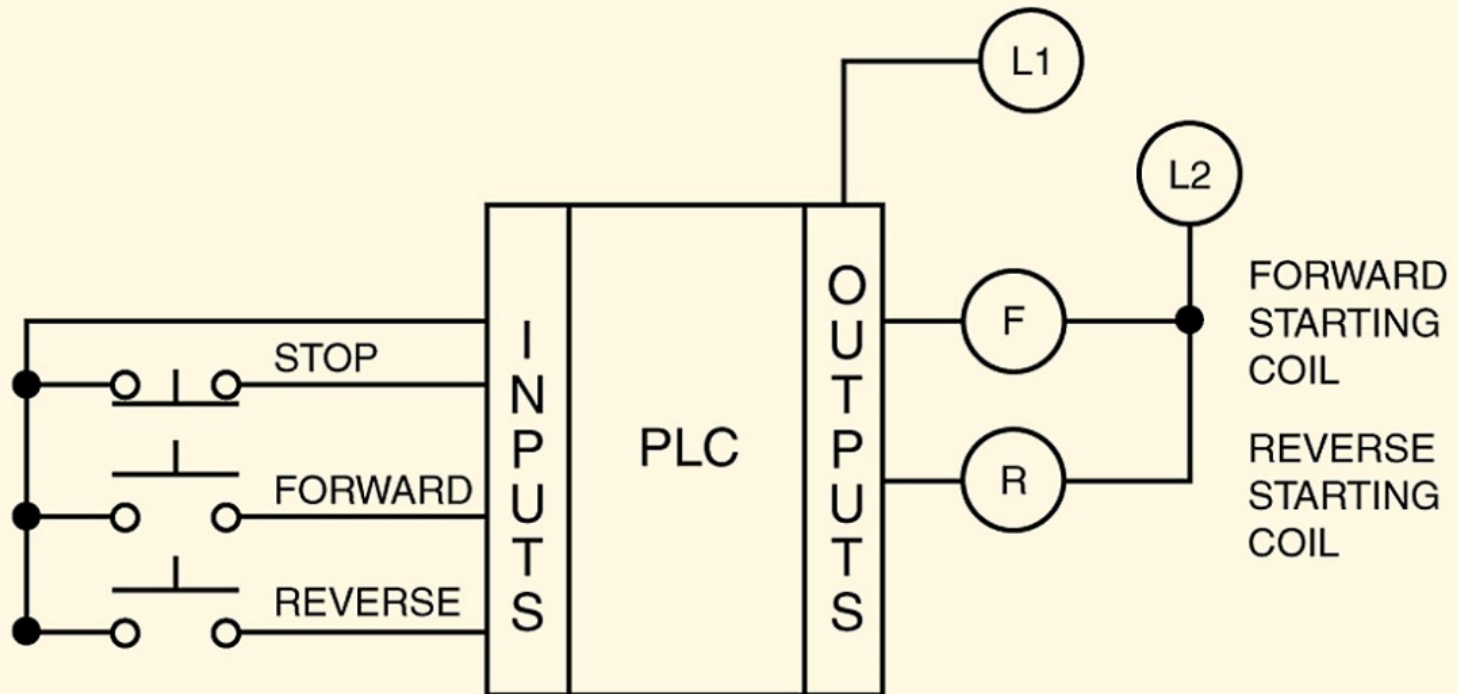




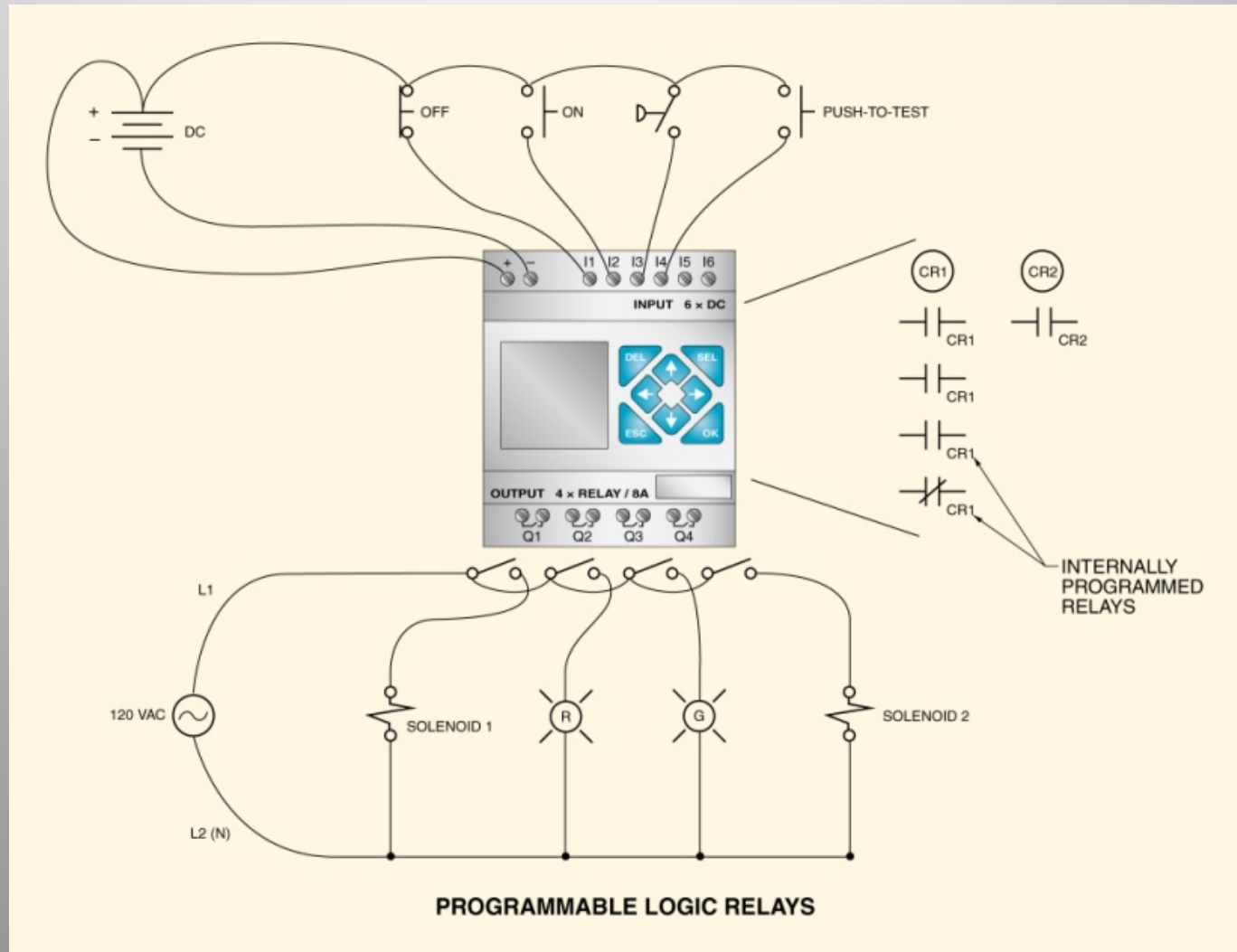


- A PLC simplifies the wiring of inputs and outputs by eliminating the need for auxiliary contacts on the starter.

PLC DIAGRAM



- Programmable logic relays are versatile and are normally used for control circuits that require numerous relays and/or frequent changes.



PLC AND SENSOR WIRING LAB

